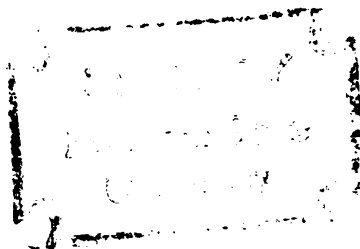


THESIS



3 1293 10533 0421



This is to certify that the

thesis entitled

IFLMAPS: AN INTERACTIVE FARM LEVEL
MARKETING AND PRODUCTION SIMULATOR INTENDED
FOR RESEARCH, TEACHING AND EXTENSION APPLICATIONS

presented by

Milton Edward Rister

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Agricultural
Economics

Gerald D. Schwab
Major professor

Date June 5, 1981



RETURNING MATERIALS:
Place in book drop to
remove this checkout from
your record. FINES will
be charged if book is
returned after the date
stamped below.

DE-70

IFLMAPS: AN INTERACTIVE FARM LEVEL
MARKETING AND PRODUCTION SIMULATOR INTENDED
FOR RESEARCH, TEACHING AND EXTENSION APPLICATIONS

By

Milton Edward Rister

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1981

Copyright by
MILTON EDWARD RISTER
1981

In se
the farm
called IFI
marketing,
representa
informatio
provided f
addition t
a methodol
developed,
the relati
to agricul

IFLMA
grain pro
select and
the month
evaluation
change in

ABSTRACT

IFLMAPS: AN INTERACTIVE FARM LEVEL MARKETING AND PRODUCTION SIMULATOR INTENDED FOR RESEARCH, TEACHING AND EXTENSION APPLICATIONS

By

Milton Edward Rister

In seeking to improve current teaching and extension activities in the farm management area, an interactive computerized simulation model called IFLMAPS was designed and constructed. The model integrates the marketing, production and financial components of a farm in a manner representative of the real world sequential decision-making process. Information endogenous to a producer's management system as well as that provided from exogenous sources is provided in a timely fashion. In addition to suggesting teaching and extension applications of the model, a methodology involving use of the model in behavioral research is developed. The primary purpose of the proposed research is to assess the relative values of traditional and probabilistic market information to agricultural producers.

IFLMAPS simulates a firm level decision-making environment for cash grain producers of wheat, corn and soybeans. Users of the model may select among several marketing alternatives for each crop during each of the monthly decision periods within a ten year simulation horizon. Evaluation of users' performance is via annual Net Farm Income and change in Net Worth. Other important features of IFLMAPS are:

(1) remote

(3) possible

runs, (4)

simultaneously

possible

extension

including

sets required

of uncertainty

provides

students

The

of agricultural

seeking to

information

simulation

tion to

into account

(1) remote access availability, (2) interactive rather than batch, (3) possibility of varying parameter data sets for different simulation runs, (4) provision for intermittent usage and (5) capability of simultaneously supporting multiple users. Because of these features, it is possible to represent different simulation conditions for teaching, extension and research applications in various geographical locations, including areas outside Michigan. The sundry exogenously specified data sets required by IFLMAPS allow for the incorporation of various sources of uncertainty into the simulated decision-making environment. This provides an excellent opportunity for teaching risk management to both students and producers.

The suggested research application of IFLMAPS addresses the ability of agricultural producers' to assemble and assimilate information while seeking to assess the relative values of alternative forms of market information. Previous research suggests that the laboratory setting of simulation models can more realistically appraise the value of information to producers than other measurement techniques which do not take into account the human element in the managerial process.

For
Dianne
and
Mom and Dad

What is written
- Win Schu

Enjoy!
- Edward P

What is written without effort is in general read without pleasure.
— Win Schuler's Restaurant; Stevensville, Michigan

Enjoy!
— Edward Rister (May, 1981)

Special
Supervisor,
fessional gu
sity is sin
with them an

Thanks
Committees:
and James Jo
been a great
the advice an
ated.

My grat.
gan State
Extension Ser
knowledge
Mrs. James Sp

Appreci
Lester Mand
cultural Expe
the financie
Michigan Stat

ACKNOWLEDGEMENTS

Special recognition first goes to Dr. Stephen B. Harsh, my Thesis Supervisor, and to Dr. Gerald D. Schwab, my Major Professor. Their professional guidance during my graduate program at Michigan State University is sincerely appreciated. The friendship Dianne and I have shared with them and their families will not be forgotten.

Thanks also goes to the other members of my Guidance and Thesis Committees: Drs. George Dike, John Ferris, Lindon Robison, Roger Brook and James Johannes. Their counsel throughout my graduate program has been a great help. Although he was not a formal member of my committee, the advice and friendship of Dr. J. Roy Black is also deeply appreciated.

My gratitude is extended to the remaining faculty members at Michigan State University and to the several members of the Cooperative Extension Service I was fortunate enough to associate with. Acknowledgement of notable teaching performance in the classroom is due Drs. James Shaffer, J. Roy Black, James Johannes and Dennis Gaffney.

Appreciation is expressed to Drs. Harold Riley, Larry Connor and Lester Manderscheid, the Department of Agricultural Economics, the Agricultural Experiment Station and the Cooperative Extension Service for the financial assistance and travel support I have received while at Michigan State University.

Since
and Rong
icks of A
Dick Ase
laire.

The
puter st
Susan Chu
thanks to
ing assist

I am
vided by
help.

The f
Linda Tod
have all,
tuate prog

To my
"bad" tim
thanks to
King.

To Tim
and Jeff
life in Mic
ways.

Sincere thanks also goes to Dr. Fred Bakker-Arkema, Juarez Silva and Rong Hsieh of the Agricultural Engineering Department, Eldon Fredericks of Agricultural Information Services, Doug Miller of the U.S.D.A., Dick Aseltine of Theiser Equipment in Mason and Steve Kalchik in Bel-laire.

The assistance of the Department of Agricultural Economics' computer staff is also gratefully acknowledged. Chris Wolf, Paul Wolberg, Susan Chu and Carol Landrum all are deserving of credit. A special thanks to Betsy Bowers and Jean Branch for their "fast finger" keypunching assistance. Without them, IFLMAPS would not be.

I am also most appreciative for the word processing services provided by COMNET. To Dr. Frank Martin and Peggy Medler, thanks for your help.

The friendship of Linda Peters, Shirley Rabbage, Sandy Casselberry, Linda Todd, Nancy Creed and Debbie Rausch is also appreciated. They have all, on several occasions, contributed to the completion of my graduate program at Michigan State University.

To my fellow graduate students who have shared the "good" and the "bad" times, good luck! For their help during my graduate program, thanks to Roger Hoskin, Bees Butler, Larry Cornell, John Strauss and Rob King.

To Tim and Ann Antoya, Luke and Janet Parsch, Jerry and Joan Skees and Jeff and Lucy Williams, God bless you. Knowing you has made our life in Michigan an enjoyable time. Best of luck as we go our separate ways.

To my p
nt sacrific
And to
ontinual s
our marriage
ments, a
always seen

•

To my parents, my most sincere gratitude goes to you. Your love and sacrifices are not overlooked. Thanks for everything!

And to Dianne, my loving wife, I am forever in your debt. Your continual support and personal sacrifices during these first years of our marriage has no equal. Being a wife, a typist and in these last few months, a mother to Karl, has not been an easy task. Somehow, you always seem to manage. My love is yours!

* * * * *

LIST OF EXHIBITS

LIST OF FIGURES

LIST OF TABLES

CHAPTER

1 INTRODUCTION

General

Research

Observation

Literature

2 REVIEW

Introduction

Risk

Decision

Management

Control

Communication

Theory

Application

Concept

Market

in

Industry

Value

For

Project

Educational

System

The

Model

System

Simulation

Summary

TABLE OF CONTENTS

	PAGE
LIST OF EXHIBITS	xii
LIST OF FIGURES	xv
LIST OF TABLES	xvi
 CHAPTER	
1 INTRODUCTION	1
General Problem Statement	1
Research Objectives	3
Observations from the Review of Literature	4
2 REVIEW OF LITERATURE	7
Introduction	7
Risk Management and Producers'	
Decision-making Processes	7
Managerial processes	11
Goals, preferences and psychological concerns	18
Theoretical issues	23
Applied studies	25
Computerized decision aids	28
Market Information and Its Usefulness	
in Deciding Marketing Strategies	31
Information and information systems	36
Value of information	40
Forecasting models	49
Producers' marketing strategies	58
Educational Techniques	65
Simulation games	68
The Systems Approach and Simulation	
Models	74
Systems approach	74
Simulation models	79
Summary	81

CHAPTER

3 CHOICE

Intro
Metho
Gen
Mod

4 INTERAC
SIMULAT

Intro
Choic
Execu
Produ
Pro
Pro
Marke
Mar
Der
Use
a
Finan
Cas
Fed
Per
Oth

5 IFLMAPS

Intro
Initi
Stru
Fina
Phys
State
Gene
Fiel
re
Sche
Outp
Output
Base
Mont
Pric
an
Mark
Inputs
Vari
Capi
Infl
Other

CHAPTER	PAGE
3 CHOICE OF METHODOLOGY	82
Introduction	82
Methodology of Research Study	84
General design features	85
Model structure	90
4 INTERACTIVE FARM LEVEL MARKETING/PRODUCTION SIMULATION MODEL	92
Introduction	92
Choice of Hardware System	93
Executive Component	97
Production Component	99
Production opportunities	100
Production activities	107
Marketing Component	140
Marketing alternatives available	142
Derivation of monthly crop prices	148
User selection of marketing alternatives	170
Financial component	183
Cash flow accounting	183
Federal and State income taxes	196
Performance measures	199
Other summary information	207
5 IFLMAPS' DATA REQUIREMENTS	208
Introduction	208
Initial Firm Structure	209
Structural organization	211
Financial position	212
Physical characteristics	218
State/Region	222
General information	222
Field operations and yield relationships	225
Scheduling of events	229
Output price information	234
Output Prices	236
Base prices	237
Monthly quasi-random price movements	238
Price movements in the futures market and forward cash contract market	239
Market outlook information	242
Inputs	243
Variable costs parameters	244
Capital investment possibilities	246
Inflation factors	248
Other technical parameters	251

CHAPTER

Gov
C
D
D
S
I
L
Yie
Fie

6 ILLUS

Int
Ind
S
F
P
Sta
G
F

O
Cut
B
M

P

M
Imp
V

C
In
O

Gov

C
D
D

S
In

L
Yie
Fie

CHAPTER	PAGE
Government Commodity Program Complement	251
Compliance	252
Diversión requirements	252
Diversión payments	253
Storage payments	253
Interest rates	254
Loan and reserve prices	254
Yields	255
Field Time	256
6 ILLUSTRATIVE COMPLEMENT DATA SETS	258
Introduction	258
Initial Firm Structure	258
Structural organization	259
Financial position	259
Physical characteristics	262
State/Region	264
General information	264
Field operations and yield relationships	266
Output price information	273
Output Prices	275
Base prices	278
Monthly quasi-random price adjustments	278
Price movements in the futures market and forward cash contract market	294
Market outlook information	297
Inputs	300
Variable costs parameters	306
Capital investment possibilities	310
Inflation factors	328
Other technical parameters	328
Government Commodity Program	330
Compliance	330
Diversión requirements	330
Diversión payments	330
Storage payments	330
Interest rates	333
Loan and reserve prices	333
Yields	333
Field Time	338

CHAPTER

7 TEACHING

Intro
Teach
wit
Mar
Pro
Fin
Lab
Mac
Tax
Dec
Obs
Cla
Ext
Qua

8 RESEARCH

Intro
Asses
Inf
Sel
Adm
Eva
Stre
Res

9 SUMMARY

Concl
Recom

APPENDIX

A IFMAPS

B IFMAPS

C IFMAPS

D DEVELOP

ILLUSTR

SELECTED BIBLIO

CHAPTER	PAGE
7	TEACHING/EXTENSION APPLICATIONS 342
	Introduction 342
	Teaching Farm Management Principles
	with IFLMAPS 346
	Marketing 348
	Production 349
	Financial 350
	Labor 351
	Machinery 351
	Tax 352
	Decision-making and information 352
	Observations and Suggestions 353
	Classroom teaching 355
	Extension 357
	Qualifications 359
8	RESEARCH APPLICATION 361
	Introduction 361
	Assessing the Value of Market
	Information with IFLMAPS 364
	Selection of survey sample 365
	Administration of survey 371
	Evaluation of results 375
	Strengths and Weaknesses of Proposed
	Research Methodology 376
9	SUMMARY REMARKS 380
	Conclusions 380
	Recommendations for Future Research 383
APPENDIX	
A	IFLMAPS' SUBROUTINES 388
B	IFLMAPS' EXECUTIVE COMPONENT 395
C	IFLMAPS' COMPLEMENT DATA SETS 410
D	DEVELOPMENT OF MACHINERY INFORMATION FOR
	ILLUSTRATIVE INPUTS COMPLEMENT DATA SET 449
	SELECTED BIBLIOGRAPHY 459

EXHIBIT

- 2.1 Impact Farm
- 2.2 Probabi Price
- 4.1 Calcula Harve
- 4.2 Calcula Time in IF
- 4.3 Calcula Maxim
- 4.4 Calcula Avail
- 4.5 Calcula Acrea Field
- 4.6 Calcula Alloc Capac Simul
- 4.7 Calcula Hours IFLMA
- 4.8 Calcula Machi
- 4.9 Calcula Old M in IF
- 4.10 Calcula Machi in IF
- 4.11 Calcula Machi Costs
- 4.12 Derivat Price
- 4.13 Derivat in IF
- 4.14 Derivat Price
- 4.15 Derivat Contr

LIST OF EXHIBITS

EXHIBIT	PAGE
2.1 Impact of Course Grain Yields on U.S. Farm Prices of Corn in 1981	56
2.2 Probability Distribution of U.S. Farm Prices of Corn in 1981	57
4.1 Calculation Technique for Determining Harvested Yield Levels in IFLMAPS	108
4.2 Calculation Technique for Determining Time Suitable for Field Operations in IFLMAPS	115
4.3 Calculation Technique for Determining Maximum Labor Availability in IFLMAPS	117
4.4 Calculation Technique Which Ascertain Available Machinery Hours in IFLMAPS	119
4.5 Calculation Technique in IFLMAPS Regarding Acreage Capacity for Each Type of Field Operation	121
4.6 Calculation Technique Used in IFLMAPS to Allocate Labor and Determine Acreage Capacities During the Simulation of Simultaneous Field Operations	122
4.7 Calculation Technique Used in Adjusting Hours of Resource Availability in IFLMAPS	125
4.8 Calculation Technique Which Derives New Machinery Units' Prices in IFLMAPS	131
4.9 Calculation Technique for Deriving Old Machinery Units' Salvage Values in IFLMAPS	133
4.10 Calculation Technique for Determining Machinery Hourly Repair Costs in IFLMAPS	135
4.11 Calculation Technique for Determining Machinery Per Hour Fuel and Lubrication Costs in IFLMAPS	139
4.12 Derivation of Monthly National Average Prices Received by Farmers in IFLMAPS	153
4.13 Derivation of Monthly Chicago Cash Prices in IFLMAPS	155
4.14 Derivation of Monthly Local Cash Market Prices in IFLMAPS	158
4.15 Derivation of Monthly Futures Market Contract Prices in IFLMAPS	160

EXHIBIT

- 4.16 Calcul
Mark
- 4.17 Deriva
Cont
- 4.18 Estim
for I
Cash
- 4.19 Deriva
Progi
- 4.20 Codes
Strat
- 4.21 Calcul
IFLMA
- 5.1 State
Ident
Compl
- 6.1 TMI Inf
Price
- 6.2 PMI Inf
Price
- 6.3 Market
Rando
For;
Compl
- 6.4 Style o
for A
TMI a
- 6.5 Style o
for A
TMI a
- 6.6 Agricult
Sizing
Inputs
- 6.7 Procedur
Units
a Fiel
Comple
- 7.1 Chart fo
Monthl
- 8.1 Input Fo
to IFL
- 9.1 IFLMAPS'
Data S
- 9.2 IFLMAPS'
Set Ir
- 9.3 IFLMAPS'
Set Ir
- 9.4 IFLMAPS'
Input

4.16	Calculation of Current Adjustment to Futures Market Contract Prices in IFLMAPS	164
4.17	Derivation of Monthly Forward Cash Contract Prices in IFLMAPS	166
4.18	Estimation of Representative Brokerage Fee for Use in Deriving Monthly Forward Cash Contract Prices in IFLMAPS	168
4.19	Derivation of Monthly Government Commodity Program Price Levels in IFLMAPS	171
4.20	Codes Representing the Various Marketing Strategies Allowed in IFLMAPS	173
4.21	Calculation of Statistical Standards in IFLMAPS	206
5.1	State Codes Appropriate for Geographical Identification of IFLMAPS' State/Region Complement Data Set	224
6.1	TMI Information Set; Illustrative Output Price Complement Data Set for IFLMAPS	301
6.2	PMI Information Set; Illustrative Output Price Complement Data Set for IFLMAPS	302
6.3	Market Outlook Information Sets When Quasi- Random Price Movements are Not Allowed For; Illustrative Output Price Complement Data Set for IFLMAPS	303
6.4	Style of TMI Statement Required in IFLMAPS for Assessment of Relative Values of TMI and PMI	304
6.5	Style of PMI Statement Required in IFLMAPS for Assessment of Relative Values of TMI and PMI	305
6.6	Agricultural Engineering Equations Applied in Sizing of Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	313
6.7	Procedure for Rating Capacity of Machinery Units Required to Perform Two Tasks in a Field Operation; Illustrative Inputs Complement Data Set for IFLMAPS	314
7.1	Chart for Recording IFLMAPS' Monthly Output Prices	354
B.1	Input Form for Signing on New Users to IFLMAPS	399
C.1	IFLMAPS' Initial Firm Structure Complement Data Set Input Form	410
C.2	IFLMAPS' State/Region Complement Data Set Input Form	416
C.3	IFLMAPS' Output Price Complement Data Set Input Form	430
C.4	IFLMAPS' Inputs Complement Data Set Input Form	435

EXHIBIT

C.5 IF/MAF
 Comp
 C.6 IF/MAF
 Inpu
 C.7 IF/MAF
 Set
 D.1 Sizing
 Calc
 Prep
 Inpu
 D.2 Sizing
 Calc
 Unit
 Data
 D.3 Sizing
 Calc
 Mach
 Comp
 D.4 Cost c
 Illu
 Set
 D.5 Cost c
 tive
 D.6 Cost c
 Illu
 for

C.5	IFLMAPS' Government Commodity Program Complement Data Set Input Form	442
C.6	IFLMAPS' Yields Complement Data Set Input Form	444
C.7	IFLMAPS' Field Time Complement Data Set Input Form	445
D.1	Sizing and Performance Capacity Rating Calculation Worksheet: Land Preparation Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	449
D.2	Sizing and Performance Capacity Rating Calculations Worksheet: Planting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	450
D.3	Sizing and Performance Capacity Rating Calculations Worksheet: Harvesting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	451
D.4	Cost of Land Preparation Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	455
D.5	Cost of Planting Machinery Units; Illustra- tive Inputs Complement Data Set for IFLMAPS	456
D.6	Cost of Harvesting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	457

INDEX

- 2.1 Alterna
- 2.2 Managen
- 2.3 Market
- 2.4 Product
- 2.5 Managen
- real
- 2.6 Simulat
- proce
- 2.7 A close
- 4.1 General
- 4.2 IFLMA
- opera
- 4.3 Total a
- perce
- 4.4 Dispos
- 6.1 Exampl
- Moni
- 6.2 Assumed
- for e
- moven
- compl
- 6.3 Graphi
- price
- 6.16
- Outpu
- for I
- 6.4 Reliabi
- expec
- 7.1 Experie
- A.1 General
- subro
- 9.1 Organiz
- IFLMA

LIST OF FIGURES

FIGURES	PAGE
2.1 Alternative decision-making criteria	9
2.2 Managerial process	13
2.3 Marketing opportunity sets	59
2.4 Producers' marketing strategies	61
2.5 Management games' representation of the real world	67
2.6 Simulation games and the managerial process	69
2.7 A closed system	75
4.1 General schematic of IFLMAPS	94
4.2 IFLMAPS' simulation procedure for field operations during each time period	113
4.3 Total accumulated repairs as a function of percent of life	137
4.4 Disposal of harvested crop in IFLMAPS	182
6.1 Example of geographical regions within Michigan for IFLMAPS	265
6.2 Assumed probability distribution functions for each crop's quasi-random price movements; illustrative Output Price complement data set for IFLMAPS	286
6.3 Graphic representation of quasi-random price movements represented in tables 6.16, 6.17 and 6.18; illustrative Output Price complement data set for IFLMAPS	293
6.4 Reliability of machinery as a function of expected useful life	322
7.1 Experiential learning process	345
A.1 General organization of IFLMAPS' subroutines	389
B.1 Organization of on-line storage files and IFLMAPS' software	396

TABLE

4.1 An

4.2 Fi

4.3 To

4.4 Se

4.5 Ba

4.6 Es

6.1 De

6.2 Id

6.3 Sc

6.4 Ti

6.5 "A

6.6 Cu

6.7 Sc

1

S

LIST OF TABLES

TABLE	PAGE
4.1 Annual Possibilities of Rental Land Tracts' Availability in IFLMAPS	105
4.2 Field Operation(s) Allowed to Be Simulated in IFLMAPS During Designated Time Periods	110
4.3 Total Accumulated Repair Cost Function Parameters Used in IFLMAPS	137
4.4 Seasonal Indexes for National Average Prices Received by Farmers in IFLMAPS	154
4.5 Bases Between IFLMAPS' National Average Prices Received by Farmers in the United States and the Chicago Cash Price	156
4.6 Estimated Indexes in IFLMAPS Modifying Random Price Movements in the Futures Market According to Age of Contract	162
6.1 Description of Currently Owned Machinery; Illustrative Initial Firm Structure Complement Data Set for IFLMAPS	261
6.2 Identification of Yield Potential by Land Tenure Arrangement; Illustrative Initial Firm Structure Complement Data Set for IFLMAPS	263
6.3 Southwestern Michigan Yield Relationships for Allowed Planting/Harvesting Periods; Illustrative State/Region Complement Data Set for IFLMAPS	267
6.4 Time Periods and Associated Field Operations in Southwestern Michigan; Illustrative State/Region Complement Data Set for IFLMAPS	269
6.5 "Average" Suitable Field Time Available in Each Time Period; Illustrative State/ Region Complement Data Set for IFLMAPS	270
6.6 Current and Maximum Allowed Planting and Harvesting Periods by Time Periods; Illustrative State/Region Complement Data Set for IFLMAPS	271
6.7 Schedule of Optional Monthly Events; Illustrative State/Region Complement Data Set for IFLMAPS	272

6.8	Mid-Michigan Local Cash Price Bases Relative to Chicago with Adjustments for Southwestern Michigan; Illustrative State/Region Complement Data Set for IFLMAPS	274
6.9	Maturity Months for Contractual Alternatives Relevant to Southwestern Michigan; Illustrative State/Region Complement Data Set for IFLMAPS	276
6.10	Mid-Michigan Futures Market Bases with Adjustments for Southwestern Michigan; Illustrative State/Region Complement Data Set for IFLMAPS	277
6.11	Quasi-Random Price Movements Corresponding to General Characteristics of Designated Market States of Nature; Illustrative Output Price Complement Data Set for IFLMAPS	279
6.12	Probability Density Function Parameters Representing Three Perceived Quarterly Market States of Nature for Each Crop; Illustrative Output Price Complement Data Set for IFLMAPS	281
6.13	Probability Density Function Parameters Representing Three Perceived Monthly Market States of Nature for Each Crop; Illustrative Output Price Complement Data Set for IFLMAPS	283
6.14	Examples of MVBETA Produced Monthly Random Observations From Probability Density Functions Described in Table 6.13, Assuming a Correlation Factor of .75 Between Months Within a Quarter	284
6.15	Markov Transition Matrix Representing Fundamental Market Environment; Illustrative Output Price Complement Data Set for IFLMAPS	287
6.16	Perceived States of Nature, Random Price Adjustments and Resulting States of Nature--Wheat; Illustrative Output Price Complement Data Set for IFLMAPS	290
6.17	Perceived States of Nature, Random Price Adjustments and Resulting States of Nature--Corn; Illustrative Output Price Complement Data Set for IFLMAPS	291
6.18	Perceived States of Nature, Random Price Adjustments and Resulting States of Nature--Soybeans; Illustrative Output Price Complement Data Set for IFLMAPS	292
6.19	Historical Markov Transition Matrices Used to Generate Forecasts of Future Fundamental Market Conditions; Illustrative Output Price Complement Data Set for IFLMAPS	295

TABLE

6.20 A

6.21 Qu

6.22 Cur

6.23 Com

6.24 Fut

6.25 Lan

6.26 Pla

6.27 Har

6.28 Mach

6.29 Salv

6.30 Expe

6.31 Reli

6.32 On-F

6.33 Rent

6.34 Diver

6.35 Diver

6.36 Loan

6.37 Randon

Para

Data

TABLE	PAGE
6.20 A Set of Forecast Fundamental Market Conditions; Illustrative Output Price Complement Data Set for IFLMAPS	296
6.21 Quarterly Point Estimates for Quarterly Quasi- Random Price Movements; Illustrative Output Price Complement Data Set for IFLMAPS	298
6.22 Cumulative Probability Density Observations Representing Quarterly Quasi-Random Price Movements; Illustrative Output Price Complement Data Set for IFLMAPS	299
6.23 Composite Variable Crop Input Budgets; Illustrative Inputs Complement Data Set for IFLMAPS	307
6.24 Futures Market Contracts' Brokerage Fees and Margin Requirements; Illustrative Inputs Complement Data Set for IFLMAPS	309
6.25 Land Preparation Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	316
6.26 Planting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	317
6.27 Harvesting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS	318
6.28 Machinery Unit Costs; Illustrative Inputs Complement Data Set for IFLMAPS	319
6.29 Salvage Value as a Function of Age and Current New Purchase Price; Illustrative Inputs Complement Data Set for IFLMAPS	321
6.30 Expected Useful Life of Farm Machinery; Illustrative Inputs Complement Data Set for IFLMAPS	323
6.31 Reliability Adjustment Factors; Illustrative Inputs Complement Data Set for IFLMAPS	324
6.32 On-Farm Grain Drying and Storage Facilities Available for Purchase; Illustrative Inputs Complement Data Set for IFLMAPS	327
6.33 Rental Land Availability Random Observations from a Uniform Distribution of 0-99; Illustrative Inputs Complement Data Set for IFLMAPS	329
6.34 Diversion Requirements; Illustrative Government Commodity Program Complement Data Set for IFLMAPS	331
6.35 Diversion Payments; Illustrative Government Commodity Program Complement Data Set for IFLMAPS	332
6.36 Loan Prices; Illustrative Government Commodity Program Complement Data Set for IFLMAPS	334
6.37 Random Yield Probability Distribution Parameters; Illustrative Yields Complement Data Set for IFLMAPS	336

TABLE

6.38

6.39

6.40

6.41

6.42

6.43

6.44

TABLE	PAGE
6.38 Correlation Matrix Relative to Random Yield Probability Distribution Parameters; Illustrative Yields Complement Data Set for IFLMAPS	337
6.39 Random Yield Factor Observations; Illustrative Yields Complement Data Set for IFLMAPS	339
6.40 Random Field Time Adjustment Factors; Illustrative Field Time Complement Data Set for IFLMAPS	341
D.1 Values Used in Association with Exhibit D.1 Worksheet to Develop Table 6.25 Land Preparation Machinery Units' Size and Performance Measures	452
D.2 Values Used in Association with Exhibit D.2 Worksheet to Develop Table 6.26 Planting Machinery Units' Size and Performance Measures	453
D.3 Values Used in Association with Exhibit D.3 Worksheet to Develop Table 6.27 Harvesting Machinery Units' Size and Performance Measures	454
D.4 List Machinery Prices; Illustrative Input Complement Data Set for IFLMAPS	458

Am

ing wh

and how

sets us

Ag

ties pe

ers. Th

damental

the farm

tion an

and/or s

Case pr

understa

substant

the part

Similar

classroom

herent

easily in

A pr

teractive

CHAPTER 1

INTRODUCTION

General Problem Statement

American farmers are continually confronted with decisions regarding what to produce, how to produce, how much to produce, when to sell and how to sell. Forecasted farm level prices are among the information sets used by farmers in evaluating and reaching these decisions.

Agricultural extension specialists at several land-grant universities participate in agricultural marketing education programs for farmers. These programs usually include a descriptive analysis of the fundamental and technical aspects of agricultural commodity marketing at the farm level. In addition, the available sources of market information are normally discussed with emphasis on how such information can and/or should be integrated into a farmer's decision-making process. Case problems are heavily utilized to both broaden and test farmers' understanding of the pertinent concepts. There appears to be, however, substantial dissatisfaction with the adequacy of such case problems on the part of both Extension program leaders and farmer participants. Similar difficulties are experienced in many university undergraduate classrooms. The complex interactions and various sources of risk inherent in agricultural producers' decision-making environment are not easily integrated into a simple classroom exercise.

A preferred teaching alternative could include the use of an interactive computerized simulation farm level marketing/production model.

This

marke

offer

users

yield

requi

use o

avail

privat

among

market

useful

develop

ated

nion.

ation

around

tensive

accurat

attitud

physical

informa

ation d

This approach would allow farmers and students to test marketing/production alternatives in a more realistic setting than that offered by most if not all case examples. Such a model would allow users to execute marketing and production decisions under dynamic price, yield and weather conditions. The consideration of risk is a necessary requirement in the real world but one not easily reflected through the use of case examples and other types of problems.

Data and/or information relating to commodity prices are currently available from several sources--the USDA, land grant universities, private marketing consultants, farm magazines and farm radio shows, among others. However, questions exist concerning whether or not the market data and information currently being delivered to farmers is in a useful form. Several agricultural economists are advocating the development and dissemination of a range of expected prices and associated probabilities of occurrence, i.e., probabilistic market information. The postulated principal advantage of probabilistic market information over the traditional form of market information is the greater amount of explicit information conveyed to the decision maker. Such extensive information is hypothesized to allow the decision maker to more accurately evaluate market situations with consideration given to own attitudes toward risk, cash flow commitments, etc. However, little empirical evidence of the alleged greater value of probabilistic market information over traditional market information exists. The evidence which does exist is heavily based on the theory of expected value.

This
cash gra
beans are
concerns
decision
study an
' Impr
teach
mark
deve
allo
mati
keti
viro
pare
the
2. Esta
ers
mar
of
fil
fyi
tive
stud
the
trat

Research Objectives

This research study investigates the above issues with respect to cash grain farms; more specifically, farms on which wheat, corn and soybeans are the principle enterprises. The primary focus of the study concerns farmers' integration of market information into their decision-making processes. Two explicit objectives of this research study are:

1. Improving current agricultural extension service and university teaching techniques regarding grain farmers' utilization of various marketing instruments and related outlook information. Previously developed farm management oriented simulation models have failed to allow for sequential decision making, the provision of market information and allowance of both frequent and several alternative marketing opportunities similar to farmers' real world decision environment. The nonexistence of a suitable model joined with its apparent value prompts the design and development of such a model as the first part of this study.
2. Establishing a means of appraising the relative value to grain farmers of two different forms of market information, i.e., traditional market information and probabilistic market information. The void of empirical data regarding such relative values can possibly be filled through a research application of the simulation model satisfying the first objective of this research study. The second objective entails the development of a methodology for such a research study. The scope of the first objective prohibits implementation of the methodology as part of this research study; however, research of that order is anticipated to be conducted at a later date.

people

ships

where

inputs

some

man

of

term

change

al

action

Althou

the

T

and

the

action

of

the

man

decisi

New

attempt

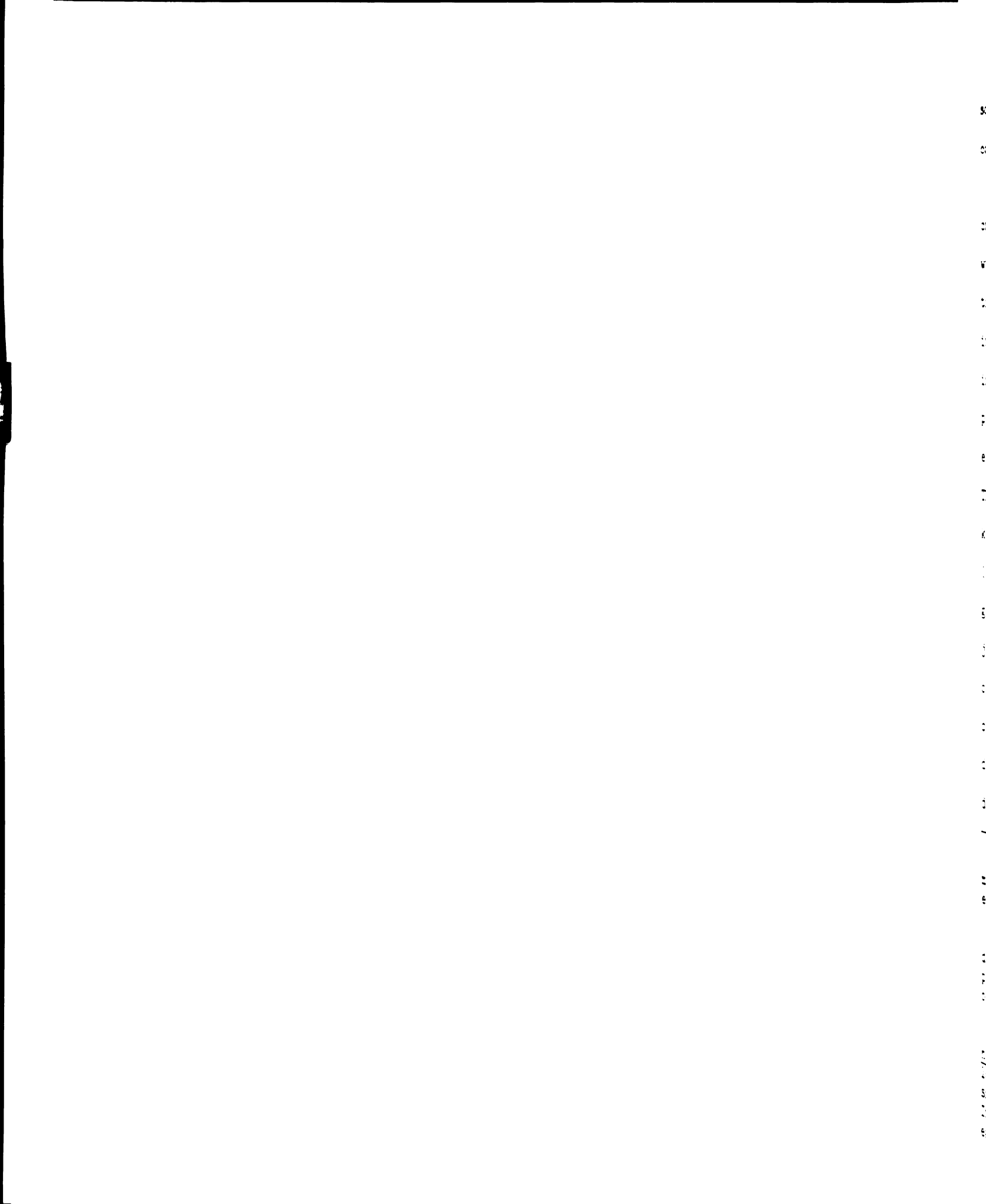
tion

being

Observations from the Review of Literature

Agricultural producers' decision-making processes are infinitely complex. Efforts to clearly discern the intrinsic cause-effect relationships of such processes are hindered by the combined presence of numerous decision opportunities, both controllable and noncontrollable inputs, numerous sources of risk and the availability (at a cost, in some instances) of various relevant information sets. Understanding the human element involved is difficult at best and prohibits the delivery of comprehensive prescriptive advice applicable to all producers concerning production, marketing, financial and other types of problems encountered in their businesses. Individual risk preferences and managerial styles influence the manner in which decisions are made. Courses of action acceptable to one producer may not be acceptable to others. Although useful in many cases, decision-making research which ignores the human component of the managerial process is incomplete.

The complexity of agricultural producers' decision-making processes and the profusion of relevant data and information are partly responsible for the emergence of "management information systems" and the application of computer hardware and software in this area. The primary focus of these efforts has been, until recently, on collecting, processing and summarizing on-farm data and information as well as developing sundry decision-making aids to be used in conjunction with such information. New developments, however, are extending these prior accomplishments by attempting to deliver to farmers more timely market, financial, institutional and weather information to be integrated into their decision-making process. Efforts are also underway to design and construct both



software to process and analyze information and hardware to execute computer-derived decisions automatically.¹

The importance of marketing products at the farm level has increased since the mid-1972 Soviet Union grain deal. The occurrence of widely fluctuating market prices impedes producers' attempts to sell for the top price. Extension and research agricultural economists are devoting considerable resources toward the examination of alternative marketing strategies in an attempt to aid farmers in their marketing decision processes. Such vacillation of output prices has also prompted a re-examination of the techniques being used to prepare price forecasts. There is considerable support for the development of probabilistic market information (PMI) as opposed to traditional market information (TMI).² The supposed advantages of PMI over TMI are associated with the greater amount of information conveyed and its amenability to the interjection of producers' individual risk preferences. Substantial amounts of resources are being allocated towards the advocacy and development of PMI and related decision-making aids. However, the capability of producers to assimilate and integrate such information into their decision-making processes has not been empirically established.³ A

¹Examples of this technology include automatic grain drying equipment, irrigation control equipment, and automatic livestock feeding equipment.

²Whereas TMI generally includes only a point estimate or forecast direction of change regarding future prices, PMI presents a range of prices or price changes and their associated cumulative probabilities of occurrence.

³A corresponding question involves identifying how many producers need to be able to assimilate and integrate this information. "Followers" imitation of "innovators'" decisions suggest the latter group should be the target audience of methods of improving upon this ability. In that case, the problem is to determine the identity of the members of each group while delivering Extension programs in this area. However,

related

informe

Pr

depende

conside

in est

tion, t

that t

ever d

tion se

for in

sets,

observat
ing thei
as much

related issue concerns market analysts' ability to prepare such information--no track record regarding the accuracy of PMI is available.

Previous efforts at establishing the value of information have depended primarily on theoretical approaches which do not explicitly consider the human parties involved. Although such approaches have merit in establishing the relative accuracies of different types of information, they appear to be meaningless if the intention is to prescribe that type of information having the greatest value to agricultural producer decision makers. Decision makers' ability to utilize an information set in a particular problem situation seems to be an important factor in determining the relative values of different types of information sets.

observations of some producers' reluctance to share information regarding their marketing strategies indicates that the target audience should be much broader than one might initially hypothesize.

2

.

2

3

4

7

11

2

10

00

20

10

10

10

10

10

CHAPTER 2

REVIEW OF LITERATURE

Introduction

This research study extends across four subject-matter areas embraced by the agricultural economics discipline:

1. Risk management and producers' decision-making processes
2. Market information and its usefulness in determining and implementing marketing strategies
3. Educational techniques
4. The systems approach and simulation models

A discussion of several pertinent references from the literature is presented below with respect to each of these areas. Recognized as an incomplete survey, this review is intended to indicate past accomplishments in these areas while concurrently establishing the need for the research contained in this study.

Risk Management and Producers' Decision-Making Processes

Farmers function in an environment characterized by risk and uncertainty.⁴ They are continually forced to make production, marketing and other decisions in the absence of complete knowledge regarding future occurrences, i.e., weather and resulting yields, input and output

⁴The terms risk and uncertainty are defined as being synonymous. The acceptance of subjective knowledge has rendered the former distinction between risk and uncertainty irrelevant (Walker and Nelson, 1980).

price

sets

value

level

house

behav

psych

define

hinder

testis

7

farm

assoc

time

topic

type

rather

the la

7

is pr

with d

whether

format

teach

applicati

order

rates

prices, government actions, etc. The usefulness of relevant information sets as aids in such decisions is obscured by the impact of farmers' values and their related goals. The requisite tradeoffs between profit levels and variance of profit as well as competition among firm and household activities result in what often times appears to be puzzling behavior on the part of farmer decision makers. Farmers' individual psychological characteristics thwart efforts at developing a well-defined explanation of how they actually make decisions in addition to hindering the prescription of appropriate information sets to be used as decision aids.

The agricultural economics profession evolved from the study of farm management. Interest in producers' decision-making processes and associated risk management strategies has not waned with the passing of time. A rather extensive review of the literature concerned with the topic has been compiled by Walker and Nelson (1977). These same authors (1980) have also prepared a comprehensive examination of the subject matter from an extension/teaching viewpoint. Several issues cited in the latter reference are relevant to this research study.

The value of subjective knowledge (probabilities) as a decision aid is promoted for situations involving several possible outcomes (each with different consequences) and numerous feasible courses of action. Whether or not producers will be capable of utilizing probabilistic information is judged to be dependent upon "the ability of educators to teach the principles of probability manipulation, elicitation, and application" (p. 25). The task of identifying a functional decision model under conditions of uncertainty is also addressed. Figure 2.1 illustrates several alternative decision-making criteria relevant to

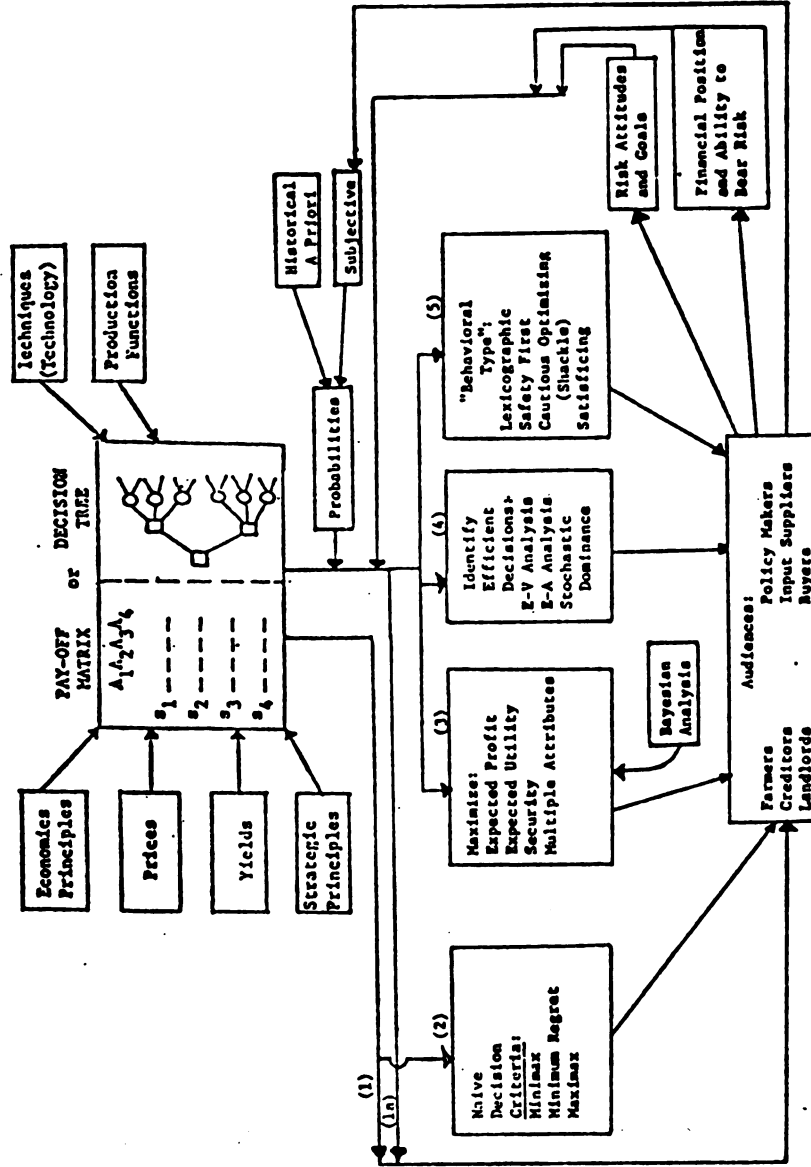


Fig. 2.1. Alternative decision-making criteria

SOURCE: Odell L. Walker and A. Gene Nelson, "Dealing with Risks in the Management of Agricultural Firms: An Extension/Teaching Viewpoint," Risk Analysis in Agriculture: Research and Educational Developments, Proceedings of a Seminar Sponsored by the Western Regional Research Project W-149 at Tucson, AZ, January, 1980, p. 24.

aggr

in o

and

have

ter"

enoc

deci

succ

gal

poss

"deve

now t

sever

1. 7

2. 7

p

a

o

3. 2

p

4. 7

to

he

wa

on

5. 7

co

tn

in

It

hence

general

agricultural producers' managerial problems. Walker and Nelson (1980), in contrasting the different types of models, indicate the advantages and disadvantages of each. The point is made that "decision makers may have their own individual ideas as to what is the important risk parameter" (p. 27) and that, as a result, substantial difficulty is generally encountered in those decision models which require identification of the decision-maker's preference function. An iterative approach including successive generation of solutions and evaluation of whether or not goals are satisfied as described by Candler and Boehlje is noted as a possible technique for overcoming this problem.

Walker and Nelson, in describing their efforts towards the "development of methods and materials for use by educators in teaching how to explicitly consider risk in making farm decisions" (p. 27) note several key premises assumed in their approach (pp. 29-30):

1. There is a human tendency to ignore risks and uncertainties
2. The organizational phase of the decision process was given highest priority, i.e., noting of the alternative actions that are available and identifying the various sources of the risk influencing the outcome of the decision alternatives
3. Decision makers can consider future events in terms of subjective probabilities and it is possible to quantify these probabilities
4. The nature of individual farmers' risk attitudes were not presumed to be either averse, loving or neutral. Rather, priority was set on helping decision makers recognize and understand their attitudes towards risk and how such attitudes might tend to be influenced by a changing financial position
5. There is a conscious effort on the part of some decision makers to control at least some of the risks affecting their farm operations through use of strategies such as flexibility, diversification, and insurance

In their concluding remarks, Walker and Nelson acknowledge the absence of "emphasis on developing computerized, on line, flexible and general tools for ready use in the field utilizing the data developed

and

taint

such

rather

Ne. so

stider

W-149

Water

prod.

seven

2-1

(WMS)

in se

moder.

proce

tion.

known

the ag

forma

aska

in, St

ature

minist

forma

literat

period

and the concepts and models appropriate to decision making under uncertainty" (p. 45). The necessary consideration of so many variables, so much data, and the interaction of so many random variables implies a rather large potential reward through the use of such models. Walker and Nelson indicate that construction of such tools will perhaps be considered either in the latter stages of Western Regional Research Project W-149⁵ or in a following project.

Managerial processes

One of the more extensive research efforts conducted concerning producers' decision making processes was conducted by Johnson and several colleagues, in the 1950s and early 1960s (Glenn L. Johnson et al., 1961). Generally referred to as the Interstate Managerial Study (IMS), the research study involved an in-depth analysis of 1075 farmers in seven midwestern states.⁶ The focus of the research was aimed towards obtaining a comprehensive understanding of producers' total managerial process as opposed to concentrating solely on the decision-making function.

⁵Initiated on January 1, 1977, Project W-149 focuses on "An Economic Evaluation of Managing Market Risks in Agriculture." Cooperating agencies are the agricultural experiment stations of Arizona, California, Colorado, Georgia, Illinois, Indiana, Michigan, Missouri, Nebraska, Ohio, Oklahoma, Oregon, Texas, Washington, Wyoming, the Economic, Statistics, and Cooperatives Service of the U.S. Department of Agriculture, and the Board of Governors of the Federal Reserve System. Administrative advisors are James Kendrick and B. Delworth Gardner, California and the SEA representative is Lloyd C. Halvorson. Several of the literature references cited in this Chapter are attributable to W-149 participants.

⁶Indiana, Iowa, Kansas, Kentucky, Michigan, North Dakota and Ohio.

Along

study of

cultural

IMS. One

lates to

(time, in

puts (dec

self, man

capital. J

ized the

functions

gether thro

The IM

tion manage

kinds of in

dual price,

are more gen

of the other

"that there

vidual farm

mix of differ

Concerni

several insi

7 Normat
positive dat
and Johnson a
practical as
problem solvi

Along with a brief retrospect of the historical development of the study of risk and decision making by both general economists and agricultural economists, Johnson (1977) provides a brief treatise on the IMS. One of the more important observations arising from the IMS relates to management being considered as an enterprise which uses inputs (time, information, data processing equipment, etc.) and produces outputs (decisions) to be used in other enterprises, i.e., in and of itself, management is not a factor of production as are land, labor and capital. Johnson and his colleagues, as a result of the IMS, characterized the managerial process as being comprised of six interdependent functions which make use of both positive and normative data linked together through a pragmatic loop⁷ (refer to Figure 2.2).

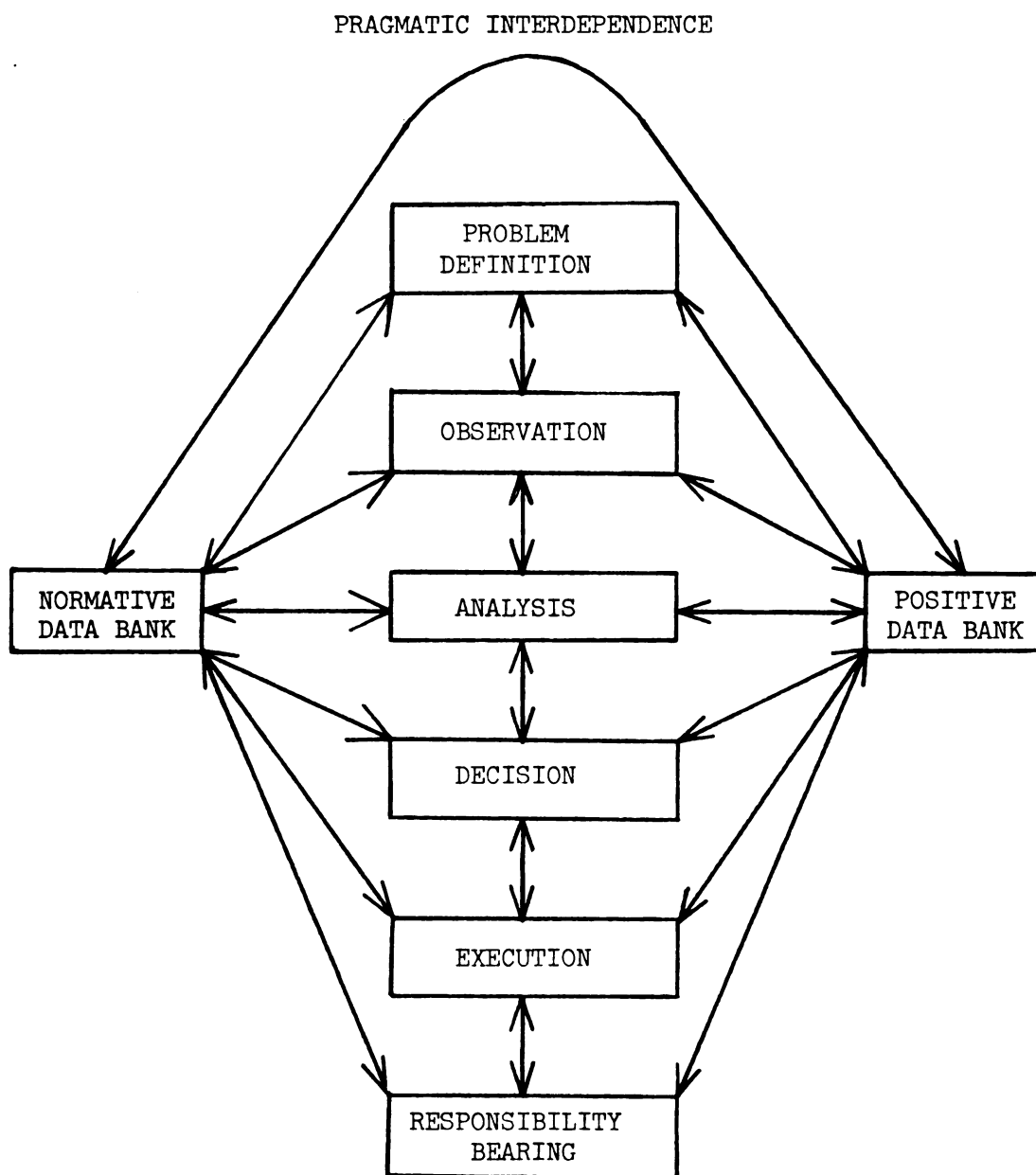
The IMS researchers concluded, with respect to the problem definition managerial function, that there is an important distinction between kinds of information and problems. What once were thought to be individual price, production, new technology, institutional and human problems are more general problems usually requiring information on one or more of the other topics prior to it being solved. The conclusion reached was "that there are probably no stable classifications of problems for individual farmers....the domain of each problem seems to involve a unique mix of different kinds of information" (p. 10).

Concerning the observation managerial function, the IMS identified several insights. The importance of the positive/normative dimension

⁷ Normative data involves goodness and badness connotation whereas positive data does not (Runes, Pearson, Popper, Robbins, Knight, Smith and Johnson and Zerby). The pragmatic loop referred to involves the practical aspects of the interdependence of the two data bases in a problem solving context (Dewey).

100
100
100

Pres
Ch. 7
New



SOURCE: Glenn L. Johnson, "Some Lessons from the IMS," paper presented at the Agricultural Development Council, Inc. Conference on Risk and Uncertainty in Agricultural Development, CIMMYT, Mexico, 1977.

Fig. 2.2. Managerial process

was established in correspondence with three broad categories of information—institutional, technological, and human. The pertinent time dimensions of past, present and future were also noted for each of these classifications. The concentration of the study on "the process whereby managers acquire, analyze and process information on past and present prices into price expectations [indicated that the] mechanistic expectations models developed by statisticians and econometricians....were far too specialized to cover what farmers actually do" (p. 12). In other words, it appears that the managerial processes of farmers is not collapsible into a mathematical model—they are infinitely more complex than can be captured by such models.

In commenting on the analysis managerial function, Johnson notes the apparent value of using what is often referred to as "sequential" analysis. Advocated by Wald as being more economical than single sample analysis, the learning technique requires specification of acceptable Type I and Type II statistical errors, thereby necessarily involving matching the cost of additional information against its value. Consequently, a farm manager must possess "knowledge of the value (nonmonetary as well as monetary)...of the kind of knowledge being acquired" (p. 15). The interdependence between the riskiness of a decision and/or an action and the reliability of all kinds of prescriptive knowledge obtained as well as the acceptability and reliability of the decision rule used is also noted.

Johnson's remarks on the IMS's investigation of the decision-making managerial function include the importance of distinguishing between the good and bad as opposed to the right and wrong, i.e., it may not always be right to do that which is good since something else may be better;

similarly, i
result in th
tive nature
to the non
risks under
ity of their
in their ab

The di
manager's
developing
formation an
able common
costs conf
tempts to an
upon on int
inherent in
components-
clear. In
tests in r
a problem-s

Johns
cludes me
execute de
necessary
the importa
back into

similarly, it is not always wrong to do the bad since such an action may result in the minimization of losses, given the situation. The prescriptive nature of the terms right and wrong are thus indicated as compared to the normative character of good and bad. Johnson infers that the risks undertaken by managers result primarily from the lack of reliability of their prescriptions for the problem at hand (their decisions) and in their ability to implement or execute those decisions.

The difficulties encountered in confirming or corroborating a manager's problem solving model are also indicated. The process of developing a prescription or decision involves (1) several kinds of information and theories, (2) adaptive attempts in ascertaining an acceptable common denominator to be used in measuring disparate returns and costs conferred and imposed on different people and (3) adaptive attempts to arrange alternative actions in some order of preference based upon an interactively sought decision rule. The associated interaction inherent in the process includes both "human" and "less human" components—the relationship between the two is somewhat less than clear. In addition, Johnson observes the incompleteness of statistical tests in handling these interactions while considering the riskiness of a problem-solving model or decision process.

Johnson's review of the execution or action managerial function includes mention of the interdependency existing between the ability to execute decisions and the required accuracy of such decisions. The necessary requirement of special skills to invoke certain decisions and the importance of incorporating feedback from the results of decisions back into the total managerial process are also emphasized.

Johnson characterizes the responsibility bearing managerial function as the source of the impetus which motivates both the decision makers and executioners. He recognizes the frequent sharing of all of the six managerial functions solely by the farm manager-operator in correspondence with the expressed need for feedback and other interaction between individual participants when it is not.

In his final remarks, Johnson indicates the failures of "specialized Cobb-Douglas analyses, linear programs, recursive linear programs, cost/benefit analyses, etc." (p. 26) to attain extensive credibility due to their lack of flexibility. The emergence of new software associated with modern electronic computers is mentioned as a solution to this problem so long as the experiences realized during the IMS are not ignored, i.e., "flexibility vis-a-vis problem definition, types and sources of information, philosophic orientation, the role of maximization and the iterative nature of problem definition and solution (including importance of interaction among investigators, decision makers and affected persons)" (p. 27).

Headley and Carlson also addressed the issue of the decision process and management behavior in problem solving. Noting the interest of economists in the "allocation of scarce resources to satisfy desires of individuals and aggregates of individuals" (p. 1219), they cite the importance of the decision process in obtaining or approaching such a goal. They mention the usefulness of observable phenomena in explaining behavior and promote the development of a model for uses in predicting future behavior, based on inferences from such observable behavior. A method of deriving detailed descriptive models of the decision process is presented with the intent of providing a means for discovering the

rules

the

"rule

ceived

being

behavio

behavio

decisio

farm fi

Ca

farms

an abbr

as the

proach,

character

under s

other

the sta

farm...

pp. 145

one in

static

within

used

via an

rules used by decision makers (farmers) in making their choices among the available alternative options. The application of heuristics or "rule of thumbs" when a decision algorithm is either unknown or perceived to be too costly in terms of time and effort, given the problem being considered, is acclaimed as an obstacle in interpreting past behavior of decision makers. The need for perceiving this type of behavior is suggested for future endeavors concerned with individuals' decisions-making processes and the organization and operation of the farm firm.

Carter investigated the appropriateness of using representative farms as a guide for decision making during the early 1960s. He offers an abbreviated survey of previous applications of the approach as well as the identification of several problems associated with such an approach. Most notably, the difficulties encountered in isolating the characteristics of farm managers having an influence on the decision under study and in quantifying managerial ability, risk aversion and other producer characteristics are suggested. Among his conclusions is the statement "Any meaningful definitions of a representative farm...must relate to the particular problem or purpose of the study" (p. 1454). Becker, in commenting on Carter's observations, acknowledges the inadequacy of the representative farm research approach due to the static nature of such studies as opposed to the dynamic environment within which farm firms operate. However, he offers support for continued usage of the approach, especially in an educational application, until an improved method is developed.

Goals, preferences and psychological concerns

As discussed above, there is some uncertainty or mystique concerning how an individual decision maker operates. Several research studies have investigated the different factors apparently involved in the process.

It is generally acknowledged that the goals of a decision maker are an influencing variable in the decision-making process. Candler and Boehlje use a linear programming model which maximizes several different goals simultaneously according to exogenously specified weights. They suggest an iterative process involving feedback from the decision maker regarding the "desirability" of the mathematical solution to capital budget problems derived under the assumed weighting accorded to the several goals considered.⁸

Keeney provides an account of an innovative approach used in evaluating various alternatives concerning the development of airport facilities of Mexico City subject to several measures of effectiveness. The procedure involves the use of probability density functions representing the impact of the alternate strategies on six measures of effectiveness (determined via the Delphi technique) and a single utility

⁸Candler and Boehlje designated four conflicting objectives or goals as being components of the traditional goal to "maximize profits": (1) maximization of the dividends paid to shareholders; (2) maximization of "net tax free cash" available to the firm at the end of the planning period; (3) maximization of the value of assets owned (or controlled) by the firm at the end of the planning period; and (4) minimization of the probability of financial collapse of the firm during the planning period. Morse, in commenting on the technique advocated by Candler and Boehlje, noted that the procedure is applicable only to a restricted class of multiple goal problems involving non-integer activity solution points and a linear objective function. The possibility of cycling between corner solutions in an attempt to converge on the desired efficient point is noted when both some of the activities considered may occur only in integer increments and the objective function is non-linear.

function which considered the joint utility realized with respect to each objective (measure of effectiveness). An iterative process involving scaling the six relevant measures at different levels and confronting the involved decision-makers with the consequences is used to ascertain the appropriate form of the aggregated utility function.

As part of the "Managing Risks in Agriculture" project (W-149), Patrick and several colleagues are investigating the impact of farmers' goals on their decision-making processes (Patrick et al.). A technique for ascertaining the relevant goals and their relative weights is developed along with a reporting of the risk management techniques practiced by several farmers included in a survey associated with the study. Patrick and Kliebenstein, in a related effort, have prepared an extensive review of the problem from a social science perspective. They note the difference in approach needed when the solution sought is for a group rather than a subgroup or individual. Several factors that should be considered when conducting research on farmers' goals are (p.41):

- "1. The type of decision being considered;
- "2. How the decision will be modeled--how do the goals enter as criteria?
- "3. What metric properties and level of aggregation are required?
- "4. What measurement techniques will provide the information in the form needed?
- "5. Will the potential benefits outweigh the added costs of analysis?"

butes

inary

speci

bound

across

dual

funct

Y

of kn

cal re

severa

Among

should

tions

client

cision

such

the fa

the r

Meyer's

forts

cations

mitigat

siderat

9

and the

Carman proposed an investigation of individual producers' attributes⁹ in association with determining their utility functions. Preliminary results of his research indicate that utility functions are specific to individuals. However, there appears to be, within certain bounds on the risk aversion coefficient, some similarity in their shapes across some individuals. Research regarding the significance of individual farmer attributes corresponding to these similarly shaped utility functions remains to be completed by Carman.

Young (1979) offers an enlightening perception of the current state of knowledge concerning risk preference measurement methods and empirical results for individual agricultural producers. He also provides several suggestions for future research and extension applications. Among his proposals are: (1) extension farm management specialists should include more and better information on alternative decision options and their objective outcome probabilities while working with their clientele, (2) researchers involved in the construction of normative decision models for future use by farmers should attempt to insure that such models are user oriented, allowing for specification of input by the farmer himself, (3) researchers should rank decision options using the rules of stochastic dominance (Anderson et al.) and, in some cases, Meyer's criteria as advocated by Robison and King, and (4) current efforts aimed at examining the dynamic structural and distributive implications of income instability in agriculture and of public policies to mitigate such instability should include incorporation of risk considerations. He also alludes to the greater expense associated with

⁹Carman defined attributes to be characteristics of the operator and the operator's business, i.e., age, farm size, etc.

obtaining risk preference measures for individual producers as opposed to specifying such "typical" standards for a designated class of producers.

The topic of human behavior has long been addressed by psychologists. Jung was among the earliest to suggest "that seemingly chance variation in human behavior is in fact not due to chance; it is the logical result of observable and measurable differences in mental functioning." Jung postulates that there are measurable dimensions of people's personality which reflect the way they "use their perceiving processes to become aware of people, things, occurrences, or ideas and the way they use their judging processes to come to conclusions about what has been perceived" (Roberts and Lee). Based on Jung's theories, Isabell Briggs Myers has developed an instrument, the Myers-Briggs Type Indicator (MBTI), which seeks to measure personal preference types of individuals. Four pairs of preferences are measured concurrently, resulting in a possibility of sixteen different types:

1. Extraversion (E)/Introversion (I)
2. Sensing (S)/Intuition (N)
3. Thinking (T)/Feeling (F)
4. Judging (J)/Perception (P)

The above measures which appear of significance to the objectives of this research study are the (S-N) and (T-F) indexes. The (S-N) classification is directed towards "ways of finding out" while the (T-F) distinction concerns "ways of deciding." A review of three discussions of the MBTI (Carlyn, I. B. Myers, and Roberts and Lee) indicates that sensing types "notice all observable facts," recognizing "the concrete details and practical aspects of a situation." Intuitive types,

conve

hidde

solvi

analy

analy

cultu

duals

tion

of c

ratic

Type

simul

contr

cogni

proje

(not-

conversely, are more inclined to delve into "inferred meanings and the hidden possibilities in a situation." They are good at "problem-solving." Thinking types base their actions on logical, cause and effect analyses. Feeling types are more apt to act based on personal values.

Roberts and Lee used the MBTI at Texas Tech University in 1977 to analyze personality types of both professors and students of the Agricultural Economics Department. Their results suggest:

that sensing and judging types prefer to teach and learn in an orderly, systematic manner using primarily their five senses and they they respond positively to varied multimedia instruction approaches and do not respond as well to the written or the spoken word (e.g., textbooks and lectures) when used alone as instructional media. The intuitive and perceptive types, on the other hand, prefer to teach and learn in a flexible, unstructured manner. They are more apt to respond positively to the written and spoken word, providing that these stimulate interest and imagery. Responses to such stimuli may range from hunches to creative discoveries. It appears then that students exhibiting these contrasting personality preferences to any significant degree should not be taught or treated in the same manner nor should they be given the same types of assignments.

Henderson and Nutt also report the apparent significance of individuals' cognitive make-up or "decision style" in influencing their selection among alternative courses of action. They investigated the effect of decision style on decision makers' perception of risk and the inclination to adopt capital expansion projects.¹⁰ Utilizing the Myers-Briggs Type Indicator test, they analyzed the executives' actions through a simulated case approach, thereby enabling them to exercise a degree of control over the experiment. Their results supported the hypothesis that cognitive style influences choices. S/F executives tended to adopt the projects while S/T executives would not. The environment of the

¹⁰The decision makers analyzed were administrators from hospitals (not-for-profit) and firms (for profit).

analy

tives

firms

resear

cultur

mary

probat

by the

normat

Theore

T

proach

in eco

econom

A

and i

with s

severa

the use

testing

from ri

behavio

1

dual fi

processe

(Hogart)

analyzed decision-makers was also found to be important as N/T executives in hospitals were more conservative than their counterparts in firms.

Musser and Musser present a comprehensive summary of psychological research perceived as being applicable to the current concerns of agricultural economists investigating decision-making processes. Their primary intent is to indicate the impact of cognitive processes¹¹ in making probability judgments. They conclude that, due to the evidence supplied by the psychological literature, "use of expected utility theory for normative firm research has doubtful validity" (p. 13).

Theoretical issues

The investigation of various mathematical and other theoretical approaches to handling risk management and other decision-making problems in economic analysis has long drawn attention in the agricultural economics discipline. Several noteworthy efforts are mentioned below.

Anderson (1974a) examines the problem of sparse data availability and its impact on the construction of probability distributions for use with such evaluative schemes as stochastic dominance. Selley reviews several approaches to identifying individual risk preferences through the use of efficiency criteria. Such identification would enable the testing of whether or not individuals' behavior differ significantly from risk neutral as well as possibly allow for estimation of risk behavioral parameters. Dillon and Scandizzo provide an indication of how

¹¹Cognitive processes are interpreted to represent how an individual functions in terms of perception, problem solving, judgmental processes, thinking, concept formation and human information processing (Hogarth, p. 272).

attitudes toward risk might be measured with respect to rural development projects. Calvin et al. suggest an approach to computing historical risk measures from time series data and examine alternative approaches previously described in the literature.

Research by Robison and King suggests that use of the Meyer (Jack Meyer (1975 and 1977)) criterion which considers stochastic dominance with respect to a function is a preferred alternative to the previously ascribed notions of first and second degree stochastic dominance (FSD and SSD). The value in using this approach will be enhanced by the ability to classify producers' utility functions within several groups according to their personal attributes.

Rae (1971a) describes a means of incorporating discrete stochastic programming, decision-makers' utility functions and information in a Bayesian framework while analyzing sequential decision problems confronting farm managers. The technique suggested indicates how various information sets including forecasts can be used as well as how various expected utility functions may be used as objective functions in a stochastic programming model. The possibility of arriving at a monetary value for additional information as an aid in decision-making is also demonstrated.

Gabriel and Baker present a conceptual framework within which the interdependency of production and investment decisions with financing decisions are considered in light of the risk associated with such decisions. They indicate that although aggregate analyses may suggest farmers are risk averse, it is possible (1) that certain categories of farmers do not respond in that manner and (2) the absolute magnitude of

behavioral response may differ among farmers. The impact of financing decisions on total risk borne by a firm is clearly demonstrated.

Bessler furnishes an extensive description of how subjective probabilities might be elicited from individuals. Young (1980), in contrast, relates how objective probability measures can be estimated and used.¹²

Applied studies

A quick review of the American Journal of Agricultural Economics issues from the 1970s indicates several articles reporting the application of many of the ideas discussed previously. A brief mention of several of these research findings demonstrates the current state of the arts regarding analysis of and prescriptions for the problems confronting producers in their decision-making processes.

Rae (1971b) examines the potential of applying discrete stochastic programming under conditions of uncertainty in a manner he suggests in an earlier cited article (Rae, 1971a). Focusing on a fresh vegetable operation involving several production possibilities and affected by weather and market price uncertainty, he presents a solid case for further study concerning use of the approach. Noting the probable absence of enough states of nature to be useful in application, he cites the failure of the more commonly accepted and frequently used technique of deterministic linear programming which fails to capture any variation in outcome (unless sensitivity analysis is performed). Rae suggests that there appears to be promise for using such a model for research or regional projects involving more than one farm when only the most

¹²Subjective measures are personal judgments on the part of decision-makers whereas objective estimates are based on either historical or experimental data (Young, 1980, p. 8).

important aspects of risk on the outcome of farm plans is considered. There is also a possibility of it being applicable to individual farmer cases under similar conditions.

Scott and Baker explore the feasibility of using a quadratic programming-risk aversion model to select an optimum farm plan under risk. The authors demonstrate how an expected income-variance efficient frontier may be developed using the technique and describe how an individual farmer might use such information in deciding upon his enterprise combinations.

Admonishing against using profit maximization criteria while analyzing producer behavior, Lin et al. examine the appropriateness of using Bernoullian and lexicographic utility. In studying six large-scale California farms (where profit maximization was thought a priori to be a valid hypothesis), the authors delineate E-V frontiers and compare the accuracy of Bernoullian utility, lexicographic utility and expected profit in predicting the actual and planned cropping system of each farm. The results of the analysis indicate that the most accurate predictor of actual behavior was realized when Bernoullian utility was used followed by the use of lexicographic utility and finally profit maximization. However, all methods tended to predict higher risk plans than those actually followed. They suggest aggregation of farms with similar utility functions when attempting to predict aggregative behavior.

In examining the impact of credit constraints on a marketing strategy of forward contracting, Barry and Willmann utilize a multiperiod, quadratic program to capture the problem dimensions of time, uncertainty and a firm's organizational detail.

Ha
produce
influer
and yi
a compe
revenue
yield e
market

An
theory
farm pl
ing th
as meas
tions, a
gramming
used q
tant din
steeper
estimate
ing risk

Map
Market
differen
variabil
income.
efficient
impact of

Hazell and Scandizzo, in commenting on market equilibrium note that producers' formulation of price and yield expectations bear prominent influence in the process. The relationship between stochastic prices and yields is demonstrated as important to consider under conditions of a competitive market. They suggest using a lagged forecast of per acre revenue expectations rather than individual assessments of price and yield expectations due to the latter approach's failure to consider a market equilibrium in which social welfare is maximized.

An integration of linear programming and statistical decision theory is provided by Gebremeskel and Shumway in an investigation of farmplanning and calf marketing strategies for risk management. Asserting the unlikelihood of producers being able to discern levels of risk as measured in terms of variance from those based on absolute deviations, a MOTAD ("minimization of total absolute deviations") linear programming model is used in the analysis rather than the more commonly used quadratic programming models when both profit and risk are important dimensions of the problem. Their empirical findings relate a steeper E-A (expected income-absolute deviation) efficient set than that estimated elsewhere for crop producers, indicating the danger of ignoring risk on cow-calf production studies.

Mapp et al. offer a review of research investigating production market and financial risks in agriculture along with an evaluation of different production and marketing strategies designed to minimize the variability of net farm income subject to receiving a specified level of income. Also considered is the probability of "success" of various risk efficient farm plans for a southwestern Oklahoma farm operation and the impact of various factors such as beginning equity level, rate of

increa
study
effici
lation
price

Comput

T
decisi
tions
as well
tentia
terest
to serv
ity of
offers
tools w
risk p
determi
eral pu

Th
far ha
linear
economy
models

1.
ty, AGN
stitute

increase in land value and rate of increase in the cost of inputs. The study involves applying a MOTAD linear programming model to develop risk efficient farm plans. These plans are used in conjunction with a simulation model to generate a specified planning horizon under stochastic price and yield conditions.

Computerized decision aids

Thus far this review of literature concerning risk management and decision-making processes has surveyed agricultural economists' perceptions of the process and of the various factors involved in the process as well as touching upon various theoretical techniques currently or potentially applicable to problem-solving research. Another area of interest concerns the capability of currently available computer software to serve as an aid in decision situations involving risk. The availability of computerized management decision systems through remote access¹³ offers a ready made avenue for supplying to decision makers decision tools which consider and analyze the effects of the various sources of risk present in their decision-making environment. So far as can be determined, models of this sort are not presently available to the general public.

The economic models developed for use on a commercial basis thus far have been rather straightforward applications of capital budgeting, linear programming, whole farm budgets, partial farm budgeting and other economic concepts (Harsh, 1980-81) rather than the more sophisticated models discussed previously in this section. Other applications of the

¹³TELPLAN at Michigan State University, FACTS at Purdue University, AGNET at Nebraska University and CMN at Virginia Polytechnical Institute are among the more extensively used systems (Harsh, 1980-81).

computerized decision systems involve use of specific models in a teaching context to stress several of the more fundamental farm management principles as they relate to a particular problem. The University of Kentucky's experience with KASH PROFITS (Debertin et al. (1979)) is an illustration of such an effort.

Connor and Vincent address the issue of increasing interest in using computers to provide information to farm managers. They indicate the need to consider the various management functions performed by farmers so as to fully realize the potential from this approach. They identify three managerial functions for which the use of computerized management information appears to be appropriate: problem definition, analysis-planning and decision making. Four categories of information are recognized in this context: descriptive, diagnostic, predictive and prescriptive.¹⁴

One example of computer software of the type perhaps useful to decision makers confronted with a risky situation is an effort by Anderson and Holt. Illustrated in the context of wheat farmers in north central Oklahoma attempting to discern between five production alternatives, each of which is subject to price and yield risk, the model utilizes a

¹⁴Descriptive information is defined "as that which portrays the of problems in an operation" (p. 71). Diagnostic information is designated "as that which portrays the 'what is wrong' condition, where 'what is wrong' is measured as the disparity between 'what is' and 'what ought to be'." Its purpose is seen as twofold: (1) to define problems that may develop in the farm business and (2) to exploit any opportunities that should arise in the farm business (p. 72). Predictive information "is concerned with 'what if...?'" Its usefulness extends across both problem recognition (defines problems in advance) and analysis (arrive at a solution to a problem) (p. 73). Prescriptive information involves specification of the 'right' course of action, i.e., 'what should be done'. Its application appears most appropriate in the decision-making function.

decision tree approach to organize and analyze producer supplied data and information prior to delivering easily understood organized output results applicable to the complex decision situation. The approach involves explicit specification of the perceived risk associated with each alternative rather than designation of a particular strategy to be followed. In this manner, the producers' different capacity to bear and desire to undertake risk is recognized. Application of the technique is possible through use of portable computer terminals and centrally located software bases which have remote access capability. As suggested by Walker and Nelson (1980), there is a rather large potential benefit to be realized from the further development of software of this type.

Other applications of the remote access computerized decision systems involves the delivery of information to decision makers. Michigan State University's TELPLAN includes a program which allows for the retrieval of various sets of information relating to economic, agronomic and other dimensions of agriculture. The University of Kentucky's pilot project, GREEN THUMB, delivers market news and other information to farmers. Purdue's FACTS includes a program which presents and interprets various grain marketing scenarios based on historical market performance. The University of Nebraska's AGNET includes an information retrieval program among its software packages (Harsh, 1980-81).

Market Information and Its Usefulness in
Deciding Marketing Strategies

This research study's concern with farmers' marketing strategies and the related value of farm level market information dictates an assessment of others' professed needs and support for such research as well as a succinct review of past and ongoing accomplishments in the subject matter area.

Brown and Collins recently completed a study concerning the information requirements of farmers. Marketing and production technology information needs were cited by farmers as most important. The lack of information was indicated as the major obstacle facing farmers attempting to accomplish their goals. "...Farmers need information to assist them in their decision of when to sell but they also want the skills to know how, where, and what to sell (practices and techniques). Another note from farmers centered around their lack of information on world marketing and the mechanisms that exist in that sector" (p. 23).

Responses to a Brown and Collins' survey question concerning the "most important source of marketing information" revealed that Cooperative Extension and Universities ranked fourth (7%) behind marketing firms (25%), farm magazines (18%), and radio and television (15%). The "preferred way of obtaining marketing information" was identified as: 1) consultation with experts (31%); 2) newspapers, magazines, etc. (29%); 3) meetings (19%); 4) television or radio (16%); and 5) neighbors (5%). A survey of Cooperative Extension employees during the course of the study indicated a tendency on their part to overestimate Extension's value in providing marketing information. The recommendations of the study included: follow-up studies to provide more specific direction for

extension programs, to develop innovative programs to meet young farmers' needs, and to make Extension contributions more visible.

A similar survey by the National Opinion Research Center (Jones et al. (1979)) of North and South Dakota farmers in early 1978 indicated a perceived need on their part of information on "the potential market demand for their crops and the prices buyers will pay" when questioned concerning the usefulness of USDA crop and livestock reports. Concern with the accuracy of USDA forecasts was also voiced by a majority of the survey respondents.

Cothern presents four primary reasons why improvements in market information and information systems should be of concern:

First, public and private decision making is being conducted in an atmosphere of minimal food stocks and this does not allow the margin of error outlook workers possessed in market evaluation in the past. In addition, markets are responding more readily to federal outlook reports and market news than they have traditionally. Second, the development of low cost electronic computers, information and computing terminals and low cost general data processing equipment has given firms potentially enormous analytic capability. Third, because of present dynamic markets almost all forms of management and policy decisions revolve around a need to know precise outlook information relevant to the time frame considered. Fourth, the marginal value of increasingly precise information relative to the marginal cost of securing it is extremely variable from sector to sector depending on firm size.

Cothern also identified three time frames within which market information should be channeled:

First, is the very short-run outlook information which facilitates analysts' and/or businessmen's day-to-day decisions; closely approximating market news, but with interpretation. Second, is the type of information which affects medium-range plans, for example the decision regarding enterprise combinations or livestock combinations might be affected by accurate seasonal supply forecasts, stock estimates or the like. Finally, longer-range outlook information which may affect the entire climate in which business is to be conducted if all inputs can be considered variable.

In addition, Cothern provides the following specific ideas concerning the components of an adequate outlook program:

- "1. Geographically relevant information must be continuously available and readily retrievable in the following areas
 - "a. Relevant seasonable prices, quantities produced and sold of affected goods and substitutes
 - "b. Exogenous demand and supply related information
 - "c. Market intelligence from international markets (prices, quantity produced, sold, weather, etc.)
- "2. Adequate clerical and/or data processing support should be provided so that file maintenance is facilitated and information can be easily and quickly retrieved
- "3. Professional staff support should be adequate to maintain familiarity with the data series, maintain close contact with industries concerned and provide quantitative-evaluative capability. In addition, the group should have the capability to communicate and articulate results of analyses verbally, graphically and in literary form
- "4. The periodic or seasonal forecasts or projections should be definitive, precise and available at regular intervals; and they should be refined for the appropriate geographical area or areas concerned
- "5. Choice of communications media should be suited to the appropriate management-time frame criteria, the target release date should be consistently met, and the analyst(s) should have the ability to communicate results articulately and efficiently "

The individual information needs of farmers and the current inability of the USDA to deliver such information also receives attention by Cothern. His summary remarks include "Present and future [outlook] programs will need to be tailored to geographical areas; they must be precise and definitive; and they need to be released at regular intervals according to the needs of a demanding and knowledgeable clientele" (p. 141).

Harris indicated the need of market participants is presently great due to unstable prices of farm commodities. He identifies four major tasks of an outlook program:

1. Gather relevant data
2. Analyze data and form a forecast or a projection
3. Integrate the forecast or projection with its implications for alternative purchasing, production, and market strategies of clientele
4. Disseminate the information

Hepp and Olson, in addressing small farm operators' information needs, note that one should identify his audience by problems, farm goals and production enterprises. They discuss the more diverse nature of small farmers' objectives as compared to those of large farmers and the necessity of presenting small farm operators with an integrated management system rather than isolated information on individual items.

Schmererhorn relates that "the market problems of the commercial farmer center around individual decisions relating to our traditional what, when, where and how to market a product." He discusses the increasing integration of production and marketing activities and a need to present appropriate information at proper levels.

Ricks defines Extension marketing work as including information on individual farmer marketing decisions such as on (pp. 4-5):

1. Where to market their farm products?
2. What market method to use?
3. When to market?
4. What crops and livestock to produce, and how much of each?

In doing so, he suggests the integration of marketing and farm management subject-matter and personnel. He notes that "A major goal of Extension marketing is to help farmers through improved marketing of their

products. To achieve this goal an important part of our program can, and should be, to provide relevant information to farmers to help them make their individual farm marketing decisions" (p. 7).

Yeutter notes "marketing skills will determine who survives in agriculture in the next 20 or 30 years. There are many producers who have not mastered these skills. Current interest rates are up to 20 percent. I have a hunch that the creditors of such producers are going to have something to say--soon--about how long they continue in business if they do not develop up-to-date marketing skills" (p. 12).

Dobson (1979), in his remarks at a Conference sponsored by the North Central Regional Committee 117¹⁵ addresses several problems associated with the U.S. agricultural market information systems. His review of research studies analyzing how farmers use market price information for decision making indicates "that farmers fail to use some market price information readily available to them and that factors other than purely economic considerations often dictate choice of markets" (p. 2). Noting that the supportive research studies were conducted during the 1950s and 1960s, Dobson suggests that replication of some of the studies might indicate if farmers' use of market information has improved since then and whether or not an educational program in the area might be beneficial. Among the suggestions for improving market news are to increase market news for local markets and to include outlook information

¹⁵Organized on April 25-26, 1973, NC-117 focuses on subject matter relating to "Organization and Control of U.S. Food Production and Distribution Systems." Cooperating agencies include State Agricultural Experiment Stations of the North Central Region as well as those of California, Canada, Colorado, Florida, Kentucky, New Mexico, New York, Oklahoma and Texas. Bruce Marion is the Regional Coordinator of the project and Walter L. Fishel is the Administrative Advisor (Michigan Agricultural Experiment Station).

along with market news to provide a comprehensive market information program. Dobson goes on to note the general absence of studies relating to market news and prescriptions relating to the use of market news to improve market performance, in pointing out research opportunities for marketing economists. He also makes several remarks regarding the reliability of market price and supply information--as well as suggests improving USDA market information and economic outlook information.

Marion, in suggesting several hypotheses to be tested through empirical research, notes three areas that this current research study is trying to touch upon (pp. 179-180):

1. Search by atomistic buyers is relatively low, allowing sizable price dispersions in such markets in the absence of publicly provided comparative price information
2. Information is distributed or obtained in unequal amounts. Large firms generally have more complete market information than small firms
3. Greater specificity is needed in market news and market information. The level of information specificity is negatively related to the incentives for contracting and vertical integration

Information and information systems

The virtues of information as a decision-making aid have received considerable attention in the literature (Arrow, Bonnen, Eisgruber (1974), Conklin and Hanson, Blackie and Dent (1979)). Eisgruber (1978), in commenting on the "economic theory of information" enumerates four factors as being responsible for the lack of theory and/or methodology applicable to the subject-matter area (p. 901):

1. For most information systems, particularly the public information systems, there is no market price that would suggest the value of information and information systems
2. Information is not a physical good and, therefore, lacks the concreteness that provides a basis for valuing many items....

3. Most information systems do not have an impact that is observable in easily measurable variables
4. Public and private values of information may differ significantly

Eisgruber also indicates that there is an increased interest in the topic of economics of information, citing several developments possibly responsible for the added concern (p. 901):

1. Cost of information and information systems have risen rapidly
2. Income distributional impacts of differently structured information systems are recognized
3. There is increasing understanding that our ability to conceptualize is limited by data
4. Related to the above, the growing awareness that during the past decade our profession may have relied too heavily on deductive analysis without proper concern for the relevance of the data base. The result is that an increasing amount of work was completed with increasingly irrelevant data

In citing Bonnen, Eisgruber identifies several concepts central to the study of information (p. 901):

Data are not information. The demand for data is generated by the need to make decisions on problems, but decision makers rarely use raw data. Rather, there are intervening acts of interpretation, through statistical and economic analysis, policy staff and political evaluation, etc., which transform data into information by placing them in a specific problem context to give meaning to a particular decision. Consequently, an information system includes at least the following: (a) data system (collection, storing, processing, retrieval); and (b) analytical capabilities to interpret the data (theory, methods). This implies that unless economic theory and economic statistics meet on common conceptual ground, there can be no mesh between empirical analysis and theory, that is, between the inductive and the deductive process of "knowing."

Harsh (1978), in citing Davis, relates a similar distinction between data and information (p. 908):

He [Davis] defines data as groups of nonrandom symbols which represent quantities, actions, things, goals and so forth. However, raw data contribute little to the decision-making process. On the other hand, when processed and transformed into useful information, data is conceived to be meaningful

and useful for decision making. The processing is an important and necessary step in transforming data into useful and usable information.

Forster, in commenting on Eisgruber's remarks, emphasizes several of the concepts discussed. The dynamic environment of the real world requires "a continuous process in selecting the best information system." The economic concepts of decreasing marginal returns and increasing marginal costs are justifiably applicable to information, both from an individual's and society's viewpoint. The presence of risk is the prerequisite for an information system and as risk increases, the value of the information system also increases. As a result, different situations require different types of information systems. The impact of an information system on income distribution is noted, especially in the case of modifying an existing information system which will result in a redistribution of income. In observing the tendency towards centralized control of the processing of low levels of information into higher forms of information, the issue of property rights to such information is raised. The association of fewer sources of information with such centralized control results in a desire to protect "trade secrets."

Harsh's (1978) recognition of major agricultural firms such as grain companies having developed their own data bases for making supply and demand estimates to use in their own decision-making processes is an extension of this issue. In general, only those closely associated with the responsible firm are privy to such privately generated and processed data. Although there is merit on such protection in some cases (patents), there is equal justification for making information available to the public if it lessens uncertainty in the decision-making process (Posner). Forster's final comment relates to the heterogeneous

information needs of diverse clientele and the need to tailor information systems to such needs.

Shaffer identifies four information system problems requiring attention by the agricultural economics discipline:

1. Do we know the current structural relationships so appropriate data is being collected?
2. Is the quality and accuracy of data for rural areas adequate?
3. How do we reduce misrepresentation and potential misuse of data?
4. Can appropriate data be delivered in a timely and usable fashion?

All of these points, especially the second and fourth ones, appear to be related to a focus of this research study--market information as an aid in farmers' decision making processes. There is a need to continue with projects similar to "Managing Risks in Agriculture" (W-149) in both the researching and extension areas to improve upon our ability to provide usable data as well as to enhance the ability of our clientele to make intelligent use of this "correct" data. With respect to the last issue, delivery of the data itself, care must be taken to not overload the clientele with neither data extraneous to the problem under consideration (Ackoff reinforces this concern) nor more data than can be assimilated into the decision-making process.

Infanger et al., in discussing the implications of information delivery systems, suggest several areas of concern for those institutions contemplating the institution of a system for the first time (pp. 919-920):

1. An information system will have to force some changes in the interface between extension and researchers involved
2. There is no general agreement on the relative advantages of a batch versus remote access organization

3. Costs are extremely high in terms of equipment and personnel and will preclude many of the smaller states from initiating their own systems
4. Serious evaluations of existing systems have not been completed so there is little information to guide the "comparison shopper"

The increased emphasis on information delivery systems in recent years is reflected by efforts of the University of Kentucky (ANSER, GREEN THUMB) and of Michigan State University (COMNET, MSUIFS). These systems are designed to provide farmers and other extension clientele with a variety of different types of information as well as access to an assortment of software intended to assist decision makers confronted with a problem. A more in-depth discussion of the design and operational features of these systems is presented by Debertin et al (1979).; Moore et al.; Davis and Jones; Harsh and Fredericks; and Fredericks et al.

Value of information

The contention that information serves as an "aid" to decision makers implies that such information has value. Walker and Nelson (1980) cite one of the "Managing Risks in Agriculture" project's (W-149) objectives as being "to estimate the value of qualitative changes in flows of market and financial information that affect the capacity and willingness of primary producers to manage market risks" (p. 35). In an examination of "some new and emerging risk research contributions" they discuss several recently completed and currently on-going projects concerned with payoff matrices and decision trees, subjective probabilities, measuring risk aversion and alternative models for decision making. With respect to subjective probabilities specific attention is directed towards assessing the value of probabilistic information. In referencing the objective of the "Managing Risks in Agriculture" project (W-149),

Walker and Nelson indicate that its fulfillment will allow extension and university educators to both "have an idea of the potential payoff of information that they might convey" and "be able to predict the effect of information on the capacity and willingness of producers to manage market risk" (p. 40). In general, little progress has been made in assessing the values of information to producers and their associated capability of using such information. Several applied research studies which have attempted to assess such value are reviewed in this section.

Focusing on the level of fertilizer to be used subject to the uncertainty of yield levels, Perrin endeavors to assess the value of information regarding such optimum fertilizer levels for a farmer's particular class of soils. Citing Schlaifer, he proposes "the value of the information is the increment in expected payoff that can be realized by utilizing the information in making the decision" (p. 55). Perrin notes the distinction between expected utility and profit maximization while suggesting that although the former is the preferred approach to determining optimum fertilizer levels and value of information, the latter can be used interchangeably for risk neutral decision makers and it also provides an upper bound estimate for the risk averse decision maker. Although the results of the analysis¹⁶ appear to suggest a high potential value for soil test information, Perrin notes that the measured value is arrived at by assuming an alternative condition where the

¹⁶The analytical procedure involved the use of two linear response and plateau models (LRP) to predict, a priori, the most profitable of the fertilizer treatments used at each evaluation site. One of the models included the soil test information while the other did not. "Differences in average net returns from the treatments selected by the various approaches provide an estimate of the expected value of each approach" (pp. 57-58).

farmer knows nothing about the piece of land. Recognizing that farmers generally have an extensive knowledge of their land's performance capability, Perrin suggests that, "if so, the net value of the soil test information would be small" (p. 60).

Lee and Nicholson, in commenting on managerial information systems in Canada, similarly indicate that an intuitive appraisal of specific data tends to overvalue that data as potential information. This is so since the "real" value is related to the next best source. This next best source is often overlooked. Since there is a wide variety of independent sources of information, the evaluation of one in isolation is not a useful procedure (p. 928).

Another approach to valuing information involves Bayesian decision theory.¹⁷ One example of this approach with respect to valuing weather forecasts is offered by Doll. Acknowledging the importance of knowing the value of such information when 1) deciding whether or not the public should invest in its preparation and 2) an individual is deciding whether or not to purchase privately provided forecasts, he presents a systematic review of the process necessary to employ the approach. Doll recognizes as a problem of doing such analysis the general nonavailability of the necessary data (p. 651):

the information necessary to estimate the value of the forecast is the same information needed to implement it and, as such may not be available. Given this lack, a realistic approach at the initial stages of research would be to ask: Will the value of the forecast be sufficient to justify the research and development costs of making the forecast operational? This would entail developing the forecast technology as well as reliable estimates of the production function and the prior distribution.

¹⁷For an in-depth discussion of this approach, refer to Anderson et al.; Halter and Dean (1971).

Baquet et al. also employ the Bayesian approach to assessing the value of frost forecasting. Advocating the methodology as having "general application to determination of economic value of information under conditions of uncertainty" (p. 511), they derive values of forecasts for a sample of eight orchardists while noting that such results cannot be extrapolated to all orchardists in the sampled area "without assumptions regarding the risk philosophies and other input data of the unsampled orchardists." More specifically, "while we conclude that the frost forecast service is of considerable value to the eight orchardists sampled, general recommendations as to appropriate frost protection strategies for all orchardists cannot be made and the value of the forecast for the entire county cannot be determined" (p. 519).

Leuthold combines information theory and Bayesian decision theory in determining the value of information related to a short-run hog pricing situation. The technique ascertains whether or not the information conveyed in a forecast is "good" or "bad" and the value of such information to an individual user.

The gaming approach is another technique for valuing information and manager's ability to utilize such information. Debertin et al. (1975) in a study involving college senior level undergraduates and Debertin et al. (1976) in a related study involving farmers present the results of such an approach in assessing the value of information and feedback to experimental managers of laboratory corn and soybean farms. Recognizing the hypothesis "that a manager's skills in coordinating resource use may be as important in determining profits as the amount of resources (land, labor and capital) available" the authors propose that

"little is known about how the availability of information influences the profits of a firm" (p. 316). They further suggest that (p. 316):

additional information should lead to greater allocative efficiency in the use of other inputs if (a) the information is related to the decisions that the manager makes in operating the business, (b) the information can be obtained from sources readily available to the manager, and (c) the information is correct in that it leads the manager to the "right" decision.

The studies sought to test three hypotheses: (1) profits are directly related to the availability of research information, (2) profits are related to the availability of feedback from the previous decision that is provided to the manager, and (3) there exists a positive interaction between research information and feedback (pp. 316-317). The authors recognize the value of information and feedback is conditional upon their initial levels and acknowledge that most few decision-makers have access to some of the other, if not both. In that regard, they note the less than realistic design of their experiment.

The two Debertin et al. studies (1975 and 1976) involved use of the Purdue University Corn-Soybean Production Management Game (Debertin et al. (1974)) over a simulated five-year period. Annual decisions incorporated into the game included (a) the combination of corn and soybeans to be planted, (b) variety and row width selection, (c) fertilization levels, (d) planting and harvesting dates, and (e) moisture levels for artificial drying. The decisions included were chosen due to the availability of research or extension information useful in making the decision. Construction of the game also insured that the management decisions included had an impact on gross returns and/or costs of production. A substantial effort was extended in the game's development

towards insuring "that relationships¹⁸ in the model were consistent with relationships that would be expected on an Indiana grain farm" (p. 317). Extensive validation runs were conducted to assure such correspondence with reality including sensitivity runs attempting to isolate the impacts of a selected change in each decision variable.

The studies invoked an analysis of variance methodology in assessing the assorted proposed hypotheses. All participants were initially asked to complete decisions for each of the five periods in the absence of any information except that characterizing the 600 acre farm operation being simulated. In addition to familiarizing the studies' participants with the gaming procedures, the results of these decisions were used to randomly assign the participants to different treatment groups so as to insure the possibility of making meaningful comparisons. In the case of the study involving students (fifty two in total), four treatment groups were considered--(1) no information or feedback,¹⁹ (2) information only, (3) feedback only, and (4) both information and feedback. Consideration of the relatively high cost of the study when conducted outside the classroom (approximately \$100 per participant) forced

¹⁸Cobb-Douglas production functions representing yield response to fertilizer as well as other production functions are an intrinsic part of the model.

¹⁹Feedback consisted of information similar to that found in a detailed set of farm records--yields per acre, prices received, harvest moisture, hired labor, machinery, fertilizer, herbicides, and other variable costs, taxes on land, and interest on borrowed capital. Information was comprised of research data primarily from the Purdue Agronomy Farm pertaining to the effect on yield and costs of different machinery, production technology, fertilizer, planting dates, and harvesting dates as well as returns to drying at alternative market prices. Such information was delivered via an information retrieval system which utilized a remote computer terminal and magnetic discs containing the research data (p. 318).

limiting the farmer sample size to forty participants. Based on results from the earlier conducted student study indicating a great deal of within group variability in profit performance, only two treatment groups were considered: (1) only feedback and (2) both feedback and information.

The environmental conditions of the game were the same for all participants. Weather varied over the 5 year period resulting in some variability in yields. Prices used were historical data from 1968-72 although "managers" were told only that they should expect a set of prices which "might prevail over a five-year period." A perceived to be successful attempt was made to discourage the sharing of information across treatment groups as well as between members within a particular treatment group. Each treatment group met at different locations to obtain information and/or feedback and make decisions in addition to monetary awards being offered for "best" individual game performance (largest total profits). Also, a sum of \$10 was paid to each participant in the experiment so as to encourage them "to do a 'good' job at making managerial decisions consistent" with how they would function in the real world (p. 318).

Results of the student study indicated a "consistently significant positive return to both feedback and information" (p. 319). Both a comparison of mean profits across all participants within each treatment group during each of the five periods and a separate analysis of variance test for each participant's performance during each decision period was made. In the latter case, F-ratios at significant levels ranging between .25 and .005 supported the individual value of feedback and information while the interaction between feedback and information was

found to be insignificant, i.e., there is an additive but not multiplicative effect on profits (pp. 319-320).

In evaluating the student study, the authors promote the development of improved information delivery systems utilizing computers rather than traditional research and extension bulletins for providing research information to farmer clientele. The authors cite three individual areas of caution to be aware of when interpreting the results of the analysis:

1. The participants were novice rather than experienced farm managers
2. While contending that the novice farm managers are possibly representative of beginning farmers, it is recognized that some, but not all, such farmers have some college education. Consequently, the educational level of the study participants possibly overstates the value of research and extension information to beginning farmers
3. The use of a managerial game as opposed to real world conditions poses some inconclusiveness of the study results. There is no way to prove the game functioned identically to the real world nor that the participants functioned in the laboratory experiment as they would have in the real world facing real risks in an actual social and political environment (pp. 320-321)

The subsequent study involving farmer participants as opposed to students was conducted in response to criticism of the first point noted above. Following a similar approach, the authors found a significant return to information but not as great as that exhibited in the study involving students. Also, the general profit levels of the farmer study group was below that of the student study group. A two-way analysis of variance of the data was used to interpret the results.²⁰ The authors'

²⁰ The results of the statistical test were: (a) information had a significant positive impact on profit levels in three of the five decision periods, (b) students generated significantly greater profits with the game than farmers in four of the five decision periods, and (c) a lack of significance in the ability of students versus that of farmers to decide and use information in a decision-making context (the interaction effect was significant in only one of the five decision periods) (pp. 321-322).

conclusions from the farmer study were: (1) the higher performance level of students as opposed to farmer study participants might reflect marginal returns to education, (2) the differences in student and farmer behavior with the simulation model could be attributable to the students adapting to the game conditions more quickly due to their experience of academic pressures in a university environment--if such is the case the students were not better farm managers but rather better "players" of the game and (3) the information prepared and presented for use in the experiment as well as serving as a basis for the simulation model itself might not be representative of the real world--students might tend to accept such information at face value while farmers may be prone to discounting such information, relying more upon their own real world experiences. They issue a call for research indicating the correspondence of game behavior to real world behavior along with an expressed need to incorporate additional managerial decisions into the gaming approach.

Rosenberg and Gray offer a contrast in methodology for assessing the value of market information in a real world study which examines variation in prices received by alfalfa hay producers. Paired analysis of forty producers comprising two study groups of New Mexico alfalfa producers, one of which received an experimental "Market Newsletter" and the other which did not, indicated: (1) a significant (.05) level reduction in the dispersion of prices received by the "informed" group when compared to the "control" group, (2) members of the "informed" group tended to sell their hay more quickly than did members of the "control" group (2 days after harvest as opposed to 24 days after harvest, significant at .10 level), (3) although not a significant difference, the "informed" group received slightly more than the "control"

group for its hay when considering all five cuttings (\$21.93 versus \$21.59/ton), (4) the Informed group received significantly more for first cutting hay than did the Control group, and (5) no significant difference in prices received for the second through fifth cuttings was observed.

As might be expected, research of the type performed by Rosenberg and Gray has been almost non-existent. The potential damage to a class of producers receiving the "wrong" information set generally precludes use of this approach. Henderson, in commenting on market information related research questions notes the following (p. 178):

The controlled experiment, in which market information becomes an experimental variable, and changes in market participant behavior and economic performance are observed, appears to be a reliable research technique and perhaps the most useful of the methodologies now employed. However, these are costly and appear to have considerable political and social limitations. It is not hard to understand political and social resistance to such experimentation when individuals' economic well-being may be significantly affected primarily for the sake of scientific experimentation.

Forecasting models

Both private and public agencies involved in the development and deliverance of market outlook information generally use a combination of objective and subjective data/information in their analyses. This section 1) examines several recent suggestions for improving upon such techniques, 2) presents a brief review of several studies concerning the historical accuracy of different types of forecasts, and 3) discusses the current state of the arts in commodity forecasting with respect to the more prominent large econometric models.

Smyth and Bullock have separately examined the impact of market price information on society from a theoretical viewpoint. Smyth

concluded, that regardless of whether the variance of price in the absence of forecasts was finite or not, the public announcement of forecasts tend to stabilize price, i.e., lessen the variance. Recognition of suppliers' reactions to such forecasts tends to increase the estimated variance of price over what is hypothesized in the absence of consideration of such reactions. Bullock in investigating the social costs resulting from erroneous agricultural production forecasts, deduced that such costs are dependent upon supply and demand conditions existing at the time of the forecasts and that reduction of the average forecast error will not always result in social benefits. Bullock fails to estimate the social payoff to improving the accuracy of the Statistical Reporting Service forecasts, noting that such an estimation requires "first, projections of the probability distribution of possible supply and demand conditions at the time of the forecast and secondly, estimates of the conditional frequency distributions of forecast errors (given the existing supply and demand situation) prior to and after the modification of SRS forecasting techniques" (p. 80). He postulates that efforts directed toward this purpose would probably be ill-fated, due to the problems associated with obtaining the necessary information in a world of far more uncertainties than SRS forecast errors alone.

Crowder, in differentiating between theoretical and user oriented econometric model builders, observes that the latter group's interest with respect to a model is "did it help make a better decision?" He notes the apparent value of probabilistic information regarding whether or not a specific price level will be attained and infers that the accuracy of such probability limits is as important as the reliability of the forecasted price. Myers (1972) similarly distinguishes between the

development of techniques for publishing purposes and the development of decision-making aids for management.

Cromarty and Myers suggest several improvements needed in the area of commodity price forecasting. Their comments were precipitated by the increased interest in such forecasting following the Soviet-American grain deal of mid-1972. They propose that the value of a particular forecast is dependent upon the technique used to generate the forecast being designed explicitly for the problem under consideration. The need to improve upon data collection concerning world demand and supply conditions is cited as is the need to incorporate subjective judgment into forecasting models.

Penson and Hughes, in commenting on the development of economic projection models for agriculture, express a need to incorporate general economic outcomes into such models. The interdependency of the agriculture sector with the general economy is inferred as is the general lack of data necessary for such integrated modelling.

Gunnelson et al. examined the accuracy of more than 1000 USDA crop production forecasts as part of a larger project directed towards meeting the increasing information needs of management. Their results indicate a tendency towards more accurate forecasts over the time period considered (1929-1970). They also found that: (1) within year accuracy tended to improve as time passed and revised estimates were issued, (2) forecasts for commodities with shorter forecast periods were more accurate than those for commodities with longer forecasting periods, and (3) a slight and constant tendency to underestimate crop size was observed in the analysis of first crop forecasts--such an error is probably the result of assuming normal growing conditions from the time of

the first forecast up until harvest time. The authors conclude that future improvements in the accuracy of such forecasting will remain modest until such time that a new technology such as remote sensing or some other means of obtaining a more accurate assessment of the situation becomes operative.

Smith and Schrader, in responding to claims by farmers that production estimates are contrived to manipulate prices, present an analysis of corn and soybean production forecasts for the period 1960-1975. Their results are similar to those of Gunnelson et al., indicating that the accuracy of the forecasts tend to improve during the season as well as over time. The charge of a systematic pattern or bias in the reports is refuted.

Marquardt investigated the relative price-forecasting accuracy of several futures markets as opposed to several outlook letter sources.²¹ Two separate analyses were conducted: (1) "the deviation between the forecast price and the actual cash price obtained at the specified future date was investigated," and (2) "the direction of the predicted price movement was recorded and compared with the direction indicated by the futures market quotation in the case of nonspecific dollars-and-cents forecasts made by any source." With respect to the first analysis,

²¹The outlook letter sources evaluated were "Doane's Agricultural Letter," Farm Journal Farmer's Outlook Letter," Iowa Farm Outlook, "Kiplinger Agricultural Letter," Nebraska Farmer, Successful Farming, "U.S.D.A. Livestock and Meat Situation," "Washington Farm Letter" and Western Livestock Roundup--the identity of the outlook sources was hidden in the results of the study, i.e. their relative performance was not explicitly revealed. The commodities considered were live fat cattle, live fat hogs, wheat, corn and soybeans. The time period covered by the forecasts analyzed was dictated by when the respective outlook letter sources issued their forecasts. In general, it appears that such forecasts were in the range of 3 months to a year into the future.

only 77 observation points were available over the four-year study period for all 10 outlook letters. Although no significant difference was established, the futures market tended to be more accurate, i.e., for five of the seven comparisons against individual outlook letters the futures market gave a closer average deviation of forecasting price change from the actual price change. An analysis of the 988 cases involving projection of the actual price level resulted in the futures market being judged significantly superior to eight of the 10 individual letters.

With respect to the second type of analysis conducted by Marquardt, "the futures market not only gave more frequent forecasts (five days a week), but also gave more frequent forecasts of the direction of a price change and a higher percentage of accuracy when predicting the direction of price movements" (p. 136). Consideration of the individual commodities involved in the study indicated 1) superiority of the futures market for corn, finished weight cattle and hogs, 2) no difference between the two types for soybeans and 3) a more accurate record with outlook letters for wheat. The paired t tests used in the analyses would appear to favor or be biased toward the outlook letters since they choose when to make their forecasts.

Ikerd (1979a), in citing a paper presented at the 1979 AAEA meetings in Pullman, Washington, notes a similar standard of accuracy for the futures market when compared to forecasts from the sophisticated econometric models of the U.S.D.A., Chase Econometrics, Doanes, Data Resource Inc. and Wharton. All of the forecasts tended to be somewhat inaccurate with such inaccuracy becoming larger as the forecasts reached further into the future. Based on such inaccuracies and the multitude of

uncertainties which can arise to affect prices over time, Ikerd issues a call for the deliverance of probabilistic market information to agricultural producers.

Nelson (1979 and 1980) has developed an extensive case for the development of an outlook program which formulates and disseminates probabilistic outlook information for the major agricultural commodities. "Because of the variability in agricultural prices and production, coupled with high financing requirements, the producer risks bankruptcy before the profits from the investment can be realized. Probabilities for these future wants can be potentially useful in assessing the amount of risk involved" (p. 5). He makes reference to individual information needs and the influence of values and goals in stating "Internal information is important [in decision making] because it relates to the producer's own situation and past experiences" (p. 3).

King also supports the provision of probabilistic market information to producers (p. 205):

...the need for an improved information base in most decision situations. This need is particularly strong with regard to decisions made by agriculture producers who face so many different types of uncertainty. Efforts must be made to supply producers with probabilistic price forecasts and to teach them to use such information effectively. Frequently, all the information needed to make forecasts in probabilistic terms is readily available to the agencies or individuals who predict future price levels, but in most cases price forecasts simply state a most likely value, or at best, an interval within which the price is expected to fall.

Freebairn also offers an extensive evaluation of outlook information needs. He notes that the time consuming biological nature of agricultural production can encompass changing seasonal conditions, economic conditions, technology and government policy from the time resources are committed to production until the output from such production is ready

to be marketed. He emphasizes that the role "of outlook information is to facilitate more effective decision making....[via actions] which result in higher levels of realized profits, utility and social welfare than would otherwise occur" (p. 295). He recommends the development of probabilistic market information in stating that (pp. 296-297):

For many decisions outlook information will be required to make estimates of the probability distribution function or likely range of future prices and quantities as well as point estimates. As argued in more detail below, forecasts of future commodity prices and quantities will be subject to errors. Many decision makers will have non-neutral attitudes towards risk. They will need information on both the variability of individual future prices and quantities and on the correlations between different prices and quantities to effectively choose enterprise combinations and to plan contingency strategies. Useful outlook information will need to assess the order of reliability and magnitude of errors of estimates of future market outcomes.

There is a great diversity in the requirements of decision makers in the agricultural sector for outlook information. This diversity stems from the atomistic structure of most of the industry. Different producers have different objective functions, differences in decision procedures and particularly the time at which decisions are made, and differences in decision alternatives and associated pay-offs available to them. For example, different wheat farmers have different attitudes to risk, different alternative enterprises to consider, different age structures and composition of machinery, and they make their decisions on how much wheat to grow at quite different times. Such diversity, together with the almost continuous inflow of new information about seasonal conditions, policy changes and other factors, mean that the content and time of release of outlook information which best meets the requirements of one set of decision makers will not be entirely satisfactory for the requirements of others.

He further notes the need to compile and present outlook information in a form understandable to producers (p. 297):

Since outlook information is an input rather than a final product it becomes valuable only if it is used by decision makers in revising decisions which, in turn, result in higher levels of realised [sic] welfare. If the information is to be helpful to decision makers it must be in a form which they can understand and readily interpret in the context of their own decision problems and options.

Exhibit 2.1. Impact of Coarse Grain Yields on U.S. Farm Prices of Corn in 1981.*

Yield of Coarse Grain Outside U.S.		Yield of Corn in the U.S.				
		<u>90-94</u>	<u>95-99</u>	<u>100-104</u>	<u>105-109</u>	<u>110-114</u>
MT/HA						
Probability		.095	.238	.286	.286	.095
		Farm Price of Corn (\$/Bu)				
1.65-1.69	.048	5.00	4.50	4.00	3.75	3.20
1.70-1.74	.333	4.25	3.80	3.30	3.00	3.81
1.75-1.79	.333	3.60	3.15	2.95	2.72	2.50
1.80-1.84	.286	3.05	2.80	2.55	2.30	2.25

SOURCE: John Ferris, Probability Forecasts on U.S. Corn Prices, Department of Agricultural Economics Staff Paper 81-1, Michigan State University, 1981.

*Assumes:

1. Harvested area of coarse grain outside U.S. = 306 million hectares.
2. Harvested area of corn in the U.S. is 76.1 million acres.
3. Trend Yields for 1981:
U.S. Corn = 102.5 bu.
Coarse grain outside U.S. = 1.77 mt.
4. Prices do not affect domestic use unless the carryout of corn in the U.S. is projected to decline below 10 percent.

Exhibit 2.2. Probability Distribution of U.S. Farm Prices of Corn in 1981.

Price Range (\$/Bu)	Probability	Cumulative Probability*
2.40 and under	.1090	.1090
2.41-2.60	.1134	.2224
2.61-2.80	.1633	.3857
2.81-3.00	.2220	.6077
3.01-3.20	.1110	.7188
3.21-3.40	.0953	.8141
3.40 and over	.1859	1.0000
TOTAL	1.0000	

"Expected" price = \$3.03

SOURCE: John Ferris, Probability Forecasts on U.S. Corn Prices, Department of Agricultural Economics Staff Paper 81-1, Michigan State University, 1981.

*Probability that prices will be less than the upper end of the range at each specified price level.

Probabilistic market information is not available to the general public at the current time. Modeling efforts in this direction have, in general, lagged behind the demands for such information. An exception to this statement is the efforts of Michigan State University with the MSU Agriculture Model (Department of Agricultural Economics, Michigan State University). Exhibits 2.1 and 2.2 are representative of probabilistic market information objectively prepared by Ferris (1981a). Another example of objectively prepared probabilistic market information is provided by Shane and Myer.

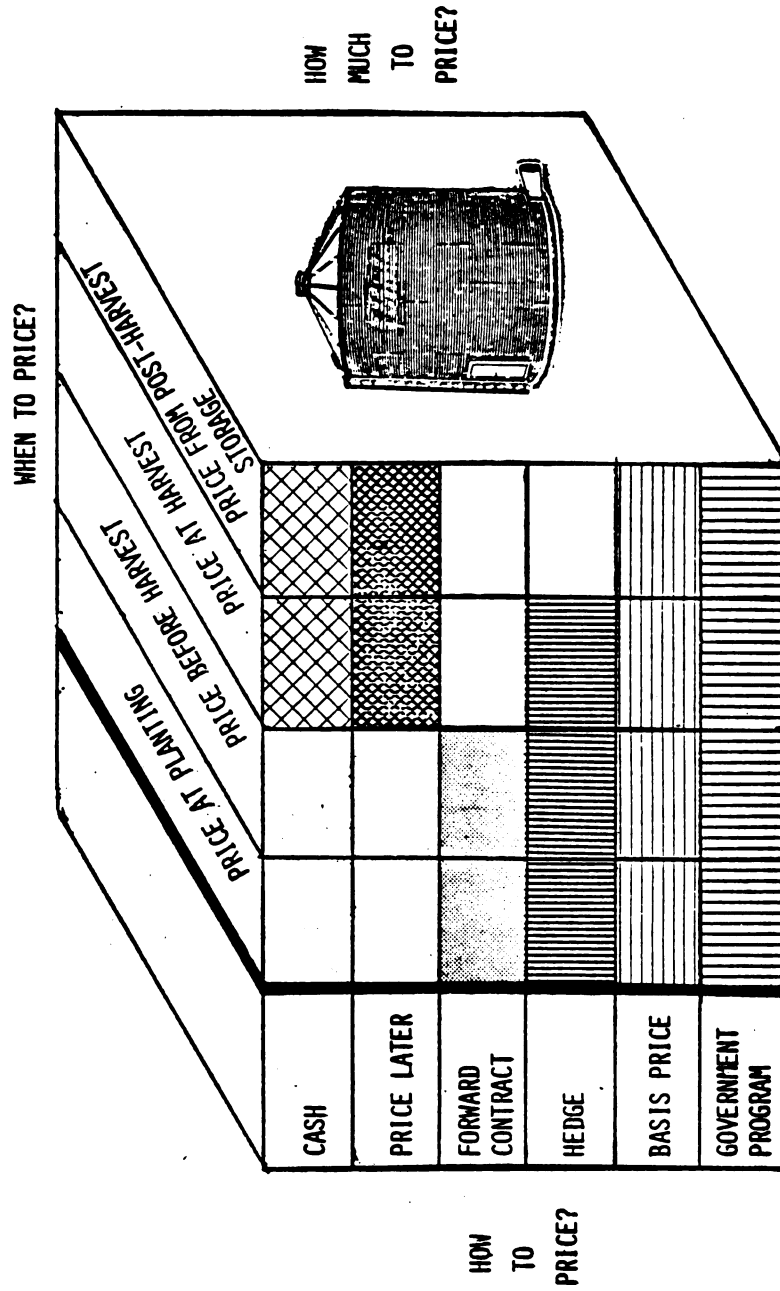
Producers' marketing strategies

The increased price fluctuation of agricultural commodities since the mid-1972 Soviet Union grain deal has resulted in an intensified interest in marketing. Both farmers and agricultural economists are involved in examining the various marketing alternatives so as to identify the more profitable and/or less risky strategies. Banks and other sources of agricultural credit are also involved, some more so than others as evidenced by the following comments by an Illinois banker (Dillon):

We've arbitrarily set a deadline of August 31 for repayments of the previous year's operating credit. We had a few farmers holding two crops at once and that usually meant having operating money out on both crops....Many of our customers have routinely paid back their operating credit before August 31 and so the ruling hasn't affected them. For the others, I think it has made them more aware of the need for more timely marketing and caused them to look harder at making profitable sales when the opportunity is there.

There are three primary questions to ask with respect to marketing of agricultural commodities: (1) When to price?, (2) How to price?, and (3) How much to price? As illustrated in Figure 2.3, the opportunity sets with respect to these issues each contain several alternatives.

THE THREE DIMENSIONS OF YOUR PRICING/MARKETING DECISION



SOURCE: Mike T. Weber, George K. Dike and J. Roy Black, Pricing/Marketing Workshops, mimeographed notes, Michigan State University, East Lansing, MI, 1978-79.

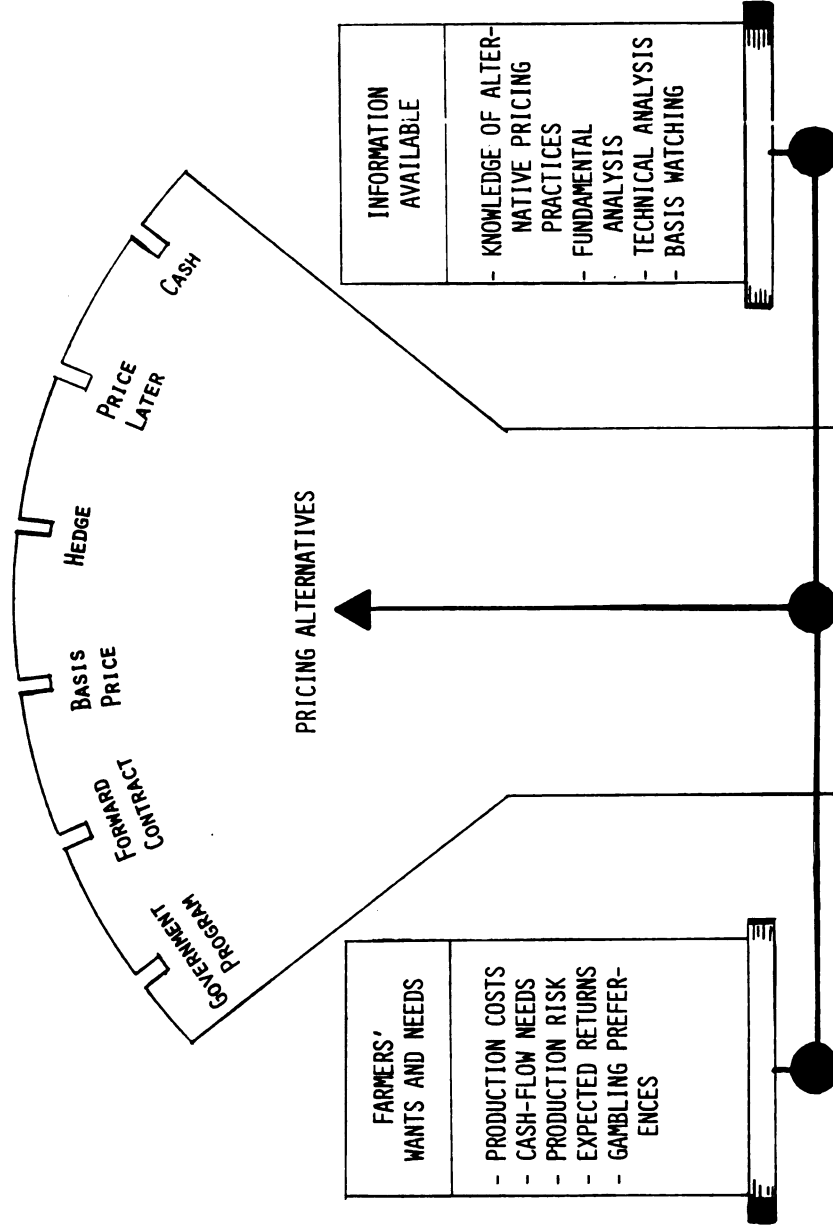
Fig. 2.3. Marketing opportunity sets

Figure 2.4 further illustrates the case, presenting the various pricing alternatives as well as noting the impact of farmers' wants and needs and assorted sets of information (Weber et al.).

In response to the heightened interest in agricultural marketing, agricultural extension economists at Michigan State University (Ferris, 1978) and at Ohio State University (Ferris, 1981b) have organized and are annually presenting "Marketing Workshops" during the winter months. These workshops concentrate on the fundamental and technical aspects²² of agricultural marketing, using historical price series and assorted case problems to emphasize the principal concepts. Agricultural economists at these universities as well as at other institutions have also prepared an assortment of papers and articles discussing the virtues of various marketing strategies (Ferris (1979, 1980), Black and Dike, Siebert, Wisner (Morrow), Hieronymous (Van Hoozer) and Marten). In addition, analyses of marketing strategies employed by farmers in their operations have been conducted by Hill for the North Central Region and by the Michigan Agricultural Reporting Service for Michigan. In the latter case, the analysis indicated that during the 1979-80 corn marketing year, 1) about two-thirds of the Michigan corn sold off farm would be sold on a cash basis, 2) 22 percent would be sold through forward contracts, 3) roughly seven percent would be sold using price-later

²²"Fundamental" refers to basic economic supply and demand forces in the market which affect the level and direction of trade whereas "technical" applies to charts, chart positions, chart signals, and other similar means of trying to determine direction in the market (Purcell, p. 20).

WHAT'S YOUR STRATEGY FOR THE PRICING/MARKETING BALANCE ACT



SOURCE: Mike T. Weber, George K. Dike and J. Roy Black, Pricing/Marketing Workshops, mimeographed notes, Michigan State University, East Lansing, MI, 1978-79.

Fig. 2.4. Producers' marketing strategies

agreements, and 4) only 3 percent was priced with a sales hedge in the futures market.

Partly because of the "Managing Risks in Agriculture" project (W-149) and also due to other general interest in the topic several more intensive research studies have likewise concentrated on the area of commodity marketing. In the livestock area, Bullock and Logan promote the usage of Bayesian decision theory as a methodology which allows for the incorporation of producers' and market forecasters' subjective evaluations with more experimental data generated by price forecasting models. As noted earlier, Anderson and Holt similarly advocate the application of a decision-tree framework for incorporating the various states of nature and possible alternative actions into an informational form easily understood by producers.

Ikerd (1979b) considers the different production phases and price cycles inherent in cattle production in recommending various forms of production and marketing flexibility. He uses price and cost data from the years 1949-78 to illustrate how risk of loss can be reduced during different phases of the cattle price cycle by reallocating one's resources. For the cow-calf operator, shifting of resources into stocker or cattle feeding operations during the unprofitable phase of the cycle is suggested as a risk management strategy. Similarly, cattle feeders are encouraged to examine the more consistent profit associated with cow-calf operations during the profitable phase of the cycle. A more narrative approach is followed by Olson and Owens in the identification of the physical limitations of producers as they attempt to respond to several sources of risk as well as reviewing the strategies livestock producers are actually engaging in to respond to such risk.

They indicate that little use is being made of such techniques as the futures market, forward contracting and extended ownership, partially due to a lack of understanding of such methods on the part of producers.

In the crop area, similar and somewhat more extensive efforts have been completed. Kenyon and Cooper examine the relative performance of technical strategies as opposed to fundamental strategies for the pre-harvest hedging of corn using a historical price data series (1973-1978). Their analysis was conducted using only that data generally available to producers on a timely basis. Their results favor the use of technical indicators as opposed to basic fundamental models. The value of more sophisticated fundamental models than those considered in the study is not ignored. However, they contend the additional cost (time and money) associated with such models tends to offset their superior value.

Bolen et al. utilized quadratic programming and a means-variance dominance test to compare several corn and soybean marketing alternatives under assumed financial and risk characteristics for farmers. Their results include an already well documented indication that higher average returns are attainable provided producers are willing to assume added risks, i.e., be susceptible to more variable income as a result of not using hedging and/or forward contracting marketing strategies. Considerable sensitiveness to variations in risk behavior are noted with respect to the "optimum marketing plans," i.e., the conservative or more risk averse marketer utilizes a different combination of the twelve possible marketing strategies than do the moderate risky and risky marketers similarly simulated. The results of the study also appear to indicate that "increasing the cash-flow requirements or reducing the credit

limits...increase the effects of risk aversion" (p. 18). Also, there is a strong inference that risk aversion behavior necessitates a substantial mixing of marketing strategies, "with more frequent and numerous pricing and delivering activities within each year than would otherwise be required."

Lutgen and Helmers conclude, through use of a simulation model, that during the 1961-1975 period, production variability was greater than marketing variability in east-central Nebraska. They report relatively little benefit is realizable from routine hedging. A significant interaction was noted between marketing and production, i.e., "the performance with respect to growth and risk of a marketing alternative, for example hedging, cannot be evaluated apart from the production alternative or crop mix under consideration" (p. 29). Persaud and Mapp utilize a MOTAD approach in analyzing risk efficient farm plans for alternative production, marketing and risk management situations for farm operations in southwestern Oklahoma. Their results indicate (1) there is a potential to increase gross margins²³ "by storing wheat and marketing it sequentially during the crop year," (2) "diversification, forward contracting and Wheat Farm Program participation were found to reduce gross margin variability for a given level of income" and (3) "crop insurance for wheat hail damage neither increased gross margins nor reduced variability when compared with government program participation" (p. 15).

Klinefelter et al. conclude from a study of marketing options for Illinois farmers that there are substantial ramifications of the

²³Gross margin is defined as actual annual yield per acre times the adjusted Oklahoma mid-month market price per unit less variable costs of production; then such returns represent a return to land, labor, capital, overhead, risk and management (p. 118).

particular technique used in the analysis. In their own case, the conflict between the theoretical advantages of a quadratic programming formulation versus the expanded activity and constraint set typically available in a linear programming model modified to reflect returns variability is emphasized. Baker and Sonka iterate the need to consider production risks (yield shortfall) associated with alternative marketing strategies while examining the impact of lending practices and marketing options in risk management.

Barry and Maberly in a more theoretical approach advance the need for further research concerning how producers form their "price and other expectations relative to their valuation of utility and degree of risk aversion" (p. 69). In a yet uncompleted effort, Black and Dike are examining a methodology for producers to first assemble and place information in a decision-making context and then to decide whether or not to use it in their decision-making, i.e., determine whether or not it is of marginal value to them.

Educational Techniques

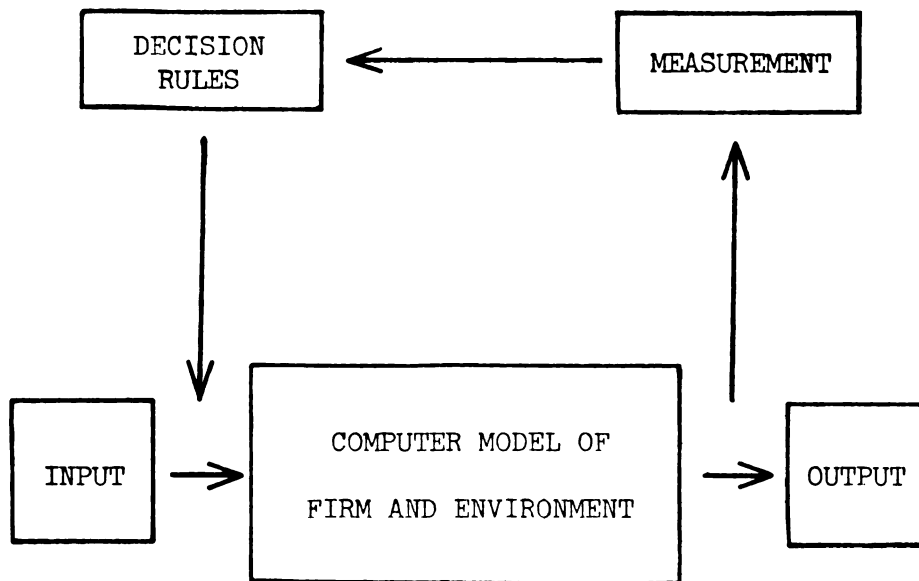
Educational techniques applicable to both the undergraduate college classroom and extension programs for farmers have received interest from the agricultural economics profession in recent years. Teaching workshops held at the University of Florida in 1972, at Michigan State University in 1976 and at Southern Illinois University in 1980 (Manderscheid) and an extension workshop held at Colorado State University in 1978 (Nelson and Nelson) are representative of this interest on the part of the profession. In addition, there is usually an "invited papers" section concerning teaching at the annual American Agricultural Economics Association summer meetings. There have also been several journal

articles written concerning teaching of agricultural economics--a few of these are discussed below.

Sjo expresses his views on the learning-teaching²⁴ environment currently existing at universities and its impact on learning-teaching in agricultural economics. He notes that although most agricultural economists are familiar with the subject matter area, their overall quality of teaching suffers from a lack of effectiveness in interpersonal relationships with students. The evolvement of the relatively larger class sizes on university campuses is recognized as one of the deterrents to excellence in the learning-teaching relationship. Sjo also mentions the need for teachers and students alike to indulge in the memorization of facts and classifications even though such learning-teaching experiences are not "fun"--such drudgery is required to learn the language and facts of a discipline. He infers that classroom instruction which tends to use problem solving and evaluative learning techniques in emphasizing learning through experience tend to persuade or incite students to neglect the need on their own part for self discipline and effort in the learning process.

French offers somewhat of an opposite view concerning instructional methods while discussing several alternatives for bringing the real world to the classroom. He emphasizes the need on the part of universities to produce a "relevant" student, one who is prepared to enter the

²⁴Learning is defined as a personal experience on the part of the individual student; teachers' effect on the learning process is recognized. "Learning is gaining facts, using that understanding to solve problems and to develop sound judgment, and finally to create ideas that add to knowledge." The teacher's role is portrayed as one of "encouraging, challenging, and exciting the student, by identifying material to be learned, and by providing sources of information" (p. 557).



SOURCE: Emerson M. Babb, "Electronic Data Processing," paper presented at the Conference for USDA-Land Grant College Committee on Computer Applications in Agriculture, Purdue University, West Lafayette, IN, 1971.

Fig. 2.5. Management games' representation of the real world

real world and continue to learn throughout his (her) lifetime. Among the techniques discussed for exposing students to the real world are (1) games and simulations and (2) case studies. In citing Babb (1971), French refers to a management game "as a model representing an organization or part of an organization usually in a competitive environment where subjects manipulate decision variables to achieve objectives" (p. 1164) (see Figure 2.5). French uses the definitions of Babb and Eisgruber to distinguish between simulators and games (p. 1165):

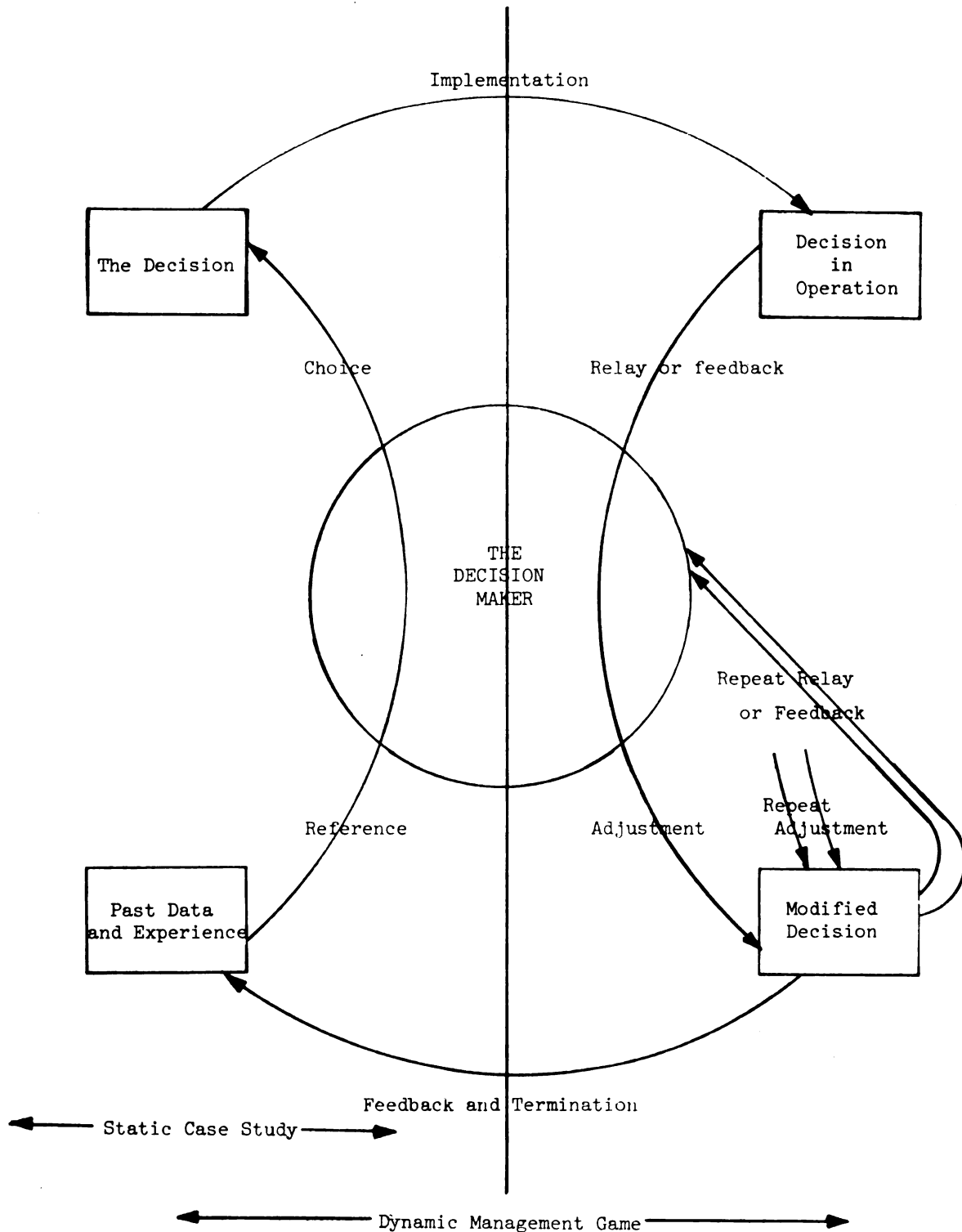
...mathematical models differ from simulation models--the first are error-free (analytic), while the latter are non-error-free (non-analytic). That is to say, simulation refers to a formalized system where the rules of validation require a sampling of the relevant entities.

In business games, the process of simulation is periodically interrupted, and the human decision-maker (or decision-making team) modifies earlier decisions in the light of new knowledge gained from results of earlier decisions.

French concludes that the potential of games and simulators is just beginning to be realized--"they are only on the threshold of their potential. They are proved, available, flexible and motivational" (p. 1165). He is somewhat more ambivalent about the use of case studies, noting the intense effort necessary on the part of the instructor to place each case in its proper perspective in the real world. He predicts an evolution of cases towards more sophisticated and more technologically efficient applications, better suited to the specific objectives of individual courses.

Simulation games

The appropriateness of simulation games for teaching, extension and research purposes is well documented. Longworth (1970) provides a detailed review of the history of such models, beginning with their origin



SOURCE: John W. Longworth, "Management Games and the Teaching of Farm Management," The Australian Journal of Agricultural Economics 13(1969):58-67.

Fig. 2.6. Simulation games and the managerial process

in a war game context. LaDue (1971) similarly inspects the development of simulation games in agriculture (pp. 62-65).²⁵

Longworth (1969) offers an in-depth discussion of "the role of games in the teaching of farm management," noting their suitability for providing a practice-oriented education in managerial processes. He offers Figure 2.6 as a representation of the managerial process. The incompleteness of most case problems with respect to this total process is noted in conjunction with the observation that (p. 67):

Games enable the student to experience the whole decision process. He must not only isolate the problem, review alternative remedies and select one, but he must also follow his plan through time and assimilate the feedback and bear the consequences of his choice.

An important contribution of gaming to the student's education is to provide experience in accepting and using this feedback in a dynamic 'on-going' environment. In this way the students are given a chance to practice learning from experience as they will be called upon to do in real life.

A more recent review of simulation games is provided by Johnson and Rausser in A Survey of Agricultural Economics Literature, Volume 2. In addition to recapitulating and extending the review of Longworth (1970), they note several distinguishing characteristics of simulation games (p. 203):

From the standpoint of participants, games are decision problems. Participants are typically provided with some information, perhaps incomplete, about the game and are asked to play by making decisions according to some specified criterion. Playing the game then requires participants to operate within a prescribed decision framework. The flexibility of the decision framework and the facility for allowing participants to refine their perception of the decision problem through

²⁵The cited reviews are extensive in nature, prohibiting their reproduction or summarization herein. Both are recommended as required reading for those persons interested in developing and/or using a simulation game in a teaching, extension or research context.

structured or unstructured learning processes determines the complexity of the game.

If games are utilized as a pedagogical device, then it is assumed that playing will result in increased proficiency. The increase in proficiency may, of course, come about as a consequence of an increase in the participant's modeling skills and analytical ability or through the accumulation of factual information about the structure of the system (Cohen and Rehnman [1961]). If games are utilized as a research tool, then records of individual play are utilized as a basis for examining the behavioral hypotheses or the outcome of the game itself.

An illustrative form of simulation games is similarly noted (p. 203):

Structures of models used for games are standard. The models include a mechanism for presenting the participant with options. The characteristics associated with the options include a payoff, restrictions on future choices, and in some cases implications for the participant's relationship to other players. As previously indicated, information available to players on the characteristics of the options and even the number of options usually includes a degree of uncertainty. Players make a sequence of choices under prescribed rules of play. The outcomes of these choice sequences are then evaluated in terms of some criteria specified either relative to the player's behavior or a standard identified with an optimal strategy given some general behavioral objective.

Johnson and Rausser offer a review of twenty-five gaming models developed from 1957-1973 (pp. 243-248). This review along with a similar examination of "firm and process simulation models in agriculture economics" (pp. 249-254) indicates limited attention has been directed towards the marketing component of farmers' decision-making processes. Rather, the farm management games and models among them reviewed appear to concentrate on production, financial and technical decisions.²⁶

²⁶ Possible exceptions to this broad contention are models by Hutton and Hinman, by Longworth (1970), Doster, Eidman et al., Halter and Dean, and Zusman and Amiad.

Johnson and Rausser promote four primary areas worthy of research and/or further development with respect to simulation games (pp. 204-206):

1. More effort needs to be extended towards corroboration of such games with the decision situations for which the participants are being trained
2. The use of such games as a learning tool could be improved upon "if more careful consideration were given to the processes by which optimal strategies are determined"
3. The determination and verification of the educational value of games is not well documented; previous efforts have been somewhat inconclusive. Evaluations of this sort would appear to be highly beneficial in the design of new games and in the promotion of existing games
4. There appears to be substantial potential for using such games as a tool in behavioral research; more specifically, research on "the behavior of ..., operators in farm growth models, market actions ..." seems feasible

Jones presents three advantages of the gaming approach:

1. Low cost data collection
2. Controlled condition for data generation, thus removing uncertainty as to "cause and effect"
3. High degree of experimental realism

Babb and Eisgruber provide a detailed discussion relating to the use of business games in both teaching and research endeavors. The ability to incorporate real world complexity into the game is noted as an advantage for educational purposes. The merit of its use in education is established with respect to several educational principles and issues. The allowed interaction among decision makers, decisions and the results of decisions is noted as an advantage in the study of the behavior patterns of firms.

Schneeberger, in remarking on the need for new techniques to better communicate functional management processes and the application of farm

economics noted the comments of an unspecified colleague, "We rarely attack such managerial problems as imperfect anticipation of future conditions, accumulative effects of decision-condition interaction over time, capital budgeting and the realities of cash flow, time sequencing of decision, firm-household competition, and firm growth." He indicates the usefulness of gaming in farm management teaching as being the opportunity to abstract, organize and plan. His summary comments on gaming include advocacy of continuous play for intense learning situations, the ability to gain an understanding of normal return and variance of returns and their use in decision making and that a survey of past game participants revealed a preference for gaming over lecture as a teaching method.

Further support for and evidence of the application of using farm management games is provided by Boehlje et al.; Boehlje and Eidman; Jones et al. (1970); Menz and Longworth; and Babb (1964). The use of educational television (Jones et al. (1977)) and computer graphics (Debertin et al. (1977)) have also received limited attention.

As noted earlier, the mission of the "Managing Risks in Agriculture" project (W-149) involves the preparation of teaching materials for use in extension programs on risk management. Thus far, several slide-cassette tape modules have been prepared (Harris and Nelson, Holt and Anderson) as well as a guidebook containing an overview of the principles and techniques relating to making risky decisions (Nelson et al.). In related efforts, Musser et al., Nelson and Harris, and Holt and Anderson have related approaches to teaching risk management to farmers.

The Systems Approach and Simulation Models

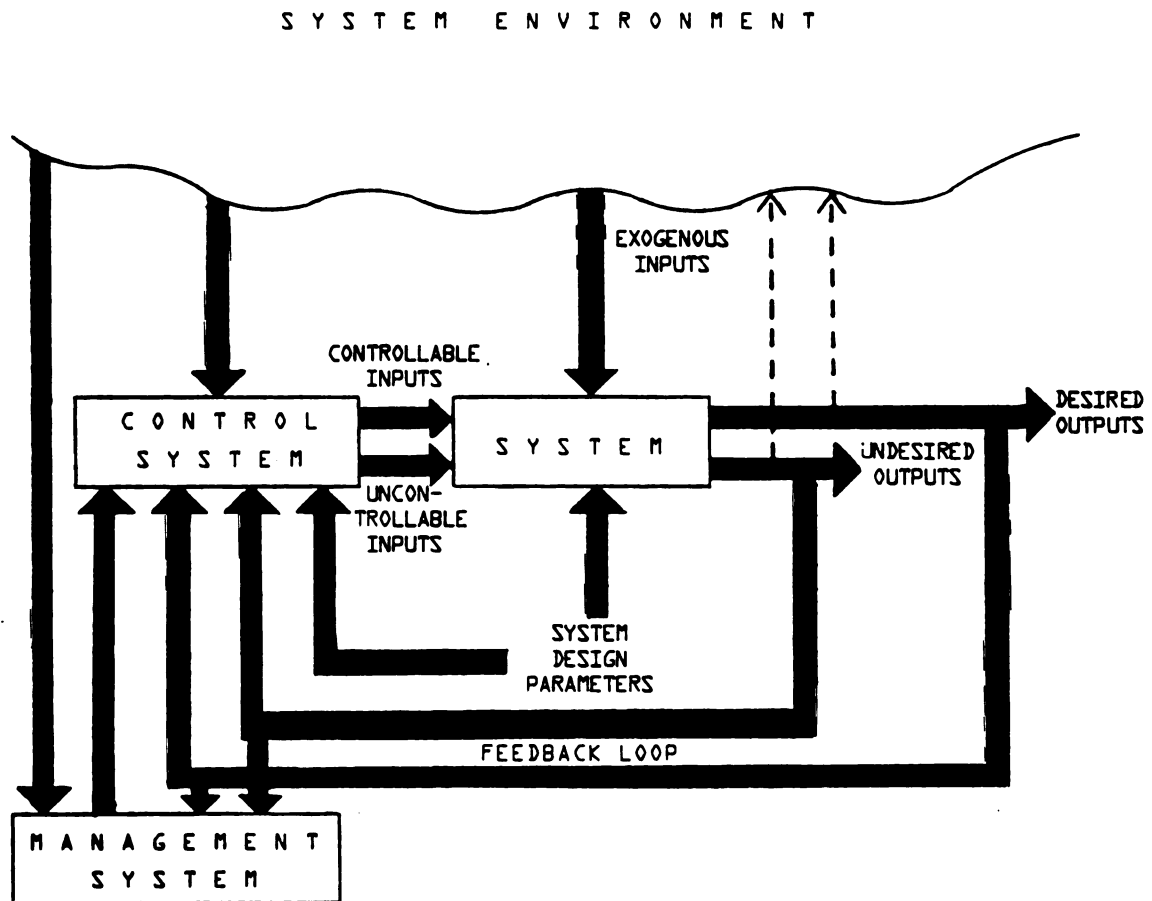
The principal concepts of the systems approach are discussed in this section along with an indication of the value of simulation models in such an approach. Recognized as an incomplete examination of the subject-matter area, the intent is to establish the general acceptance of and support for using these techniques in farm management research similar to that conducted in this study.

Fuller and Eidman, noting the vast opportunity sets of information and alternative courses of action now confronting farmers as a result of recent years' technological advancements, suggest the potential value of using the systems approach as a means of aiding farmers to solve their complex decision-making problems. More specifically, they conceptualize the possibility of developing control systems designed to handle production and marketing activities in a manner such that the improved payoffs resulting from such control more than justify the efforts required to design, construct and pretest such systems.

Harsh (1981) similarly advocates the development of such control systems. He also proposes that information (weather forecasts, market prices, etc.) delivered via a communication network be integrated into the control systems.

Systems approach

Manetsch and Park define the systems approach "as a problem solving methodology which begins with a tentatively identified set of needs and has as its result an operating system for efficiently satisfying a, perhaps redefined, set of needs and the resource limitations that are accepted as constraints in the given setting." They further indicate "two prominent attributes of this approach: (1) it overtly seeks to



SOURCE: Thomas J. Manetsch and Gerald L. Park, Systems Analysis and Simulation with Applications to Economics and Social Systems, Part I, Michigan State University, East Lansing, MI, 1977. Revised by Stephen B. Harsh, "Management on a Chip," Department of Agricultural Economics Staff Paper No. 81-23, Michigan State University, 1981.

Fig. 2.7. A closed system

include all factors which are important in arriving at a "good" solution to the given problem and (2) it makes use of quantitative models and often computer simulation of those models to assist in making rational decisions" (p. 2).²⁷

Figure 2.7 is representative of the perspective from which the systems approach views a problem. As Butler (pp. 48, 50, 67) so aptly paraphrases Manetsch and Park, definitions of the basic concepts are as follows:

A system is a set of interconnected elements organized toward a goal or set of goals. The system is made up of system inputs which are factors which cause or stimulate a change in system behavior. These inputs may come from within the system or may be exogenous (or environmental) inputs.⁸ The system structure is a set of interacting elements and related variables that intervene in the causal chain that links outputs to inputs, and are influenced by exogenous or environmental effects and by system design parameters. A system design parameter is fixed at the time a system is designed. Its value often expresses an important decision variable that effects the performance of the system. Outputs from the system may be classified as desired output which is a means of satisfying a goal for the system and undesired outputs which may or may not conflict with the achievement of goals. It is recognized in the systems approach that outputs (both desired and undesired) may have effects on the environment which may in turn affect the exogenous inputs and influences upon the system. The system also has feedback loops where system variables are coupled in a way such that a change in one variable causes a subsequent change in that same variable in a future time period. A feedback system can be designed in a manner such that a desired time path of a variable is compared with the actual

²⁷ More specifically, they note several (but not all) of the components of the systems approach (p. 3):

1. A methodology for planning/management
2. A multidisciplinary team
3. Organization
4. Mathematical modeling techniques
5. Disciplined non-quantitative thinking
6. Simulation techniques
7. Optimization techniques and
8. Application of computers

one and the difference is used to correct the errors, thus decreasing the error between "what is" and "what ought to be." This is the cybernetic "management" function of the system. Management is thus defined as manipulating inputs in order to decrease the magnitude of the error between actual and desired output.

⁸Strictly speaking, inputs are always considered to be exogenous. As will become clear, changes within the system which feed back to influence the output of the system are also termed, in this case, inputs. Note also that controllable inputs do not necessarily imply that they are endogenous to the system, nor do uncontrollable inputs necessarily imply that they are exogenous to the system.

Manetsch and Park observe that "the systems approach provides the problem solvers with logical methods and tools enabling them to identify, analyze, simulate and design the intrinsic system subsystems as they interact to accomplish some goal. The knowledge so gained can assist society, via its decision-making processes, in making rational choices among available options in critical problems" (p. 6). The capability of analyzing trade-off problems involving complex value judgments through usage of the systems approach is recognized. Emphasis is placed on the ability of simulation models to exhibit the impacts of alternative decisions upon several different measures of system performance. Decision-makers and society are thereby enabled to arrive at acceptable and/or "good" courses of action. Acknowledging that the systems approach is not an "easy" means of solving such complex problems, Manetsch and Park contend that the methodology is appropriate when three conditions are satisfied (p. 6a):

1. Where the aims or goals of the system are well-defined and recognizable if not quantifiable
2. Where the decision making process in the real system is centralized or fairly authoritarian and
3. Where a long-range planning horizon is possible

Another insight offered by Manetsch and Park regarding the systems approach concerns its use as an abstract model; three primary functions are identified (pp. 12-13):

1. Analysis--the determination of model outputs given inputs and the structure of the model
2. Management (control)--given the system structure and a set of system outputs to be achieved, determines system inputs that will achieve the desired outputs
3. Design (planning)--given system inputs available and the system outputs desired, determines a system structure that will achieve the outputs desired

Evidence of and support for application of the systems approach to agricultural problems is provided by Dent and Blackie. They recognize a particular strength of the technique as being the ability to mimic complex situations characterized by uncertainty and change over time. Two classes of simulation models are identified for use with the systems approach: (1) predictive--provides forecasts relating to alternative options and (2) mechanistic--assist understanding of the situation under study, perhaps with a long-term view of controlling it more effectively (p. 3). The possibility of utilizing computers in such modelling immensely strengthens the power of the systems approach. The ability of computers to hold and recall vast amounts of information while also faithfully following the changing states of many interacting variables over time renders the technique far superior to what can be accomplished through employment of mental simulation models alone (p. 3). In acknowledging the efficacy of computer-based models, Dent and Blackie note that the computer is an extension rather than a replacement of human mental capacity. It is the modeller's responsibility to insure that his data base is compatible with the complexity of the system under study,

that he is making valid use of the available data, that he has constructed an unbiased model and that his computer programming is accurate (p. 4).

As part of their support for use of the systems approach, Dent and Blackie define a "system" as being "a complex set of related components within an autonomous framework....The striking implication is that the complex interrelationships between components precludes legitimate study of the system in isolation. Because the interrelationships are so important, the whole system is more complex, more comprehensive, than the sum of the individual components" (p. 4).

Simulation models

A review of the foundations of the systems approach and associated simulation models is provided by LaDue (pp. 12-75, 1971); Johnson and Rausser (pp. 156-301) provide a more comprehensive survey. Both of these reviews clearly demonstrate the acceptability and appropriateness of this approach to agricultural economics research.²⁸ Well documented applications of the systems approach in agricultural analyses include Michigan State University's Korean (Rossmiller) and Nigerian (Johnson et al(1971).) experiences. Other more micro-oriented applications besides those mentioned previously in this Chapter include a hog 'production simulation model by Blackie and Dent, a pest management model by Carlson²⁹ and beef management models by Fox and Black and by Fox et al.

²⁸Two other surveys of systems work in agricultural economics are efforts by Anderson (1974b) and by LaDue and Vincent.

²⁹Simulation modelling is fundamental to the vast research currently occurring in the pest management area. Articles by De Michele and Croft et al. as well as a bibliography compiled by Osteen et al. are an indication of such research. Justification for use of this methodology in such research is provided by Beck.

Also, simulation modeling is widely used in analyses of farm firm growth as influenced by various institutional, environmental, financial and managerial characteristics.³⁰

Dobson (1970) briefly explores the positive features of computer simulation models while noting the high fixed cost and low variable cost associated with such a research approach. He suggests careful evaluation of costs and expected payoffs prior to instigation of such research. More of these models developed should eventually find their way into "the hands of operating firms, extension workers or government agencies for use in decision making" (pp. 175-176).

³⁰See Boehlje and Griffin; Condra; Halter and Dean; Hardin; Harmon; Harmon et al.; Hatch; Hutton and Hinman; Nixon; Patrick and Eisgruber; and Richardson and Condra (Richardson); also Skees(1981b).

Summary

This review of selected literature references (1) indicates the various factors involved in agricultural producers' decision-making processes under conditions of uncertainty and (2) demonstrates agricultural economists' varied opinions on the importance of these factors as evidenced by their respective research efforts. It also suggests the existing acceptance of simulation models as a teaching tool and the more tentative support for such models' use in research endeavors. The heightened interest in agricultural producers' marketing strategies subject to varied sources of risk in recent years is particularly noted. The provision of more sophisticated market outlook information as a suggested approach to improving upon producers' ability to react to such risk is also mentioned. Furthermore, this review indicates a lack of empirical evidence verifying the positive incremental value of such information.

These observations indicate the need for further research into producers' decision-making processes, especially in the area of marketing decisions. They also encourage development of more complex simulation models for use in teaching applications.

CHAPTER 3

CHOICE OF METHODOLOGY

Introduction

The complex nature of agricultural producers' decision-making processes is difficult to represent in an undergraduate classroom or extension workshop setting. The various existing interactions³¹ are often superficially examined or entirely overlooked in related teaching and extension activities. A methodology which has proven to be quite satisfactory for portraying this type of situation to a limited extent is the systems approach involving the use of computerized simulation models. Although several models (or games) have been previously designed and constructed for this purpose, there is considerable capacity for improvement, especially in the marketing area.

The design and construction of a farm management oriented simulation model containing a detailed firm level marketing component appears to have substantial merit; its potential application in teaching and extension activities appear to be of great value. Development costs of a suitable model are estimated to be somewhere in the range of \$40,000 to

³¹For example, yields are more than a function of fertilizer alone. Timeliness of field operations, growing season weather conditions, soil type and fertilizer levels all interact to determine harvested yield. Similarly, cash flow commitments for family living, operating expenses and debt service all compete with each other as well as against various investment opportunities for funds available to the farm operation. Farm operators/owners are also forced to tradeoff between family and firm activities so far as their labor (time) resources are considered.

\$50,000. The benefits to be gained from application of the model include improved marketing proficiency on the part of agricultural producers. The development and operating costs of such a model are easily justifiable if the model results in users realizing as little as 1/2 to 1 cent more per bushel for their crop. Consider the case of Michigan wheat, corn and soybean growers alone: In 1979, a total of almost 300 million bushels of these three crops was harvested in Michigan (33.755 million bushels of wheat, 237.5 million bushels of corn and 28.615 million bushels of soybeans (Michigan Department of Agriculture)). The realization of an additional 1/2 cent on as little as 10% of this production would have resulted in over \$140,000 additional income to Michigan producers during the 1979 calendar year. The anticipation of such additional returns over an extended period of time is probably not erroneous; present value calculations using a 12 percent discount rate and an annual return of \$149,935 (\$.005 times 10% of 299,870,000 bushels) indicate a value in excess of \$1,100,000 for a 20 year horizon. The estimated additional returns to producers are even greater if one assumes as much as \$.05 per bushel can be realized on 50% of the production over a 40 year horizon, i.e., \$61,801,532. These figures are offered as a partial demonstration of the potential returns associated with such a model. The consideration of the model's application in other states besides Michigan further adds to its estimated value.

The increased proficiency to execute marketing, production and financial decisions should enable producers to be more efficient in their allocation of resources, thereby ultimately contributing to cheaper food costs for society. It is also hypothesized that some additional income to producers would occur as a result of a shift of income

from grain buying companies whose mere size and scale of operation allow them to maintain a much more elaborate and sophisticated grain information network than can a single farmer operating in a near perfect competition profession. (Refer to Morgan for additional insight on the market information systems of large grain companies such as Cargill, Bunge, Dryfus, Continental and Andre).

Such a model could possibly also be utilized in a research mode for the purpose of studying behavioral processes. The systems approach and the use of simulation models are an accepted methodology in the agricultural economics discipline. The ability to account for various interactions and examine alternative management control feedback schemes are among the positive attributes of such an approach. The rapid technological advances occurring in the computer area allows for the consideration of much larger types of problems than have previously been investigated. Among the areas of research not fully exploited by methodologies of this type are behavioral studies. There appears to be substantial support for investigative research of this type.

Methodology of Research Study

The above observations serve as the premises for selecting the design and development of a farm management oriented simulation model as the primary objective of this research study. The systems approach is appropriate for constructing a model representative of a firm level farm operation. It facilitates the inclusion of the more important interdependent relationships existing in farm businesses while allowing for maintaining a distinction between endogenous and exogenous data and information. The specification of bounds for such a model should embody many of the production and financial considerations associated with

other similar models previously constructed. In addition, substantial effort towards incorporating a marketing component into the model's design appears worthwhile. It is this latter feature, along with others subsequently addressed in this Chapter, which will serve to distinguish this model from others of its type previously developed.

In addition to its apparent value for teaching and extension applications, such a model also appears to be suitable for use in research endeavors. A specific case involves the determination of the relative value of TMI and PMI. Previous approaches used to establish the value of information have either (1) ignored the impact of the human element in assimilating and analyzing information, (2) disregarded the impact of various related issues and/or (3) required the almost impossible isolation of real world producers from selected sets of information, conceivably resulting in financial loss to them. A research study consisting of using an appropriately designed simulation model in a "laboratory setting" should be an improvement upon these approaches.

General design features

Computer software aimed at general applications should be designed and constructed so as to result in user- rather than research-oriented models. Candler et al. discuss at great length the difference in computer software developed for research versus extension applications. Primary emphasis is on the need for greater clarity, speed and reliability in the latter case. Also, input by exception is stressed as an important requirement. Several additional features which should be incorporated into the programming structure of a simulation model intended for teaching, extension and research applications are:

1. Remote access availability
2. Interactive rather than batch
3. Possibility of varying parameter data sets for different simulation runs
4. Provision for intermittent usage
5. Simultaneous multiple users possible

Further discussion of each of these aspects follows.

Remote access

The simulation model should be accessible through utilization of remote computer terminals. Such terminals use existing telephone lines to link up with the computer mainframe located at a central site. This type of access facilitates the model's application in undergraduate teaching and extension activities. Also, research involving applications of such a model in farmer surveys would be facilitated by this ability to "take the model to farmers" rather than vice versa. LaDue (1976) reports on farmers' preferences for such remote access as opposed to running "batch" jobs at a central computer site.

Interactive model

An "interactive" model allows its users to execute timely on-line decisions in response to various problem situations. The approach is much faster than the "batch job" whereby (1) a farm plan is determined while off-line, (2) the plan is submitted to the computer and (3) time passes while waiting for the computer output in response to the set of decision parameters submitted. A cursory review of several existing farm management games indicates the batch job approach has generally been followed, with simulation time between decision periods varying from six months to one year in length (Schwab). Johnson and Rausser's

review yielded a similar assessment.³² This feature is all-important to the objective of allowing users of a farm management oriented simulation model to consider several sets of information (including a particular form of market outlook information) while executing various marketing, production, financial and other types of decisions ordinarily associated with managing a farm operation. A primary advantage of such an interactive feature over other farm management games' batch job approach is that it allows users to consider circumstances and execute decisions sequentially. This continuous iterative approach is similar to how "real world" farmers are forced to execute their decisions. This feature is particularly relevant to a simulation model aimed at emphasizing marketing decisions and the value of market information.

Simulation parameters

Nelson et al. recognize several potential sources of risk which confront agricultural producers in their decision-making processes:

1. Production and yield risk
2. Market and price risk
3. Business and financial risk
4. Technology and obsolescence risk
5. Casualty loss risk
6. Social and legal risk
7. Human risk

³²Longworth's model allowed for monthly decision periods. However, due to the limited storage capacity of the computer, he was unable to allow for complete interaction of all variables (LaDue, 1971).

The design and construction of a simulation model intended to represent the decision-making environment of a farm business should include selected instances of such risk sources. The selection of which types of risk to integrate into the model should be based on their importance in the real world as well as their ease of identification within a simulation setting. In recognition of the anticipated rather large size and associated operating expense of such a simulation model, it appears economical to reflect the chosen risk sources through data located in an on-line storage file rather than endogenously generate them in a stochastic manner each time the model is used. The partitioning of the required simulation parameters into several complement data sets by the type of risk source appears to have merit, i.e., complements relating to output prices, output yields, time available for field operations, input prices and government commodity programs are possible alternatives. This, in combination with the ability to identify simulation parameters for various geographical locations and initial conditions for the farm operation to be simulated, would result in substantial flexibility so far as establishing the particular set of simulation conditions to be experienced by any individual user within a selected simulation time horizon. The identification of the particular set of complements to represent an individual user's simulation environment could occur during his or her initial session with the model.

Intermittent usage

Users should not be expected to complete an entire simulation horizon in one session with a large computerized simulation model. Proper usage of a model similar to the one proposed herein is enhanced by its availability to users on an intermittent basis. It further appears

beneficial to allow for flexibility in the length of the simulation horizon to be experienced by individual users of such a model. An in-class teaching application of a model might be constrained to experiencing a two to four year horizon whereas a more extended horizon may be desirable for individualized instruction in a "Special Problems" course.

In response to the above views, it is suggested that the design of a farm management simulation model should allow for simulation of from one to ten complete years. The minimal simulation decision period should be one month. On-line storage files can be used to preserve the simulation histories of the model's users. Such storage would enable users to terminate simulation at discrete intervals within the time horizon and reflect upon previous simulated experiences while planning for the future. Intermittent usage has considerable merit from at least two viewpoints: (1) the magnitude of a large simulation model inhibits users from readily recognizing the complex ramifications of several of the required decisions; off-line contemplation and discussion can be very valuable in anticipating the consequences of various decisions, especially when a user is initially unfamiliar with the model and (2) the value of a model for teaching purposes is enhanced by requiring students, at arbitrary points determined by the instructor, to prepare and present remarks regarding their decisions prior to executing them. In addition, the scope of large scale simulation models is such that users will seldom be able to or willing to commit adequate time to complete several years' planning during one session. In general, no more than 6

months to a year should be simulated during a session. Allowing for a lapse of time between sessions permits users to evaluate the interactions of the endogenous features of the model and his or her exogenously furnished decisions.

Multiple users

Simultaneous access to a simulation model by more than one user is a necessity if its potential is to be fully realized in teaching, extension and/or research applications. A case in point would be an Extension workshop during which several "teams" of farmers would be simultaneously using the model. The isolation of individual users' simulation histories in an on-line storage file along with proper structuring of the simulation model should allow for such simultaneous usage of the model.

Model structure

In the context of Figure 2.7, a large scale simulation model such as the one developed as part of this research study can be viewed as a system. Exogenous complement data sets similar to those suggested above are synonymous with the system environment while the model's user represents the management system. The inputs are the decisions made by the user in response to observations of the simulated cash flow, net farm income, yield, price, and other measurement variables specified and various information sets provided as outputs throughout the course of a simulation horizon.

Hereafter referred to as IFLMAPS (Interactive Farm Level Marketing And Production Simulator), the model developed as part of this research study is comprised of four primary components:

1. Executive
2. Production
3. Marketing
4. Financial

It is these components which are responsible for reflecting the various interactions present in real world farm businesses. Chapter 4 discusses the functions comprising each of these components.

CHAPTER 4

INTERACTIVE FARM LEVEL MARKETING AND PRODUCTION SIMULATOR

Introduction

In this Chapter, the constructed form of IFLMAPS is discussed. Attention is first directed towards the selection of a computer hardware system appropriate for a model characterized by the various features discussed in Chapter 3. The remainder of the Chapter describes the four structural sections of the model, i.e., executive, production, marketing and financial components. The various exogenous data needs associated with each of the components are recognized where appropriate. Rather than presenting a detailed analysis of such data in this Chapter, the relevant complement data set is merely noted. Chapter 5 describes the data collection and preparation required to specify each of the respective types of complement data sets. The manner in which such data sets are stored in an on-line storage file is also discussed in Chapter 5.

IFLMAPS is a simulation model meant to approximate reality based upon a large number of exogenously specified data parameters. These data represent output prices, yield and field time information, initial farm business financial position, input costs, etc. It is intended to be used for teaching management and marketing concepts as well as in behavioral research applications. It is not to be generally used by individual producers to test alternative decision strategies concerning their own real world operations. IFLMAPS' users should not anticipate

its simulated circumstances to identically correspond with those they might observe in the real world. The intent of the model is to allow portrayal of several economic scenarios while emphasizing many of the more important management and marketing principles associated with operating a farm business.

Choice of Hardware System

Figure 4.1 illustrates the general design and constructed form of IFLMAPS. The source code of the model is written in FORTRAN IV. The general subroutines comprising the model are briefly described in Appendix A. It is currently in operation at the computer facilities located on the University of Michigan campus in Ann Arbor, Michigan. An AMDAHL 470V8 mainframe computer and the MTS operating system constitute the hardware and supportive software components of the facilities. This system was selected due to four features: (1) virtual memory, (2) direct access file structure, (3) accessibility to off campus users and (4) system familiarity.

In view of the anticipated size of IFLMAPS, it appeared desirable to utilize a system having virtual memory capacity. Due to its presence, overlaying and other relatively more complex programming techniques were not required in developing the model. Consequently, it was relatively easy to augment the model with additional subject-matter considerations during the development process.

More important, however, to IFLMAPS' design is the availability of on-line storage files via direct access. The sundry features discussed in Chapter 3 (remote access, interactive, multiple data sets, intermittent usage and multiple users) are immensely facilitated by this feature. The ability to directly edit files without having to go

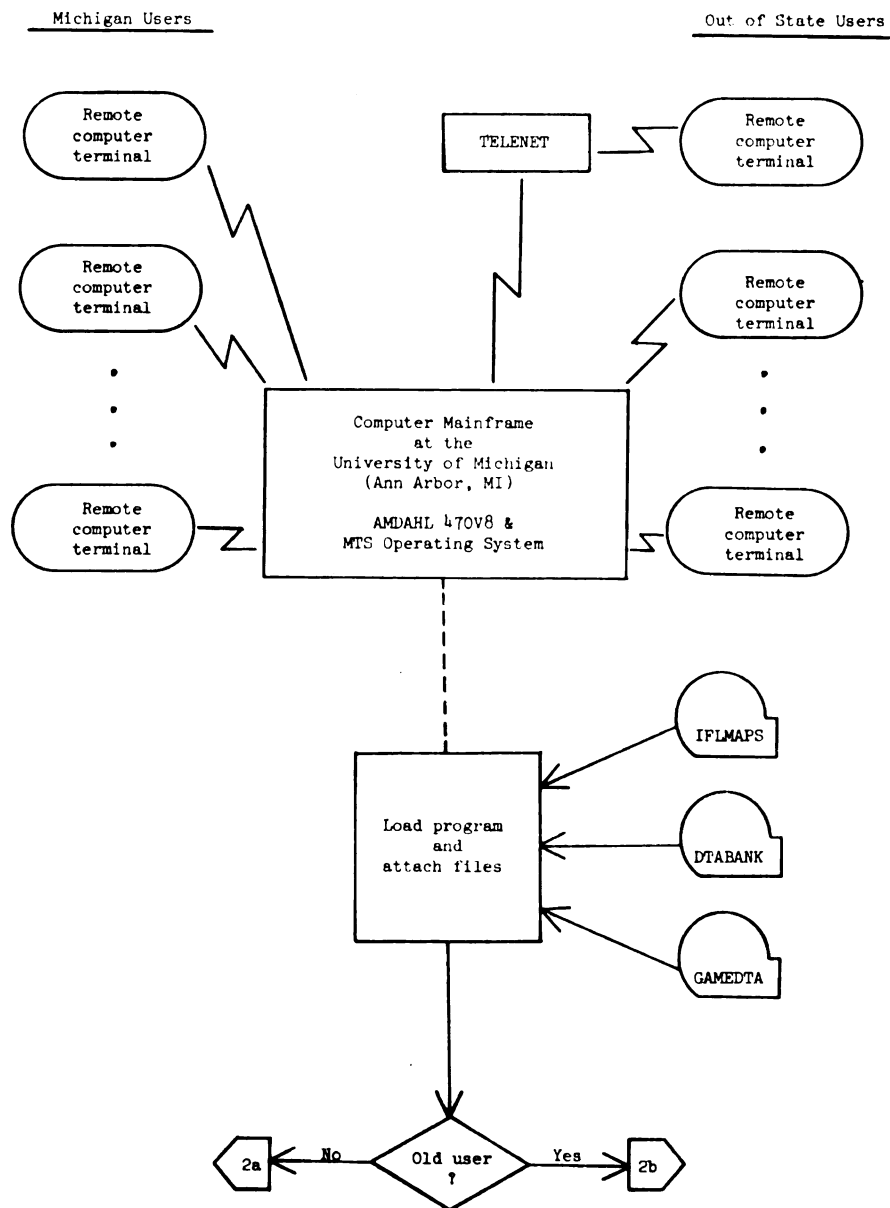


Fig. 4.1. General schematic of IFLMAPS

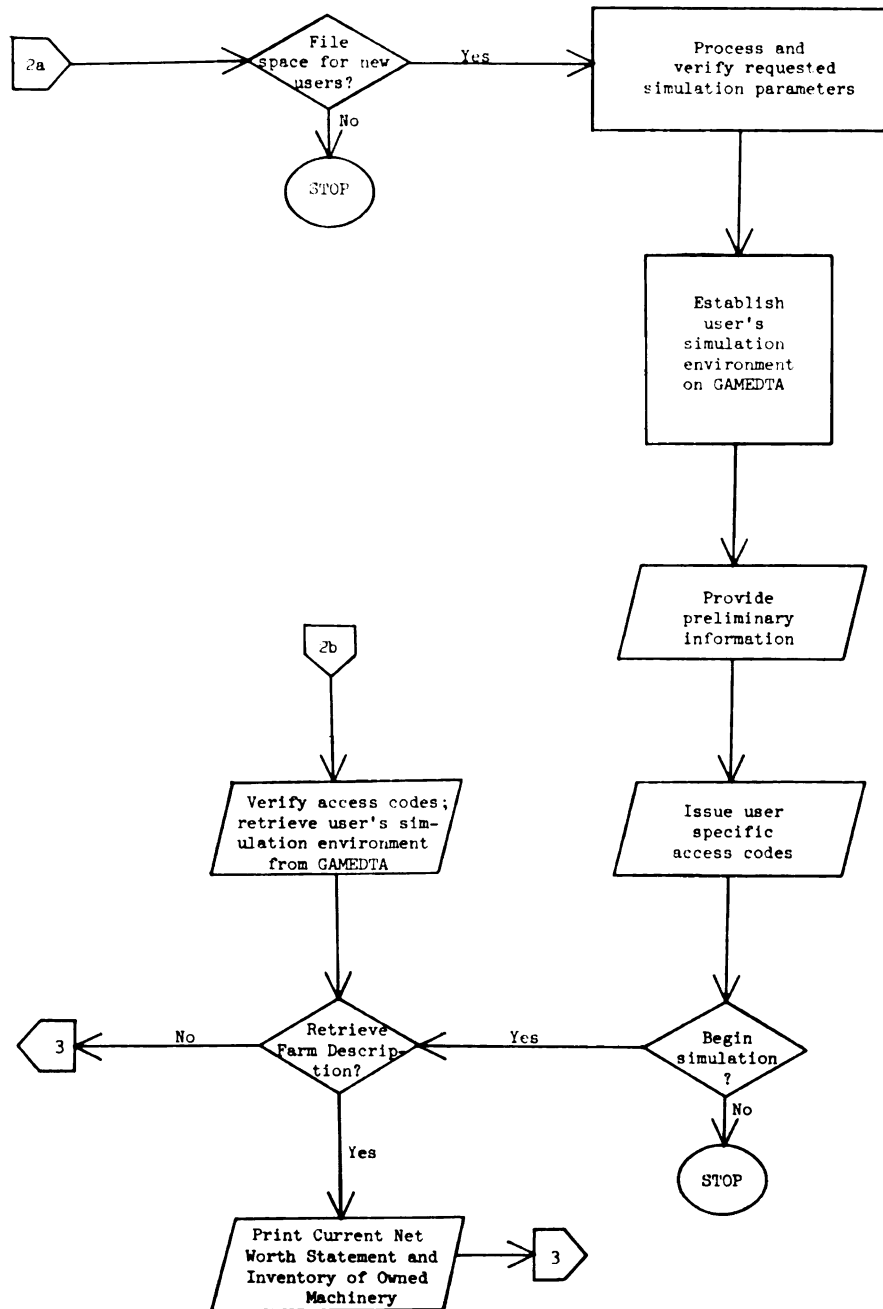


Fig 4.1. (continued)

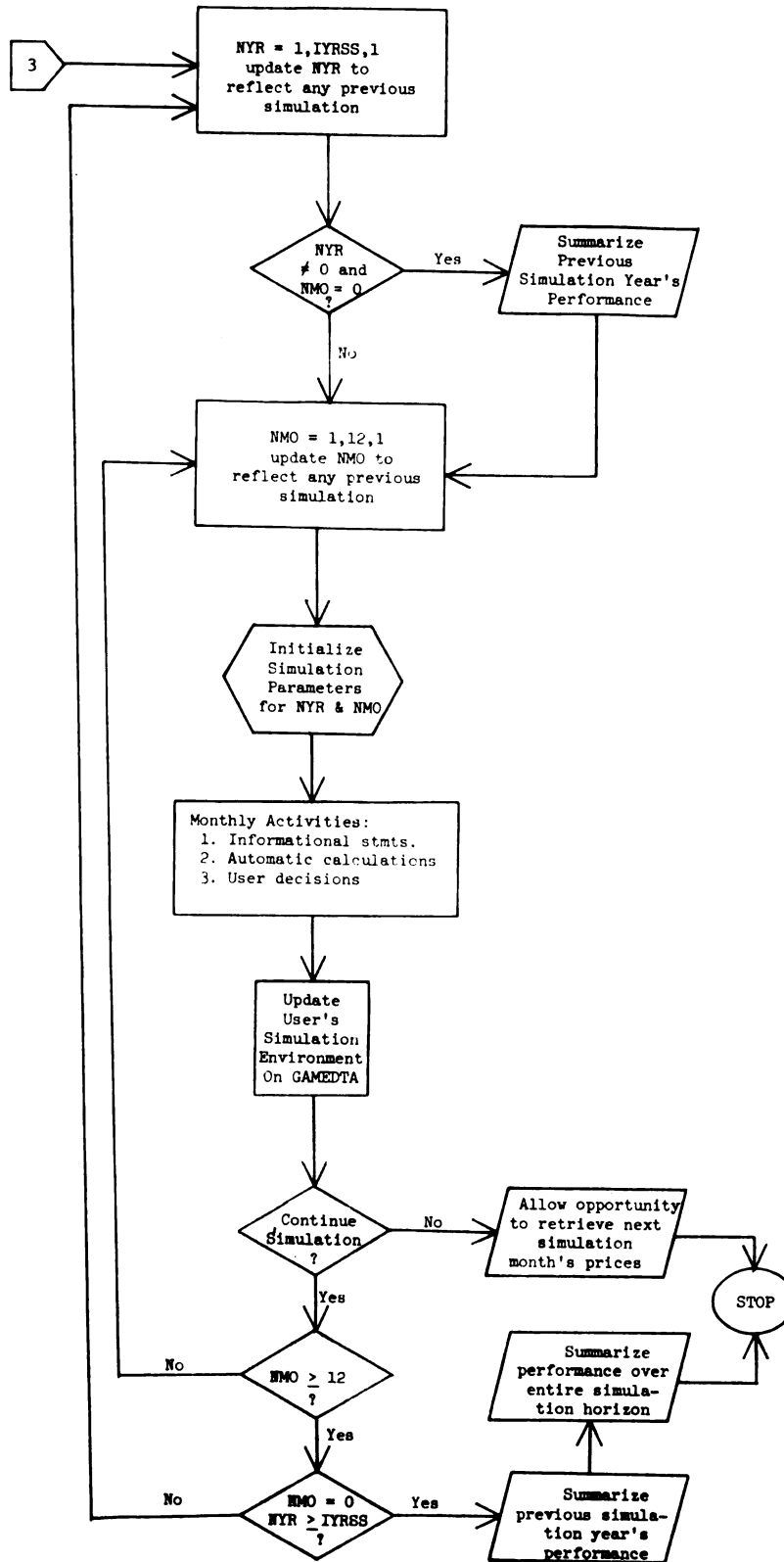


Fig. 4.1 (continued)

through any intermediate steps was desirable during this initial development of IFLMAPS. The feature also allows for segmentation of files in a manner that provides for a systematic method of referencing the respective types of associated data.

The University of Michigan's computer facilities are also readily accessible to off-campus users, both through WATS telephone lines and the TELENET network. Michigan State University's record of success with TELPLAN on this system (Harsh, 1980) supports a similar location for a model intended for teaching, extension and research applications in Michigan as well as in other states.

Finally, previous personal experience in using the University of Michigan's operating system software further supported selection of the hardware system for IFLMAPS' location. It was anticipated that utilization of this prior obtained knowledge would compensate for any additional costs associated with using the facilities rather than Michigan State University's own facilities.

Executive Component

IFLMAPS' executive component provides the desired user orientation of the simulation model. It facilitates users' access to the model, directs the representation of the desired simulation conditions and maintains a record of each user's simulation history throughout his or her simulation horizon.

The "interactive" nature of IFLMAPS does much to accomplish the desired user orientation. User decisions are solicited in an order analogous to that experienced on real world farm operations. Decision opportunities are preceded by presentation of as much relevant information deemed possible without overly confusing and/or discouraging the

simulation model user. Inasmuch as the simulation model is incomplete in the sense of totally portraying the real world, the user must, by faith, accept IFLMAPS for what it is--a restricted representation of a real world grain farm operation that is designed and constructed for a specified purpose (see Chapter 1).

The executive component performs the following functions that attempt to provide a real world representation:³³

1. Attach data files
2. Identify type of user
 - a. New user
 - 1) Determine if file space available
 - 2) Process and verify requested simulation parameters
 - 3) Create user's simulation record on GAMEDTA file
 - 4) Solicit and provide preliminary information
 - 5) Issue user specific access codes
 - 6) Determine if simulation should commence
 - b. Old user
 - 1) Verify access codes
 - 2) Retrieve user's simulation record from GAMEDTA file
3. Allow for retrieval of brief description of the simulated farm operation at the beginning of each simulation session

³³ An extensive discussion of the functions performed by the executive component is presented in Appendix B. The implicit inclusion in the executive component of various facets of the production, marketing and financial components preclude presentation of such a discussion at this point. Completion of this Chapter by the reader is recommended prior to studying Appendix B. At this juncture, it is important and necessary to recognize that IFLMAPS includes a means of controlling or directing the remaining components discussed in this Chapter in a manner conducive to the model's objectives.

4. Monitor indexes representing simulation time period completed and currently being simulated
 - a. Beginning of a simulation year
 - 1) After first year, summarize performance during previous year
 - 2) Allow user re-specification of selected simulation parameters
 - 3) Initialize various simulation parameters
 - b. Within a simulation month
 - 1) Initialize various simulation parameters
 - 2) Direct simulation processes
 - a) Perform automatic calculations
 - b) Provide sundry sets of information
 - c) Allow opportunity for user decisions; enact any specified
 - 3) Maintain updated record of user's completed simulation time
 - 4) Determine if simulation should continue
 - a) If so, continue with next simulation period
 - b) If not, allow retrieval of market prices in effect during next simulation period and then terminate session
5. Upon completion of requested simulation horizon, allow opportunity to retrieve brief summary of performance over entire simulation horizon

Production Component

This section addresses the various aspects of IFLMAPS that represent a grain farm's production element. Included is mention of the several theoretical and heuristic assumptions considered in arriving at such design features.

IFLMAPS allows for users to execute decisions regarding several sub-systems of the production component. Included among the types of decisions are:

1. Enterprise selection
2. Land tenure arrangements
3. Machinery management
4. Labor management
5. Election of government commodity program participation

The interdependency of these production-oriented decisions and the mechanics of their simulation in IFLMAPS are now discussed.

Production Opportunities

Enterprise possibilities

IFLMAPS simulates a farm operation consisting of crop enterprises only--no livestock enterprises are considered.³⁴ Only three specific crops are included: winter wheat, corn and soybeans.³⁵

IFLMAPS' users are allowed to designate their planting intentions for each of these crops during each simulation year. As described below, if labor and machinery capacity are available, such intentions are fulfilled. Prior to the required designation of planting intentions, users are normally allowed an opportunity to retrieve enterprise budgets based on current input costs, historical yield averages and current harvest delivery forward cash contract prices.³⁶

³⁴The frequent occurrence of integrated crop/livestock farm operations in United States agriculture is acknowledged. However, to confine the decision-making environment of IFLMAPS to a comprehensible level, only crops are considered.

³⁵A total of three crops was determined to be the maximum number allowable in IFLMAPS. Three crops were considered to pose a sufficient management problem for users in such a gaming context. Corn and soybeans were selected because of their importance throughout the Midwest; winter wheat was included due to its apparent importance in Michigan crop rotations, i.e., in terms of 1979 harvested acreage in Michigan, winter wheat ranked fourth behind corn, soybeans and hay of all types, respectively (Michigan Department of Agriculture, p. 22). The inclusion of more than three crops would also severely limit the narrative description accompanying various financial statements and other information sets. Such output should be brief so users will not be discouraged by an overextensive presentation of simulation circumstances and feedback information.

³⁶The presentation of enterprise budgets for each crop is an event scheduled by administrators within the applicable State/Region complement data set. If the event is not scheduled therein, users will not be allowed an opportunity to retrieve such budget information.

This information allows users to consider the relative profitability of the different crops. Users can change planting intentions as the planting season for a particular crop progresses.³⁷

Land tenure classes

Three land tenure classes are allowed in IFLMAPS: owned land, cash rented land and share rented land. In addition to the associated distinguishing features of such land tenure arrangements,³⁸ the possibility of specifying different potential yield levels for each of the three crops on each land tenure class exists. The inclusion of these various land tenure classes introduces an interesting set of management problems: (1) which land tenure class should a user employ in his or her operation and (2) should a user select the identical enterprise mix on each land tenure class when land is controlled under two or possibly all three of the different land tenure arrangements.

The beginning acreage controlled in each land tenure class is designated by the user in the Initial Firm Structure complement data set. Although no additional owned land may be purchased during the course of a simulation horizon, the opportunity to obtain control of more rental land normally exists. Such limited opportunities for

³⁷This feature allows users to react to the effects of weather combined with machinery and labor capacity on the timeliness of field operations. It also allows for the altering of planting intentions in reaction to new output price information.

³⁸Farm operators realize the total yield associated with owned land and similarly bear all costs incurred in producing such yield. Similar treatment of yields and costs are associated with cash rented land. However, farm operators must pay the owner of such land a cash sum for the use of his land during each crop year. Share rent agreements normally allow for farm operators (tenants) and landowners to share, in negotiated share amounts, in the income and costs associated with production on land so rented.

expanding acreage are provided so as to confront users with several of the many decisions concerning growth while seeking to avoid the possibility of excessive debt repayments that would possibly be associated with the purchase of additional land.³⁹ Any additional land rented during a simulation horizon is assumed to be subject to the same terms as land similarly rented at the beginning of the simulation horizon.

Users are assumed to compensate landowners of cash rented land during the simulation month in which additional land is offered for rent.⁴⁰ Share-rent landowners' part of income and expenses are assumed to be collected and paid by them as these items are incurred. A user need be concerned only with the tenant's proportionate share of income and expenses when considering managerial decisions related to acreage of this land tenure class. This includes contemplation of drying and/or storage as well as marketing of harvested grain. IFLMAPS endogenously deletes a landowner's share of the crop from the user's responsibility upon completion of the harvesting operation prior to drying and/or

³⁹It is acknowledged that land purchases have an impact on cash flow commitments and related marketing strategies of agricultural producers. IFLMAPS provides for consideration of such impact by allowing the specification of an existing land mortgage and the associated annual amortized payment in the Initial Firm Structure complement data set. However, it was considered expedient to disallow further purchase of land throughout the simulation horizon so as to force users to focus their attention on the several other managerial problems involved in IFLMAPS as well as the above cited desire to prevent users from experiencing financial obligations in excess of their repayment capacity. IFLMAPS is not a growth simulator. It is designed so that users' skills in marketing/production decisions can be enhanced as well as researched.

⁴⁰Scheduling of such rental opportunities occurs in the State/Region complement data set. The FORTRAN subroutine responsible for the simulation of rental land availability (RENT) includes a section which accounts for cash rent payments. Such payments result in a debit to both cash flow and net farm income as well as qualifying as a tax deductible expense.

storage, i.e., the landowner's share of the crop is assumed to be sold or otherwise disposed of from the field as it is harvested.⁴¹

Land rental opportunity. As already noted, administrators of the State/Region complement data sets are responsible for scheduling of the land rental opportunity. Such scheduling is generally recommended to occur during one of the spring simulation months prior to users' decisions regarding whether or not to participate in the government program in effect during the particular simulation year. It should also be scheduled prior to the required specification of desired planting intentions regarding corn and soybeans.

Regardless of when the land rental opportunity occurs, a user has three options with respect to each of the rental land tenure classes:

1. Leave as is
 2. Rent the offered tract in its entirety
 3. Terminate the lease on part or all of the land currently so rented
- The first choice is reasonably self-explanatory. A user simply maintains the status quo. The second choice is discussed at length below. The last choice is included for at least two reasons: (1) it allows a user to reduce the size of the operation upon recognizing that growth in acreage controlled has surpassed available and obtainable labor and/or machinery capacity and (2) it allows a user to switch from one rental

⁴¹It is acknowledged that this is seldom the case in the real world. A variety of arrangements between landowners and share tenants exist. Frequently, landowners contribute drying and storage facilities, pay the tenant for drying and/or storage of the crop, allow the tenant to market the entire crop, etc. However, the assumptions noted herein allow representation of this aspect of IFLMAPS in as simple a way as possible. The included degree of reality is considered to be sufficient depiction of the managerial responsibility associated with share rental land.

land tenure class to another during a simulation horizon upon perceiving the possibility of increased profitability by such a shift.⁴²

The procedure employed to represent the annual availability of rental land assumes (1) managers of large farms are generally interested in adding relatively larger tracts of land to their controlled acreage than are operators of relatively smaller size farms, (2) landowners are similarly interested, for the most part, in renting large tracts of land to one farmer rather than to have several tenants and (3) there is the possibility that, in some years, an individual farmer will not have an opportunity to rent additional acreage, i.e., either land is not available within a reasonable radius of the base operation⁴³ or landowners refuse to rent to the farmer due to their personal perceptions of his or her managerial ability. Based on these observations, IFLMAPS offers users an annual opportunity to rent one of several size tracts of land with respect to each rental land tenure class. Acreage available for rent is a function of current base acreage. Endogenous data regarding the different tracts available for different size farms are represented in Table 4.1. Each tract has an equal probability of being available for rent during each simulation year.⁴⁴

⁴²The allowed specification of different potential yield levels for each of the crops among the land tenure classes enables such a situation to be represented.

⁴³What is considered to be a "reasonable range" is subject to discussion. Such a determination is largely a function of the section of the country and associated type of agriculture under consideration as well as the personal preferences of the individual farm manager. For purposes of this study, it is enough to recognize this factor and offer it as partially responsible for the failure to allow users an opportunity to rent additional land belonging to a particular land tenure class during some simulation years.

⁴⁴The identification of the particular tract size to be offered with respect to each land tenure class during each of the ten simulation

TABLE 4.1

Annual Possibilities of Rental Land Tracts'
Availability in IFLMAPS

Current Farm Size (Acres)*	Tract Sizes Available (Acres)**
0-500	0, 40, 80, 120
501-1000	0, 40, 80, 120, 160, 200
1001-1500	0, 40, 80, 120, 160, 200, 240, 280
1500+	0, 40, 80, 120, 160, 200, 240, 280, 320, 360

*Total of acreage currently controlled with respect to all three land tenure classes--owned, cash-rented and share-rented.

**Corresponding to each range of current farm sizes noted, the tract sizes deonted as possibly available are each assumed to have an equal probability of being offered for rent in any one simulation year.

As noted previously, a user must either rent the offered tract in its entirety or not at all. It is recognized that farm managers ordinarily compete for available rental land within a specified geographical location. Such competition is ignored by implicitly assuming that the user has already outbid his or her competitors. The issue to be resolved is whether or not the user will effectuate the lease agreement.

Priority for field operations. As discussed in substantial detail below, realized yields are affected by the timeliness of simulated field operations. The possibility of different yield potentials among the three land tenure classes prompts consideration of the priority for field operations among the alternative land classes. IFLMAPS allows users to specify this priority ranking.⁴⁵ Simulated field operations are appropriated across the land tenure classes in that order so long as

years is facilitated by administrators' specification, in the Inputs complement data set, of two sets of ten random observations from a uniform distribution of 0 to 99. Drawing of two-digit numbers from a random number table is advised (Schlaifer, p. 321). For example, assume a user currently controls a 450 acre farm (total of owned, cash-rented and share-rented land) and the random observations applicable during a simulation year are 19 and 77, respectively, concerning the availability of additional cash and share rental land. Table 4.1 infers a 25 percent probability of each size tract being offered to the manager of such a size operation (0 acres is considered to be an alternative). IFLMAPS endogenously recognizes 19 as falling within the lower quartile and offers 0 acres of cash land for rent and similarly offers 120 acres of share rental land since 77 falls within the highest quartile. Conversely, if the current farm size was 1400 acres, tracts of size 40 acres and 240 acres, respectively, would be offered as available for rent corresponding to the second and seventh octiles. Note that inherent in such a calculation scheme is the fact that larger farms have a smaller probability of not having any rental land be available as well as the greater possibility of larger tracts being available--not an unreasonable assumption if one associates superior managerial ability with size of operation or if one perceives landowners to make such an association.

⁴⁵Specification for the first simulation year is included in the Initial Firm Structure complement data set. Users are allowed to change such priority ranking during subsequent simulation years provided the applicable management option was activated during the signing-on as a new user process (refer to Appendix B).

labor and machinery time are available within the respective time periods.

Production activities

As previously mentioned, the simulation of realized yields associated with each of the crops included in IFLMAPS includes consideration of the effects of field operation timeliness and weather conditions. This section discusses the manner in which realized yields are calculated. The various managerial problems associated with the risky nature of yields are denoted with particular emphasis on machinery and labor management. An explanation of the manner in which field operations are simulated is presented. Attention is also directed at the method used to account for the fixed and variable costs associated with field operations, i.e., machinery ownership and operating costs.

Determining harvested yield

The effect of timeliness of field operations, haphazard impact of weather and production potential of the different soil types possibly associated with the land tenure classes are all accounted for in the calculation of each crop's harvested yield during each simulation year. Yields are determined as indicated in Exhibit 4.1. The consideration of weather's effect on yields poses a realistic dilemma for users. Whereas the effect of field operation timeliness can be dealt with by astute machinery and labor management, little can normally be done with respect to weather risk in most farm operations. As will be discussed in the marketing component, the net effect of such weather risk is uncertainty

Exhibit 4.1. Calculation Technique for Determining Harvested Yield Levels in IFLMAPS.*

$$Y_{ijkl} = Y_i \times A_{jk} \times RY_l$$

where

- i : land tenure class; 1 = owned, 2 = cash rented and 3 = share rented
- j : planting time period; may range from 1 to 5
- k : harvesting time period; may range from 1 to 5**
- l : simulation year; ranges from 1 to 10
- Y_{ijkl} : a crop's simulated harvested yield level on land tenure class i acreage if planted in planting period j and harvested in harvesting period k during simulation year l
- Y_i : the maximum yield level obtainable on land tenure class i under ideal growing conditions for the optimal planting/harvesting period; data is contained in user's Initial Firm Structure complement data set
- A_{jk} : an adjustment factor (values may range from 0.00 to 1.00) accounting for the effect of timeliness of planting and harvesting in time period j and k, respectively; data is contained in the applicable State/Region complement data set
- RY_l : a random factor representing effect of weather conditions during simulation year l; data is contained in the selected Yield complement data set

*The same technique is used for determining yields for each of the crops included in IFLMAPS, i.e., wheat, corn and soybeans. An additional subscript representing crops is not included in an attempt to maintain clarity; the values on the right-hand side of the equation vary according to the crop being considered.

**The number of planting and harvesting periods allowed for each crop is specified in the State/Region complement data set.

regarding yield levels prior to completion of harvest. As a consequence, users are confronted with uncertainty during their pre-harvest marketing decisions.

Field operations

The Field Operation sub-system of IFLMAPS consolidates the consequences of limited labor, machinery and/or field time in simulating three basic types of field operations: land preparation, planting and harvesting. The untimely performance of these operations can possibly reduce yields below the potential level obtainable under ideal conditions.⁴⁶ It is acknowledged that the preferred timing of these field operations varies among geographical regions of the United States as do the effects of delayed operations on yield relationships. Administrators are able to address these issues in the State/Region complement data sets used to represent distinct geographical areas.

Also specified by administrators in the pertinent State/Region complement data set are the calendar time periods and associated types of field operations allowed during a simulation year. Up to 47 time periods may be delineated for a simulation year. The field operations performed within a time period can be either a single task or multiple tasks. Only one type of field operation may be specified for each time period. The allowable field operations and the respective scheduling codes are indicated in Table 4.2. Field tasks not included are assumed to occur during non-confining time periods. Only the major field tasks which

⁴⁶Any yield reduction occurring as a result of untimely field operations is represented by the A_{jk} values indicated in Exhibit 4.1.

TABLE 4.2

Field Operation(s) Allowed to be Simulated In
IFLMAPS During Designated Time Periods

Field Operation*	Code
1. Land preparation	01
2. Land preparation and plant wheat	02
3. Land preparation and plant corn	03
4. Land preparation and plant soybeans	04
5. Land preparation and plant corn and soybeans	05
6. Land preparation and harvest wheat	06
7. Land preparation and harvest corn	07
8. Land preparation and harvest soybeans	08
9. Land preparation and harvest corn and soybeans	09
10. Land preparation and harvest corn and plant wheat	10
11. Land preparation and harvest soybeans and plant wheat	11
12. Land preparation and harvest corn and soybeans and plant wheat	12

*The designation of field operations allows for the simulation of dissimilar field tasks within a single time period (field operations 2-12); such multiple tasks are endogenously prioritized as follows:

Operations 2, 3, 4: Land preparation and planting of one crop. Provided planting intentions are positive for the designated crop, all land currently prepared is first planted, labor and machinery capacity permitted. If planting intentions and labor and machinery capacities remain positive, land is simultaneously prepared and planted. If planting intentions or planting machinery capacity falls to zero, only land preparation occurs. Operations stops whenever (1) no land is left to prepare, (2) land preparation machinery capacity is exhausted, or (3) labor availability reads zero. Each of the above is performed across all land classes in order of user specified priority.

Operation 5: Land preparation and planting of corn and soybeans. Same as above except within planting operation, corn planting intentions dominate soybean planting intentions; i.e., plant all corn possible before beginning to plant soybeans.

Operations 6, 7, 8: Land preparation and harvesting of one crop. Harvesting dominates; prepare land if labor resources exist after conclusion of all harvesting possible. IFLMAPS allows for 1 to 5 harvesting periods for each crop. Simulation of harvesting assumes all of a crop planted during the earliest planting period is harvested across all land classes before beginning to harvest what was planted in subsequent planting periods (1 to 5 planting periods also allowed).

Operation 9: Land preparation and harvesting of corn and soybeans. Same as above except soybean harvesting dominates corn harvest.

Operations 10, 11: Land preparation, harvesting of one crop and planting of wheat. Plant all wheat possible first, subject to wheat planting intentions, acreage of prepared land, and machinery and labor availability. Next, prepare land and plant wheat simultaneously. Then harvest crop, prepare land and plant wheat simultaneously. Last, only land preparation occurs. All tasks subject to available acreage and remaining machinery and labor capacity.

Operation 12: Land preparation, harvesting of corn and soybeans and planting wheat. Same as above except soybean harvesting dominates corn harvesting.

affect yield are simulated.⁴⁷ In the case of two or more field tasks being simultaneously simulated during the same calendar time period, IFLMAPS endogenously simulates such sets of operations in a subjectively predetermined order, i.e., corn planting dominates soybean planting as does soybean harvesting dominate corn harvesting. The footnote accompanying Table 4.2 states the pertinent assumptions in this regard.

The Inputs and Initial Firm Structure complement data sets include the specific information regarding the machinery requirements associated with the three basic field operations simulated in IFLMAPS. Some of the relevant information is now presented to explain how field operations are simulated in IFLMAPS.

The purchasing, selling and/or trading of machinery units designed to perform the field operations are among the managerial decisions permitted IFLMAPS' users. Simulation begins with a user possessing three or more units of machinery.⁴⁸ As simulation proceeds through the designated

⁴⁷ Administrators are ultimately responsible for defining which field tasks comprise each of the three basic field operations simulated. It would be possible to incorporate all field tasks normally performed within these three operations. However, there appears to be no need to be explicitly concerned with cultivation, nitrogen side-dressing and other post-plant operations. Such tasks can normally be assumed to be accomplishable during time periods in which they do not directly compete with the more important tasks in terms of required timeliness. The illustrative Inputs and Initial Firm Structure complement data sets presented in Chapter 6 represent a manner in which these issues may be considered and/or resolved.

⁴⁸ At least one unit of machinery should be owned for each field operation. IFLMAPS does not allow for the hiring of custom operators. Without ownership of the necessary machinery, simulation of the associated field operation(s) will not occur. Assumptions regarding machinery units owned at the beginning of a simulation horizon are included in the Initial Firm Structure complement data set. Administrators and/or users should be sure to specify at least one unit of each machinery type as being owned. As many as ten units of machinery designed for each of the three field operations may be included so as to allow for the simulation of different sizes of farm operations. Machinery is not allowed to be custom hired since 1) it is desirable to confront users with the cash

time horizon, a user may desire to alter his or her machinery inventory according to the acreage being farmed and/or the apparent effect of field operation timeliness on yields.⁴⁹ The initial purchase of such machinery along with the associated annual ownership and operating costs affect cash flow. This cash flow impact may influence marketing decisions.

The interaction of machinery availability and performance on yields is an important component of this production/marketing simulator. Several planting and harvesting periods are possible for each crop. A simulation procedure is modeled to determine the respective periods in which these field operations are performed. Figure 4.2 offers a graphic representation of the process.

Field conditions. IFLMAPS includes consideration of the amount of time during which field soil conditions are suitable for field operations in each time period, i.e., the soil is dry enough to allow land preparation, planting or harvesting activities. This introduction of

flow and tax management problems associated with capital purchases and ownership and 2) the economic principles embedded in the decision whether to buy or "rent" machinery is present in the offering of additional land for rent.

⁴⁹The Inputs complement data set contains an inventory of machinery units available for purchase. During each simulation year, users are allowed an opportunity to buy, sell or trade machinery units (discussed later in this Chapter). Individual machinery units assumed owned by IFLMAPS' users must be identified in terms of the comparable size of unit available for purchase. Such identification facilitates the annual determination of each owned unit's current market value. Such a value is used in the preparation of the Net Worth Statement as well as for establishing the trade-in or salvage value of a unit should a user wish to dispose of it. This required identification occurs in the Initial Firm Structure complement data set. It is therefore necessary that administrators and/or users designate Initial Firm Structure complement data sets with respect to particular Inputs complement data sets. Also, they should be careful to include both interrelated complement data sets among those chosen to represent a user's simulation environment.

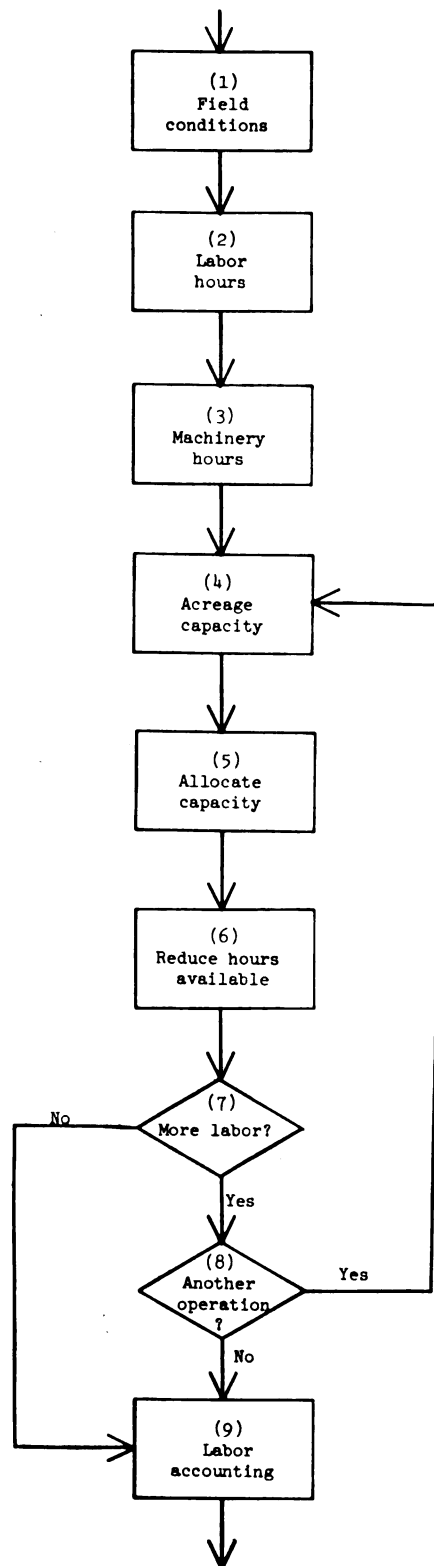


Fig. 4.2. IFLMAPS' simulation procedure for field operations during each time period

weather uncertainty poses somewhat of a dilemma for users attempting to make machinery investment/disinvestment decisions. The marginal profitability associated with additional or less machinery cannot be explicitly determined under such conditions of uncertainty.⁵⁰

The calculation executed to determine time available for field operations during each time period of a simulation year is illustrated in Exhibit 4.2. The calculations for such field time availability are performed once each simulation year and stored in each user's data file. Such storage avoids the necessity of recomputing the values each time a user accesses IFLMAPS when he or she is using the "intermittent usage" feature to simulate one or two months per session.

Labor hours. The availability of labor for performance of field operations during each time period is considered in IFLMAPS so as to emphasize the joint impact of labor/machinery managerial decisions on yield levels and the associated profitability of a farm operation, i.e., the purchase of bigger machinery does not always ensure higher yields and/or more profit. Labor is assumed to be available from two primary sources in IFLMAPS: (a) operator, family and annual full-time hired labor and (b) part-time hourly hired labor. Part-time hourly hired labor is distinguished from annual full-time hired labor by the assumed availability of the former on a seasonal basis (individual time periods) whereas in the latter case, such labor is assumed to be available during each time period. Users specify their initial intentions regarding

⁵⁰For example, the decision regarding whether or not to purchase another planting unit is hindered by the fact that field time is quite variable between years. Planting on a timely basis may be achieved in one year while in another year, the lack of available time would result in greatly delayed planting and accompanying yield loss if the current machinery capacity was left unchanged.

Exhibit 4.2. Calculation Technique for Determining Time Suitable for Field Operations in IFLMAPS.

$$FT_i = AFT_i \times RF_i$$

where

i : time period of simulation year; may vary from 1 to 47

FT_i : time suitable for field operations in time period i

AFT_i : average time suitable for field operations in time period i ; data is contained in relevant State/Region complement data*

RF_i : random factor representing impact of weather on field conditions. Values may differ for each time period and simulation year. Data is contained in relevant Field Time complement data set

*An in-depth discussion of such information is contained in Chapter 5. It is, however, important to note at this point that such average time availability considers both (1) suitability of soil conditions for field operations during each day of the respective time periods and (2) the length of work day assumed possible for the different operations, i.e., if there are 4.5 days deemed suitable for field operations in a 7 day time period and a 10 hour workday is assumed, the average suitable time for field operations in that time period would be 45 hours.

maximum allowed hours of labor from each of the two sources during the process of signing-on as a new user.⁵¹ The maximum labor available for field operations in each time period is calculated as illustrated in Exhibit 4.3.

As noted above, users can state the maximum allowed labor hours from each source (A and B) during each time period. The simulation process' consideration of machinery capacity and acreage requiring the different field operations may result in some of this available labor being left unused. An important endogenous assumption of IFLMAPS is that when labor is specified as being available from both source (A) and source (B) during a particular time period, both sources of labor will be utilized in equal proportion; IFLMAPS does not use all of source (A) labor and then start to use source (B) labor. The assumption made is that, during the respective time period, when field conditions are suitable for field operations, such operations will be conducted on a day by day basis, i.e., on each day of the period, all available resources are fully utilized. As a result, users may often recognize instances of labor from source (A) being left unused while part-time labor from source (B) was employed.

Users may be allowed to "manage" their labor resources during January of each simulation year, provided the management option was elected

⁵¹Such specification cannot be prematurely specified as part of the Initial Firm Structure complement data set, since as should become evident, desired labor availability is both a function of owned machinery available for the different field operations (contained in Initial Firm Structure complement data set) and time periods and associated field operations allowed or required in the geographical area being simulated (specified in the State/Region complement data set). It is advised that users be familiar with the process of simulating field operations as described in this section prior to specifying such labor availability.

Exhibit 4.3. Calculation Technique for Determining Maximum Labor Availability in IFLMAPS.

$$LT_i = (LA_i + LB_i) \times LE \times FE$$

where

- i : time period of simulation year; may vary from 1 to 47
 LT_i : maximum number of labor hours available for productive purposes during time period i
 LA_i : user specified labor availability from source (A)* during time period i
 LB_i : user specified labor availability from source (B)** during time period i
 LE : a factor representing labor efficiency so as to reflect time necessary for servicing of machinery, road time to and from field, lunch, etc.; a factor of 0.80 is endogenously incorporated into IFLMAPS, i.e., labor is assumed to be accomplishing a field operation during 80% of each hour
 FE : a factor representing field efficiency so as to reduce labor availability for the performance of field operations commensurate with the manner in which machinery hours are defined.*** A field efficiency factor of 0.65 is endogenously incorporated into IFLMAPS--although some operations may be performed more efficiently, this seems to be an acceptable lower limit

*Operator, family and annual full-time hired labor.

**Part-time hourly hired labor.

***Machinery capacity is rated in terms of acres per hour, adjusted for field efficiency levels. In order that a labor hour be equivalent to a machinery hour, labor hours need to be similarly adjusted downward. As a result, when an hour of machinery time and an hour of labor time is paired to produce an hour of field operation time as indicated in Exhibit 4.5, more than one hour of total labor time must be available. In fact, due to the accompanying assumption regarding labor efficiency as stated above, almost two hours of labor must be available in order to supply one hour of labor for field operation time.

during sign-on as a new user (refer to Appendix B). This feature allows users to review labor usage during previous simulation years and respecify labor availability during those periods in which labor appears to be either excessive or deficient. A review of such usage is allowed each year even when this management option has not been activated so as to alert users to labor usage during each time period. What may appear to be loss in field operation timeliness due to lack of machinery capacity may be in fact be occurring due to labor shortages. Also, at the completion of simulating the field operation associated with each time period, IFLMAPS automatically provides users with a summary of labor and machinery resources available and used during the respective time period. This information should similarly alert users as to which resources are impacting adversely on the timeliness of field operations.

Machinery hours. As previously indicated, three primary classes of field operations are considered in IFLMAPS--land preparation, planting and harvesting. IFLMAPS allows for the simultaneous simulation of all three field operations (land preparation, planting and harvesting) within the same time period (see Table 4.2). In order for such simultaneous simulation of dissimilar field operations to reasonably occur, each unit should include a power source (tractor) among its components. The calculation required for the determination of available machinery hours during each time period is presented in Exhibit 4.4.

Acreage capacity. Recognition of the available labor and machinery resources in equivalent hour units allows for the determination of the acreage capacity of such resources during each of the time periods. As described in Table 4.2, several sequences of operations may occur within each time period. Some involve the performance of only one operation

Exhibit 4.4. Calculation Technique Which Ascertain Available Machinery Hours in IFLMAPS.

$$MT_{ij} = OU_j \times FT_i \times FE$$

where

i : time period during simulation year j; may vary from 1 to 47

j : machinery type; 1=land preparation, 2=planting and 3=harvesting

MT_{ij} : machinery time available in time period i from machinery of type j

OU_j : represents number of units of machinery type j owned by a user

FT_i : suitable field time in time period i as defined in Exhibit 4.2

FE : a factor representing field efficiency so as to reduce labor availability for the performance of field operations commensurate with the manner in which machinery hours are defined.* A field efficiency factor of 0.65 is endogenously incorporated into IFLMAPS. Although some operations may be performed more efficiently, this seems to be an acceptable lower limit

*Machinery capacity is rated in terms of acres per hour, adjusted for field efficiency levels. In order that a labor hour be equivalent to a machinery hour, labor hours need to be similarly adjusted downward. As a result, when an hour of machinery time and an hour of labor time are paired to produce an hour of field operation time as indicated in Exhibit 4.5, in excess of an hour of total labor time must be available. In fact, due to the accompanying assumption regarding labor efficiency as stated above, almost two hours of labor must be available in order to supply one hour of labor for field operation time.

while others require the performance of two or possibly all three operations simultaneously. In all such cases, the procedure for determining acreage capacity is shown in Exhibit 4.5. In narrative form, the minimum of available labor and machinery hours represents the maximum time that can be spent performing a specific field operation sequence. This minimum amount of hours multiplied by the average capacity of all owned machinery designed to perform the field operation represents the maximum amount of acreage on which the field operation may be performed.

Whenever two operations must be simultaneously simulated (land preparation and planting, for instance), remaining available labor is divided in inverse proportion to the relative capacities of available machinery for such operations. Acreage capacity for both operations is consequently determined as indicated above. A similar process is followed for allocating labor when the sequence involves the simultaneous simulation of three operations. Exhibit 4.6 indicates the computational procedure used to perform such allocations.

As inferred in Table 4.2 with respect to multiple field tasks within a time period, the simulation process involves cycling through the different field operations and using available resources to complete such operations. So long as resources are available and acreage remains to be covered, the process continues. The preceding discussion refers to each such pass through the process during an individual time period as a sequence.

Exhibit 4.5. Calculation Technique in IFLMAPS Regarding Acreage Capacity for Each Type of Field Operation.

	$AC_{ijk} = \min(RLT_i, RMT_{ij}) \times AAPH_j$
where	
i	: time period during simulation year; may vary from 1 to 47
j	: machinery type; 1=land preparation, 2=planting and 3=harvesting
k	: represents particular sequence of field operation being simulated within time period*
AC_{ijk}	: represents acreage capacity of machinery units of type j during time period i and sequence of operations k
RLT_i	: remaining available labor hours in time period i; is simply LT_i as defined in Exhibit 4.3 reduced by any labor already used during time period i for other field operation sequences
RMT_{ij}	: remaining available machinery hours of machinery type j in time period i; is simply MT_{ij} as defined in Exhibit 4.4, reduced by any machinery hours of type j already used during time period i for other field operation sequences
$AAPH_j$	: the average acre per hour capacity of all owned units of machinery type j.** Such capacities may be endogenously adjusted downward using data from the Inputs complement data set to represent lessening degrees of reliability as machinery units age

*Consider for instance field operation 03 from Table 4.2, i.e., planting of corn. The first sequence of operations in this operation consists of planting alone; the second sequence involves both planting and land preparation simultaneously; and the third sequence involves land preparation only-- k=1, 2 and 3, respectively, for these three phases of simulating field operations within the time period. In the cases of the other types of field operations identified in Table 4.2, the number of possible sequences ranges from one (field operation 01) to seven (field operation 12).

**IFLMAPS does not maintain the identity of individual machinery units during the simulation of a field operation; all owned units are assumed to be employed simultaneously at the average of their capacities. Users attempting to increase the capacity of their machinery by purchasing new and/or bigger units should trade in or sell any small or old owned units characterized by low acre/hour capacities. The additional programming required to maintain such individual identities of units and, more specifically, individual machinery items, is perceived as not being essential to the expressed purposes of this model.

Exhibit 4.6. Calculation Technique Used in IFLMAPS to Allocate Labor and Determine Acreage Capacities During the Simulation of Simultaneous Field Operations.*

(1) For the simultaneous simulation of two operations:

(a) sum average acre/hour capacities of both types of machinery

$$\text{RATE} = \text{AAPH}_{(j1)} + \text{AAPH}_{(j2)}$$

(b) allocate labor between operations in inverse proportion so that the same acres will be covered by the two operations

$$\text{HOUR1} = (\text{AAPH}_{(j2)} / \text{RATE}) \times \text{RLT}_i$$

$$\text{HOUR2} = (\text{AAPH}_{(j1)} / \text{RATE}) \times \text{RLT}_i$$

(c) determine maximum acreage capacity with respect to each operation

$$\text{MXCAP1} = \min(\text{HOUR1}, \text{RMT}_{i(j1)}) \times \text{AAPH}_{i(j1)}$$

$$\text{MXCAP2} = \min(\text{HOUR2}, \text{RMT}_{i(j2)}) \times \text{AAPH}_{i(j2)}$$

(2) For the simultaneous simulation of three operations:

(a) establish relationship among average acre/hour capacities of different machinery types

$$\text{RT1} = 1.0$$

$$\text{RT2} = \text{AAPH}_{j1} / \text{AAPH}_{(j2)}$$

$$\text{RT3} = \text{AAPH}_{j1} / \text{AAPH}_{(j3)}$$

(b) sum relative rates

$$\text{RATE} = \text{RT1} + \text{RT2} + \text{RT3}$$

(c) allocate available labor in proportionate relationships among the three operations

$$\text{HOUR1} = (\text{RT1} / \text{RATE}) \times \text{RLT}_i$$

$$\text{HOUR2} = (\text{RT2} / \text{RATE}) \times \text{RLT}_i$$

$$\text{HOUR3} = (\text{RT3} / \text{RATE}) \times \text{RLT}_i$$

(d) determine maximum acreage capacity with respect to each operation

$$\text{MXCAP1} = \min(\text{HOUR1}, \text{RMT}_{i(j1)}) \times \text{AAPH}_{i(j1)}$$

$$\text{MXCAP2} = \min(\text{HOUR2}, \text{RMT}_{i(j2)}) \times \text{AAPH}_{i(j2)}$$

$$\text{MXCAP3} = \min(\text{HOUR3}, \text{RMT}_{i(j3)}) \times \text{AAPH}_{i(j3)}$$

*Refer to Exhibit 4.5 for the definition of those variables not defined in this presentation.

Allocate capacity. It was previously indicated that users are able to specify their preferred priority ranking of land controlled under each tenure arrangement for field operation performance. Such information is applicable at this point of the field operation simulation process.

The above steps have resulted in the determination of the maximum acreage that can be covered with respect to the field operations to be simulated. This acreage capacity is allocated among the respective land tenure classes in the user specified order of priority so long as (1) capacity remains and (2) acreage requiring the operation(s) exists in the respective land tenure classes.

It is imperative that the potential impact of the priority ranking of land tenure classes be recognized by the user. This process of allocating acreage capacity to a great extent influences the realizable gross profit margin⁵² from land controlled with respect to each land class. Users should generally be inclined to give the preferred priority ranking to the land tenure class generating the greatest gross profit margin. The specification of different relative yield potentials for the three crops among the three land tenure classes thwarts efforts at easily arriving at such priority rankings. Contrary to the real world in which priority of field operation performances may vary across crop and type of field operation, an identical order of preference is assumed in IFLMAPS.

⁵²Returns associated with land of each land tenure class are, after variable costs have been accounted for, returns to labor, management, machinery, risk, and in the case of owned land, land. Such returns are termed gross profit margin. This distinction is somewhat similar to that of Persaud and Mapp.

Reduce hours available. Upon completion of allocating available acreage for whichever sequence is being simulated within the time period, remaining resource availability is adjusted downward to reflect that amount of labor and machinery time already used during the time period. Exhibit 4.7 presents the necessary calculations. An interpretation of these calculations is that resource availability is reduced by the proportionate share of acreage completed to acreage possible times maximum resources committed to that operation. When several operations are being simultaneously simulated, this step of resource adjustment is repeated for each operation being simulated.

More labor. After completion of adjusting resource availability an internal check regarding remaining labor resources is conducted. When there is no remaining labor, simulation of field operations in time period i is halted.⁵³ However, so long as labor is available simulation of field operations in this time period normally continues.

Another operation. Provided additional sequences of operations remain to be simulated, the Acreage capacity section is returned to. If not, the amount of labor used is accounted for and simulation of field operations during time period (i) is completed.

Labor accounting. An accounting of labor used during the period must be conducted so as to recognize the expense of any part-time hourly labor employed during the period. Any annual full-time labor hired is

⁵³Unless labor is available it is meaningless to continue simulation as acreage capacity would always be zero for the remaining sequences of operations scheduled for the time period, i.e., AC_{ijk} in Exhibit 4.5 would be equal to zero inasmuch as $\min(RLT_i, RMT_{ij})^k$ would be equal to zero.

Exhibit 4.7. Calculation Technique Used in Adjusting Hours of Resource Availability in IFLMAPS.

	$RLT_i = LT_i - [(CA_{ijk}/AC_{ijk}) \times ML_{ik}]$
and	
	$RMT_{ij} = MT_{ij} - [(CA_{ijk}/AC_{ijk}) \times MM_{ijk}]$
where	
i	: time period during simulation year; may vary from 1 to 47
j	: machinery type; 1=land preparation, 2=planting and 3=harvesting
k	: represents particular sequence of field operation being simulated within time period*
RLT_i	: remaining available labor time in time period i
RMT_{ij}	: remaining available machinery time with respect to machinery of type j in time period i
LT_i	: available labor time in time period i; replaced by RLT_i after first sequence of operations within a time period**
MT_{ij}	: available machinery time with respect to machinery of type j in time period i; replaced by RMT_{ij} after first sequence of operations within a time period**
CA_{ijk}	: completed acreage of field operation j during time period i and sequence of operations k
AC_{ijk}	: acreage capacity of machinery type j during time period i and sequence of operations k
ML_{ik}	: represents maximum labor possibly used during sequence of operations k in time period i; reflects consideration of $\min(RLT_i, RMT_{ij})$ and allocation of labor among simultaneous operations as described in Exhibit 4.6
MM_{ijk}	: similar to ML_{ik} except for machinery of type j

*Consider for instance field operation 03 from Table 4.2, i.e., planting of corn. The first sequence of operations in this operation consists of planting alone; the second sequence involves both planting and land preparation simultaneously; and the third sequence involves land preparation only--k = 1, 2, and 3, respectively, for these three phases of simulating field operations within the time period. In the cases of the other types of field operations identified in Table 4.2, the number of possible sequences ranges from one (field operation 01) to seven (field operation 12).

**Refer to Exhibit 4.5 for discussion of RLT_i and RMT_{ij} .

expensed at the end of each simulation month during the cash flow accounting process as discussed in the financial component.

IFLMAPS internally preserves a record of the maximum labor available during each time period, i.e., LT_1 of Exhibit 4.3. At the end of simulating field operations in time period (i), remaining labor resources are represented by RLT_1 . Should RLT_1 be zero, all of LB_1 is expensed at the hourly rate contained in the Inputs complement data set. Should RLT_1 be greater than zero, the amount of part-time hourly labor used is calculated as follows:

$$ULB_1 = LB_1 \times [1. - (RLT_1/LT_1)]$$

In other words, the unused proportion of maximum available part-time labor is discarded and not recognized while calculating part-time labor expense during a particular time period.

Also included in this accounting process is the recording of the level of labor resources actually employed from both sources. Using the methodology noted above with respect to part-time labor expense when all labor resources are not exhausted, the usage levels of labor from sources (A) and (B) are calculated and recorded on a user's section of GAMEDTA. Such recording facilitates the previously mentioned review of labor usage allowed at the beginning of each new simulation year as well as allowing presentation of the summary information set denoting available and used resources during a particular time period.

Land states of nature

The simulation of three types of field operations in IFLMAPS and the desire to associate the timeliness of such operations with realized harvested yields necessitates maintenance of several states of nature

for land controlled with respect to each land tenure class. The states of nature accounted for in IFLMAPS are:

1. Harvest of prior crop completed and unprepared for planting of next crop
2. Prepared for planting of next crop
3. Planted in planting time period (j) to crop (m)
4. Idle acres not planted
5. Diverted acres not planted

As the simulation of harvesting occurs for acreage planted to each of the three crops included in IFLMAPS, the harvesting time period is noted (referred to as (k) in Exhibit 4.1) and the corresponding yield is realized by the farm operation. Simultaneously, the acreage passes from a planted state to an unprepared state. As a result, all acreage is assumed to require the same type tasks with respect to the land preparation field operation, regardless of previous crops grown, i.e., in IFLMAPS acreage previously planted to soybeans requires the same magnitude and type of land preparation as that planted to corn.

The land preparation field operation is responsible for converting acreage from the unprepared state to the prepared state. Consideration of this operation allows representation of the tradeoffs which occur between harvesting and fall plowing and the resulting delay in planting which normally accompanies spring plowing in the Midwest. As inferred previously, up to five distinct planting periods may be identified in the State/Region complement data set for each crop. As the simulation of planting occurs, acreage is converted from the prepared state to planted to crop (m) in the respective planting time period (j). This information, in conjunction with recognition of the harvest time period

(k), allows identification of the relevant yield adjustment factor for timeliness of field operations as noted in Exhibit 4.1.

Should a user elect participation in the Government Commodity Program in effect for the simulation year, acreage will frequently be required to be diverted from production at planting time. Such acreage is transferred from a prepared state to a diverted state. At some time, as scheduled by the administrator in the State/Region complement data set, such acreage is converted from the diverted state to the prepared state.⁵⁴ An assumption made with respect to this transfer of states of nature for diverted acreage is that such acreage must be prepared. The variable operating costs associated with land preparation are incurred but such field operations are assumed to occur during non-constraining time periods and, as such, are not explicitly simulated in the manner laid out above. Similar treatment is accorded idle acreage. Such acreage is land remaining unplanted in the spring after the last allowed corn and soybean planting periods either due to insufficient machinery capacity and/or constraining weather conditions or a user's stated planting intentions being insufficient for the amount of acreage controlled.

As inferred above, the user is responsible for dictating the acreage of each crop to be planted. The timing of such planting intentions are scheduled by administrators of the State/Region complement data set. Normally the intentions should be scheduled immediately prior to the first planting periods for the respective crops. When required to

⁵⁴ Scheduling of this transfer is generally recommended for early fall, prior to the time period in which the first planting period allowed for winter wheat.

state planting intentions, users have at their disposal information concerning (1) the present status of their land with respect to each of the states of nature noted above, (2) an indication of current prices regarding several marketing alternatives for the crop, (3) an enterprise budget presenting the potential gross profit margin associated with the crop on each of the land tenure classes and (4) an indication of their present machinery capacity. Throughout the planting periods being simulated, users are allowed to review information detailing planted acreage and amount of land in other states of nature prior to being allowed an opportunity to restate their planting intentions. This feature of IFLMAPS is an embellishment afforded by the interactive nature of the model. Users are allowed to be dynamic decision-makers.

A final note with respect to the states of nature concerning the disposal of harvested crops is in order. As each crop is harvested, the appropriate yield levels are determined. This completes simulation of the production component. The disposal of harvested yield is addressed in substantial detail later in this Chapter.

Machinery costs

The expenses associated with owning and operating the machinery units designed to perform the three types of simulated field operations are explicitly considered in IFLMAPS. The cash flow consequences and related impact on taxable income merit their incorporation. Users may own from one to ten units of machinery designed to accomplish each of the three types of simulated field operations. A "unit" of a particular type of machinery includes a power source (tractor or self-propelled combine) and the accessory equipment required to perform the various field tasks comprising the field operation (for land preparation, such

equipment might include a disk harrow, a chisel plow and a moldboard plow).

Administrators are responsible for developing appropriate sets of machinery units for the three operations and for specifying the various parameters of such sets in the Inputs complement data set. Similarly, administrators and/or users, while defining an Initial Firm Structure complement data set, must aggregate the various machinery items associated with a grain farm operation into the three types of machinery units allowed--land preparation, planting and harvesting. Such consolidation of machinery should approximate the design used in the selected Inputs complement data set since the salvage value of a user's owned machinery units are determined as a function of the cost of new machinery of a similar size. The assumed expense associated with owning and operating the various machinery units are related to the description of new units contained in the Inputs complement data set.

Purchase/salvage values. The purchase prices for several sizes (up to 10 each) of each of the three sets of machinery units are specified in the Inputs complement data set. Such costs are explicitly stated for simulation time 0. A set of annual compounded inflation factors⁵⁵ is contained in the Inputs complement data set to allow derivation of the purchase prices during each of the possible ten simulation years as designated in Exhibit 4.8.

The salvage value or sales prices of the different sizes of each of the machinery types must be included in IFLMAPS so as to account for the

⁵⁵An annual compounded inflation factor is defined to incorporate previous years' assumed inflation into one index, i.e., if a 10 percent rate of inflation is assumed for years 2-4, the respective factors for years 1-4 would be 1.00, 1.10, 1.21, and 1.33.

Exhibit 4.8. Calculation Technique Which Derives New Machinery Units' Prices in IFLMAPS.

$$NP_{ijk} = BP_{ij} \times MI_k$$

where

- i : denotes size of unit; may vary from 1 to 10
- j : indicates machinery type; 1 = land preparation, 2 = planting and 3 = harvesting
- k : represents simulation years; may vary from 1 to 10
- NP_{ijk} : new price for machinery unit of size i and type j in simulation year k
- BP_{ij} : base price in simulation time 0 for machinery unit of size i and type j; data is contained in the Inputs complement data set
- MI_k : machinery inflation factor for year k*

*Several sets of inflation rates affecting various costs included in IFLMAPS are specifiable by administrators in the Inputs complement data set. It is recommended that such factors be set to 1.0 for each of the 10 years possible in a simulation horizon except when (1) a user is familiar with the complexity of the simulation model and the associated involved decision-making problems (he or she has used it on several previous occasions), (2) the real world time frame allowed for the simulation process is extensive enough to allow the user to integrate such inflation effects into his or her decision-making process (the user is able to exercise the intermittent usage feature of IFLMAPS such that no more than one year per session is simulated and a maximum of two sessions per week occurs) and (3) administrators, either verbally or in writing, supplement the market information provided in IFLMAPS with a "state of the economy" forecast at the beginning of each simulation year.

cash flow consequences of a user selling or trading in a machinery unit. Such salvage values should reflect the age of the machinery unit and the accumulated usage. The endogenous calculation of the respective salvage values are illustrated in Exhibit 4.9. This approach incorporates any assumed inflation in new machinery prices into the salvage value of old machinery. The applicable salvage factors as a function of age are contained in the Inputs complement data set. The guidelines set forth by Bowers (p. 35) are recommended for approximating the depreciation occurring due to physical wear and tear and technological obsolescence.

Ownership costs. Fixed costs associated with the owning of machinery are both explicitly and implicitly included in IFLMAPS. Explicit treatment is accorded depreciation, insurance, and taxes.⁵⁶

Depreciation expense for the purpose of the Net Farm Income Statement is treated in the same manner as that used for the calculation of federal and state income tax liabilities. The technique used is a combination of a seven year double-declining balance method and additional first year depreciation along with an assumed zero salvage value. Any book value remaining after six years is included in the depreciation charge for the seventh year.⁵⁷ Depreciation for physical wear and tear

⁵⁶Some portion of annual machinery repair costs is often treated as a fixed cost. In IFLMAPS, all repair costs are treated as variable; i.e., incurred only when machinery units are used. Further detail is contained below in the operating costs section.

⁵⁷The inadequacy of most methods of depreciation to reflect true replacement costs in an inflationary economy and the resulting distortion of the Net Farm Income and Net Worth Statements are recognized (Hopkin, et al., p. 101). However, for the purposes set forth for this model, it appears that the use of a consistent technique is the important criteria rather than the technique itself.

Exhibit 4.9. Calculation Technique for Deriving Old Machinery Units' Salvage Values in IFLMAPS.

$$SV_{ijkl} = NP_{ijk} \times SF_{jl}$$

where

- i : denotes size of unit; may vary from 1 to 10
 - j : indicates machinery type; 1 = land preparation, 2 = planting and 3 = harvesting
 - k : represents simulation years; may vary from 1 to 10
 - l : represents age of machinery unit; may range from 1 to 10+
 - SV_{ijkl} : salvage value for machinery units of size i, type j and age l in simulation year k
 - NP_{ijk} : new price for machinery unit of size i and type j in simulation year k; calculated as indicated in Exhibit 4.8
 - SF_{jl} : salvage factor for machinery of type j and age l; data is contained in the Inputs complement data set
-

an

s:

tl

t

t

f

n

c

c

v

n

s

and technological obsolescence is incorporated into the calculation of salvage or trade-in values for the respective machinery units.

Property taxes and insurance costs are both included in IFLMAPS on the basis of a charge per \$1000 of assessed market value.⁵⁸ Specification of the applicable rates occurs in the Inputs complement data set.

Interest ownership costs are treated as an "opportunity cost" in that a cash charge is not explicitly levied. Rather, the investment of funds in machinery prohibits their use elsewhere, resulting in an "opportunity cost" of not being able to pursue other investments. This opportunity cost is not to be confused with the cash interest cost associated with borrowed funds.⁵⁹

Operating costs. Two categories of variable expenses associated with the hourly operation of machinery are considered in IFLMAPS: repair and fuel costs. Labor costs are explicitly accounted for separately as previously discussed.

Repair costs are assumed to be a function of accumulated prior usage (Bowers, pp. 30-37). The Inputs complement data set in effect contains an assumption regarding annual usage and expected lifetime (hours) for each owned unit of each machinery type.⁶⁰ Hourly repair costs based on these assumptions are calculated as indicated in Exhibit 4.10. The essence of this approach is that it (1) assumes repair

⁵⁸IFLMAPS does not assess property taxes on machinery during the simulation of Michigan geographical locations. This is consistent with the nature of property taxation in Michigan. However, for all other states, machinery is included among the taxable property.

⁵⁹Opportunity cost of capital is "the yield that capital would earn at its best alternative use" (Hopkin et al., p. 256).

⁶⁰It is recognized that this technique is an approximation at best. However, for the purposes of this model it appears acceptable.

Exhibit 4.10. Calculation Technique for Determining Machinery Hourly Repair Costs in IFLMAPS.

	$RCPH_{jk} = (TAR_{j2k} - TAR_{j1k}) / HPY_j$
where	
i	: denotes size of unit; may vary from 1 to 10
j	: indicates machinery type; 1 = land preparation, 2 = planting and 3 = harvesting
k	: represents simulation year, may vary from 1 to 10
l	: represents age of machinery unit; may range from 1 to 10+
$RCPH_{jk}$	: repair costs per hour for an "average" unit of machinery of type j in simulation year k
TAR_{j2k}	: total accumulated repairs for "average" machinery unit of type j at end of simulation year k*
TAR_{j1k}	: total accumulated repairs for "average" machinery unit of type j at beginning of simulation year k
HPY_j	: assumed hours per year each owned unit of machinery type j is used; designated in the Inputs complement data set

*The calculation of the difference of TAR's between the beginning and end of the year identifies the marginal repair cost associated with the current year's usage. The latter part of this Exhibit on the following page indicates how these total accumulated repairs are computed.

Exhibit 4.10 (continued).

The procedure for calculating the total accumulated repairs (TAR's) noted in this Exhibit (previous page) involves the following equation (Bowers, p. 14):

$$TAR_{jlk} = NP_{ijk} \times RC1 \times RC2 \times (\%L)^{RC3}$$

where

- i : denotes size of unit; may vary from 1 to 10
 j : indicates machinery type; 1=land preparation, 2=planting and 3= harvesting
 k : represents simulation year; may vary from 1 to 10
 l : represents age of machinery unit; may range from 1 to 10+
 TAR_{jlk} : total accumulated repairs for an "average" unit of machinery type j in simulation year k; l = 1 and 2 represent beginning and end of year, respectively
 NP_{ijk} : new price of machinery unit of size i, type j in simulation year k; unit size i is assumed to be the closest representative unit to the "average" unit owned;* calculated as indicated in Exhibit 4.8
 RC1,RC2,RC3: agricultural engineering factors which serve to escalate repair costs at an increasing rate as machinery ages (see Figure 4.3)**
 %L : indicates portion of expected life that has been expended
-

*The average horsepower size of the units currently owned is matched against the various units available for purchase as stated in the Inputs complement data set--the nearest size is used as representative of the "average" unit.

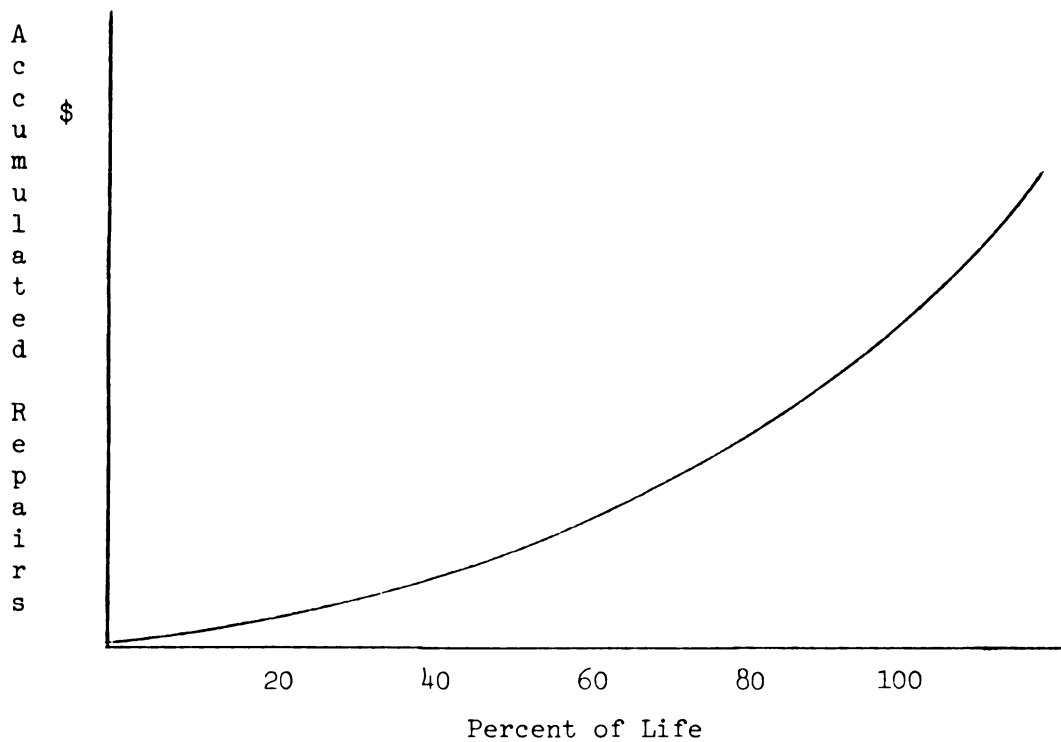
**Allowing for the possible inclusion of various implement types in units of the three machinery types, Table 4.3 presents the RC_m (m = 1, 2 and 3) factors endogenously incorporated into IFLMAPS. The RC2 and RC3 factors selected result in an accumulated repair function which rises slowly at the beginning stages of equipment's expected useful life but relatively faster at the latter stages of expected life, relative to the other options presented by Bowers (p. 13).

TABLE 4.3

Total Accumulated Repair Cost Function
Parameters Used in IFLMAPS

Parameter	Machinery Type		
	Land Preparation	Planting	Harvesting
RC1	1.04	1.00	.33
RC2	.000251	.000251	.000251
RC3	1.8	1.8	1.8

SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970), p. 14.



SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970), p. 13.

Fig. 4.3. Total accumulated repairs as a function of percent of life

po
su
ti
alc
lev

po
su
ti
alc
lev

costs are correlated with the initial price of a unit, (2) allows for the effect of inflation through consideration of the current NP_{ijk} and (3) results in accelerating marginal repair costs as machinery ages.

The aggregation of the above information (repair cost per hour) with the average per acre capacity of a user's owned units of each machinery type allows for the computation of a per acre repair cost. Such a cost along with the per acre fuel cost represents the cash operating costs associated with land preparation, planting and harvesting field operations throughout IFLMAPS on Enterprise Budget, Cash Flow Statement and Net Farm Income Statement information sets.

Fuel costs calculations are based on information contained in the 1979 Agricultural Engineers Yearbook (American Association of Agricultural Engineers, pp. 244-255). They include an allowance for associated oil and lubrication costs. The basic assumption is that .085 gallon of fuel per horsepower hour of fuel is consumed during each hour of operation.⁶¹ Fuel and lubrication costs for the operation of machinery are computed as shown in Exhibit 4.11. As in the case of repair costs, by combining this hourly cost with the average acreage per hour capacities of the various owned machinery units, a per acre fuel cost can be determined.

⁶¹Horsepower hour refers to the horsepower rating of the unit's power source. Also, a 100% load and diesel fuel are implicit in the assumed level of fuel usage. The allowance for associated oil and lubrication costs resulted in the rounding up of specified level of fuel usage alone of .082688938 gallons per horsepower hour (p. 248) to the assumed level of .085.

Exhibit 4.11. Calculation Technique for Determining Machinery Per Hour Fuel and Lubrication Costs in IFLMAPS.

$$FCPH_{jk} = .085 \times AHP_{jk} \times FCPG_k$$

where

- j : indicates machinery type; 1 = land preparation, 2 = planting and 3 = harvesting
- k : represents simulation year; may vary from 1 to 10
- $FCPH_{jk}$: fuel and lubrication costs per hour for machinery units of type j in simulation year k
- AHP_{jk} : average horsepower size of owned units of machinery type j in simulation year k
- $FCPG_k$: fuel costs per gallon in simulation year k; the initial cost level and applicable inflation factors are contained in the Inputs complement data set
-

Marketing Component

A primary goal associated with this research study and the design and construction of IFLMAPS is to incorporate a degree of output marketing reality heretofore ignored in farm management simulation models of this type. The interactive nature of the model combined with monthly decision periods and several allowed marketing alternatives provides this aspect of realism. Its inclusion has considerable potential merit to enliven both teaching and extension activities. The marketing component also lends itself to the possibility of measuring the relative values of traditional and probabilistic market information (TMI and PMI, respectively) provided to farmers. This section provides an extensive review of the concerns, assumptions and modelling techniques employed so as to design a marketing component in IFLMAPS that resembles, to a reasonable extent, the marketing environment confronting farmers in the real world. The basic issues of what marketing alternative to use when and in what magnitude are addressed (refer to Figures 2.3 and 2.4 in Chapter 2).

A few words of caution are in order before discussing the marketing component in detail. It is imperative that users of IFLMAPS recognize the model as a simulation model rather than a predictive model. The Output Price sub-system of IFLMAPS is intended to reflect varying market conditions under which agricultural producers might be expected to execute marketing/production decisions in the real world. While the price relationships and fluctuations observed throughout the course of the simulation period should approximate reality, it is not necessary nor generally recommended that administrators attempt to model the prices

actually expected during the next ten years.⁶² Users of IFLMAPS should necessarily disassociate their simulated farm operation from conditions currently existing in the real world. The several information sets provided throughout the course of a simulation horizon are extensive enough to provide ample description of the simulated farm business environment. IFLMAPS has been designed and constructed to allow for users' quick adaptation to this simulated decision-making environment. Again, however, it is essential that users realize the conditions simulated are meant to resemble what they might encounter in the real world but not in any sense what they should expect during the next few years, unless otherwise noted.⁶³

This section is organized into four basic subdivisions. The first indicates the several marketing alternatives included in IFLMAPS. The second examines the various grain handling functions considered in the model. The third presents the modelling techniques used to generate prices for the respective marketing alternatives. The fourth discusses how users specify their desired marketing strategies and the consequences of such selections.

⁶²Forecasted prices can certainly be incorporated into IFLMAPS, provided several adjustments are executed so as to prepare such price information in the style required for input of Output Price data in IFLMAPS (this format is discussed in detail in Chapter 5 with respect to the Output Price complement data set). The point is that several other output price scenarios can and should be simulated if IFLMAPS is to be utilized for the purposes for which it was designed and constructed.

⁶³In the rare and highly unlikely instance that an exhaustive forecast of output prices, input prices, weather conditions and other forecast environmental parameters have been specified in the respective complement data sets, such conditions could be simulated.

Marketing alternatives available

The four primary marketing alternatives allowed for each of the crops grown in IFLMAPS are: (1) local cash market, (2) forward cash contracts, (3) futures market and (4) government commodity programs. These marketing alternatives were selected as a result of (1) observations of farmers' historical use of such marketing strategies (Michigan Agricultural Report Service, Hill) and (2) previous educational efforts by Extension Specialists concerning the employment of these strategies (Ferris, Dike, Wisner).⁶⁴

Each of these marketing alternatives is available in some form during each month of a user's simulation horizon. Based upon exogenous data, monthly prices are endogenously calculated in IFLMAPS and users are allowed to retrieve such information, if they so desire, at the beginning of each simulation month. Users decide what alternatives are to be employed for marketing of the different crops. If such marketing intentions are not specified, there are certain default strategies which are executed at selected intervals.

Cash market

The simplest of all strategies is to sell the crop on the local cash market. Such a sale may occur either at harvest or from storage at some point after harvest.

⁶⁴This latter point is applicable for two reasons: (1) the desired objective of using IFLMAPS in extension activities demands it be compatible and applicable to the topics normally embraced in such programs and (2) the intent of possibly using the model in a research survey of farmers so as to assess the relative values of TMI and PMI require some familiarity on the part of the survey participants regarding the marketing alternatives available in the model.

Futures market

Both hedging and speculating opportunities in the futures market are allowed in IFLMAPS. A facsimile of the Chicago Board of Trade (C.B.O.T.) market is incorporated into the model. Two contract delivery dates are assumed possible for each crop--one matures during the harvest season and the other matures at some point following harvest (a storage hedge contract). The flexibility in design of IFLMAPS allows administrators to specify the appropriate maturity months of such contracts as part of the State/Region complement data set. As a result, the simulation of different geographical locations may occur with the proper futures contracts represented in each instance.⁶⁵

The futures market facilitates both hedgers and speculators in the buying and selling of contracts for several different commodities. Several contract delivery dates are normally available for each crop. Contracts generally become available for trading anywhere from 12-15 months prior to their maturity date (Chicago Board of Trade). IFLMAPS assumes a 15 month time horizon with respect to each futures contract included as a marketing alternative. It is conceivable that four contracts could be available for a particular crop at some point during the simulation year.⁶⁶

⁶⁵The diversity in climatic conditions in the United States contributes to a diversity of harvest seasons across the country. As a result, American farmers in different parts of the country who are interested in the futures market may consider different contract months, depending on the proximity of the various available contracts' maturity dates to his or her particular harvest season. IFLMAPS takes this into account by (1) properly identifying the correct maturity dates and (2) as later discussed, deriving the respective monthly contract prices based on other information contained in the State/Region complement data set.

⁶⁶The four contracts would include two for harvest delivery--one for the current simulation year and the other for the next simulation

Should a user's simulated farm operation not produce enough grain nor have sufficient grain in uncommitted storage to satisfy the terms of a contract, IFLMAPS endogenously purchases any unfulfilled amount of a maturing contract at a premium of five percent above the current cash market price and, in turn, sells it at the applicable forward contract price.⁶⁸

Government commodity programs

The Government Commodity Program sub-system of IFLMAPS includes both loan and reserves alternatives for each crop. In view of the complex and frequently altering real world programs several concessions are necessary to simulate such alternatives within the context of IFLMAPS.

Grain is allowed to be entered into the 9-month loan program only at harvest time. Grain may be entered into the 3-year reserve either at harvest or switched to the reserves from the the loan program prior to its maturity therein. Grain may be in the loan program for a total of nine months. Any grain not redeemed and sold on the local cash market or switched to the reserves prior to such maturity is assumed to be taken over by the government. Grain may be held in the reserve program for up to three years. Interest charges are assessed against grain sold out of the loan and reserves program, i.e., there is no forgiving of interest charges. Grain may be sold at any time from the reserve

⁶⁸The premium is meant to reflect the transaction costs associated with such a purchase. There is some opportunity for periodic speculation here on the part of users who are astute enough to recognize when cash prices at contract delivery time will be lower than current forward cash contract prices. However, as subsequently noted, (1) there is often considerable risk in such speculation as prices are apt to move in an opposite direction than one might anticipate and (2) there are limits imposed on the maximum amount of grain that may be contracted with respect to each crop and contract type.

program. However, such sales when the national average price for a crop is below the release price results in substantial penalties being incurred, similar to the real world program. The loan and reserve programs are always assumed to be "open" for additional grain--entrance of grain therein is never refused as is frequently the case in the real world.

Grain handling considerations

Three grain handling functions are accounted for in IFLMAPS: storage, drying and hauling. Inclusion of these functions both improves upon the marketing component and enhances its integration with the production component.

Storage. With respect to the storage of grain, IFLMAPS allows for the possibility of storage facilities being available at both on- and off-farm locations. Concerning on-farm facilities, a user's Initial Firm Structure complement data set includes an indication of any owned facilities assumed to exist at the beginning of the simulation horizon. In addition, various sizes of storage facilities can be purchased throughout a user's simulation horizon. Off-farm storage facilities are assumed to exist in sufficient magnitude to handle any of a user's desired storage intentions. IFLMAPS allows for separate specification of monthly cash costs associated with storage at the two alternative locations. Also, the purchase of on-farm facilities is assumed to qualify for investment tax credit and be subject to depreciation rather than be treated as a current cash expense as are expenses associated with off-farm storage.

Drying. One crop included in IFLMAPS, corn, requires drying down to a 15.5% moisture content from whatever level is assumed to occur at

harvest

(assumed

facility

assumed

adminis

applica

set.

H:

drying

ties a

and/or

to the

grain

trator

and/or

vest
plant
tion
analo

trans
consi
affec
recog
ing o
IFLMA
er, it
acrea
comple
wishes
by inc
the h
case,
hauling
only ma

harvest time.⁶⁹ Such drying occurs at on-farm storage facilities (assumed to include necessary drying equipment) provided ample unused facility capacity is available. If capacity is unavailable, drying is assumed to occur at the off-farm facility. As in the case of storage, administrators are able to specify different per bushel drying rates applicable to the two locations as part of the Inputs complement data set.

Hauling. All crops must be hauled from the field to either on-farm drying and storage facilities or to off-farm drying and storage facilities at which the cash sales site is also located. Should grain be dried and/or stored at the on-farm facility, when sold it must be transported to the off-farm sales site. IFLMAPS requires all costs associated with grain hauling to be expensed at commercial rates specified by administrators in the Inputs complement data set. The ownership of trucks and/or grain carts by users is not allowed.⁷⁰

⁶⁹The respective State/Region complement data set contains the harvest moisture contents assumed to correspond to the respective planting/harvesting period combinations allowed for corn. The calculation procedure used to account for the removal of excess moisture is analogous to that discussed by Dike and Rister.

⁷⁰It is recognized that many farm operators own their own grain transportation equipment. However, recall the intent of IFLMAPS is to consider the ownership of machinery and equipment whereby it directly affects the yield levels realized in farm operations. It is further recognized that insufficient transportation equipment slows the harvesting operation (Loewer *et al.*). Inclusion of this type of detail in IFLMAPS is not necessary for the stated objectives of the model. However, it can be incorporated to a limited extent by adjusting the acreage/hour capacities of the various harvesting units in the Inputs complement data set according to whatever assumptions an administrator wishes to make concerning the adequacy of such equipment. In addition, by increasing the costs of such harvesting units it is possible to shift the hauling expense to this phase of the simulation process. In such a case, an administrator should probably adjust downward the commercial hauling rates stated in the Inputs complement data set so as to reflect only marginal costs affiliated with hauling to the off-farm location.

Derivation of monthly crop prices

There are several aspects of IFLMAPS which serve to complicate the modelling of the Output Price sub-system. The desire to construct a model capable of simulating various geographical locations and the inclusion of several marketing alternatives per crop during each month of a simulation horizon are among such features. An aspiration to incorporate a simple means of representing different output price scenarios during different simulation horizons is also a factor. A related concern involves the preparation and presentation of corresponding market outlook information periodically during a simulation horizon. The procedure used to generate crop prices for IFLMAPS accounts for all of these interrelated factors. The approach used facilitates the development of both TMI and PMI in association with the second objective of this research study. It also conforms with the desired usefulness of IFLMAPS for both teaching and extension applications.

Output prices are endogenously generated in IFLMAPS using data from the Output Price, State/Region, Inputs and Government Commodity Program complement data sets. The various State/Region complement data sets contain price data which facilitate the derivation of output price relationships normally experienced in the respective geographical areas. This feature of IFLMAPS greatly enhances its widespread application and possibility of acceptance by users. The Output Price complement data set serves as a storage location for initial crop price levels and subsequent price movements during the simulation horizon. Such data is

stored on-line rather than endogenously determined in IFLMAPS for four primary reasons:

1. The intent of using IFLMAPS in teaching, extension and in certain research applications requires administrators to have the ability to control the computation of output prices so as to allow for their designating the absolute price levels and/or relationships among the various market alternatives' prices at selected points of a simulation horizon
2. Frequently administrators will desire several users to experience the identical output price scenarios. The use of data sets assures representation of such a price scenario in the respective users' simulation horizons
3. The need on the part of administrators to prepare and present corresponding market outlook information requires a priori knowledge on their part regarding past price movements and future expected price movements. Such information allows them to provide statements describing hypothetical conditions responsible for such market behavior in a manner consistent with the information farmers encounter in the real world
4. An individual output price scenario has the potential of being used several times in IFLMAPS due to the intent of its application for teaching and extension purposes. The one time derivation of the necessary data and on-line storage of such data for subsequent reference is perceived as being a less expensive approach as opposed to repeated derivation of such data each time the model is used

The Inputs complement data sets includes an indication of inflation factors applicable during the simulation horizon. The Government Commodity Program complement data set identifies the pertinent data regarding derivation of price information regarding the loan and reserves programs.

The calculation procedure employed to derive monthly output prices implicitly recognizes three primary components for monthly price changes: (1) storage costs, (2) uncertainty regarding future supply and demand conditions and (3) fluctuation of current fundamental supply and demand conditions. IFLMAPS endogenously calculates output prices, in the absence of information relating to the third component noted, to reflect seasonal price movements farmers might expect to normally experience. The monthly nature of marketing opportunities combined with this feature offers an excellent opportunity for analyses of normal returns to storage following harvest as well as a chance to portray normal price relationships in a particular geographical area. This latter set of information is useful for purposes of interpreting the meaning of prices and the associated "best" or "preferred" marketing strategy when non-equilibrium economic conditions are simulated to occur, i.e., fundamental supply/demand conditions are assumed to be fluctuating.

The following discussions indicate the manner in which cash, futures market, forward cash contract and government program prices are calculated. The discussions distinguish between the price movements normally experienced under general equilibrium economic conditions and those associated with fluctuating fundamental supply/demand conditions.

Also, the ability to inflate output price levels is indicated where appropriate. However, as noted previously (refer to Exhibit 4.8), use of this feature of IFLMAPS is, in general, discouraged.

Cash prices

The three distinct cash prices calculated for each crop during each simulation month are: national average price received by United States farmers, Chicago price and local price. The national average price received by farmers is included in IFLMAPS as a result of its importance to the Government Commodity Program subsystem.⁷¹ The Chicago price serves as a common reference from which local prices relevant to cash sales of commodities in various geographical locations may be calculated.

The national average price received by farmers is assumed to be the basic price from which all other commodity prices in IFLMAPS are derived. Its monthly level for each crop is determined as indicated in

⁷¹ IFLMAPS includes a representation of the national average cash price received by farmers each month in order to determine if any grain held by users in the government reserve program is in "release" or "call" status. Grain is assumed to be "release" status whenever the national average price received by farmers is above the calculated government reserve program release price for the respective crop. Grain is in "call" status whenever the national average price received by farmers is above the calculated government reserve program call price. "Release" status allows farmers to redeem their loan and sell their reserve grain if they so desire without incurring any penalties. The sale of reserve grain when the national average cash price received by farmers is below the "release" price results in users being penalized commensurate with the real world government reserve program, i.e., pay back loan, storage payments, liable for interest on both items, etc. "Call" status in IFLMAPS, rather than allowing a 90 day grace period as allowed in the real world, results in the loan automatically being redeemed and the grain switched from a reserve storage state to an uncommitted storage state. Users are then allowed, at their discretion, to use the cash market, futures market contracts and/or forward cash contracts to dispose of the grain.

Exhibit 4.12. The essence of these calculations is that a predetermined annual base price is seasonalized to arrive at the monthly national average price received by farmers under stable equilibrium economic conditions. An opportunity exists for increasing or decreasing this price to reflect inflationary or deflationary general economic conditions. Similar price movements due to fluctuating fundamental market conditions may be reflected. The last variable noted, PR, is simply an accounting variable used in IFLMAPS for purposes of preserving a record of previous random price movements experienced by a user in his simulation horizon rather than require their repeated calculation.⁷²

As noted above, the presence of a Chicago cash price in IFLMAPS serves as a benchmark from which it is possible to calculate prices for different geographical locations. The selection of the Chicago price as such a benchmark rather than the national average price received by farmers follows from assuming that it would be relatively easier for administrators to identify the requisite bases between Chicago cash prices and local cash price as required for input in the State/Region complement data set than would be the case for bases between national average price received by farmers and local cash prices. The derivation of the Chicago cash price is illustrated in Exhibit 4.13. An implicit

⁷²The monthly random price movements designated in the Output Price complement data are assumed to have a cumulative effect on prices in IFLMAPS. Rather than require administrators to exogenously derive such cumulative effects, a record of such is maintained endogenously in IFLMAPS. This approach takes into consideration convenience to administrators and assured accuracy as well as the need for administrators to prepare market outlook information on the basis of the monthly random price movements. The identification of such movements in cumulative rather than on an individual monthly basis would complicate this task. The record of previous random price movements is updated at the completion of each simulation month and maintained as part of a user's simulation record for future reference.

Exhibit 4.12. Derivation of Monthly National Average Prices Received by Farmers in IFLMAPS.

$$NP_{ij} = [(BP \times SI_i) \times PI_j] + R_{ij} + PR$$

where

- i : simulation month; varies from 1 to 12
 - j : simulation year; varies from 1 to 10
 - NP_{ij} : national average price received by farmers in simulation month i and year j
 - BP : base annual price for crop; identified in Output Price complement data set
 - SI_i : a seasonal index factor for calendar month i; contained internally in IFLMAPS (refer to Table 4.4)
 - PI_j : a price inflation factor for simulation year j; specified in Inputs complement data set
 - R_{ij} : random price adjustment for simulation month i and year j due to changing current fundamental market conditions; specified in Output Price complement data set
 - PR : sum of previous simulation months' random price adjustments; maintained in user's simulation record on GAMEDTA
-

TABLE 4.4

Seasonal Indexes for National Average Prices
Received by Farmers in IFLMAPS

Month	Crop		
	Wheat	Corn	Soybeans
January	1.05	.98	.94
February	1.05	.99	.96
March	1.02	.99	1.02
April	.99	.98	1.02
May	.96	1.00	1.11
June	.96	1.04	1.13
July	.89	1.05	1.08
August	.99	1.08	.99
September	1.02	1.03	.93
October	1.03	.95	.90
November	1.03	.92	.90
December	1.04	.97	.93

SOURCE: Walter L. Emery, ed., Commodity Year Book 1980 (New York: Commodity Research Bureau, Inc., 1980). Data collected for crop years 1968-69 to 1978-79, 1970-71 to 1978-79 and 1975-76 to 1978-79 for wheat, corn and soybeans, respectively.

Calculations for deriving indexes:

$$I'_{ij} = I_{ij} \times [100 / (\sum_{i=1}^{12} I_{ij} / 12)]$$

with:
$$I_{ij} = \left[\frac{\sum_{k=1}^n P_{ijk}}{\sum_{k=1}^n AP_{jk}} \right]$$

where: I'_{ij} = adjusted index for crop j in month i; adjustment accounts for data being weighted according to monthly sales

I_{ij} = unadjusted indexes

P_{ijk} = average price received by United States farmers for crop j in month i of crop year k

AP_{jk} = average price, weighted by sales, received by United States farmers for crop j in crop year k

Exhibit 4.13. Derivation of Monthly Chicago Cash Prices in IFLMAPS.

$$CP_{ij} = NP_{ij} - (CB_i \times BI_j)$$

where

i : simulation month; varies from 1 to 12

j : simulation year; varies from 1 to 10

CP_{ij} : Chicago cash price in simulation month i and year j

NP_{ij} : national average price received by farmers in simulation month i and year j ; calculated as shown in Exhibit 4.12

CB_i : basis between national average price received by farmers and Chicago cash price in calendar month i ; contained internally in IFLMAPS (refer to Table 4.5)

BI_j : a basis inflation factor for simulation year j ; specified in Inputs complement data set

TABLE 4.5

Bases Between IFLMAPS' National Average Prices Received By
Farmers in the United States and the Chicago Cash Price

Month	Crop		
	Wheat	Corn	Soybeans
January	-.34	-.19	-.19
February	-.37	-.19	-.22
March	-.34	-.19	-.34
April	-.26	-.24	-.33
May	-.29	-.25	-.23
June	-.35	-.24	-.14
July	-.19	-.21	-.08
August	-.12	-.21	-.19
September	-.15	-.20	-.11
October	-.15	-.18	-.18
November	-.24	-.27	-.31
December	-.30	-.20	-.23

SOURCE: Walter L. Emery, ed., Commodity Year Book 1980, (New York: Commodity Research Bureau, Inc., 1980). Derived from cash price data for 1975-76 to 1978-79 crop years.

NOTE: Recognizing the possible impact of inflation and changing structure on bases as well as a limited data set (4 years), the observed bases from the latter part of the data period are weighted heavier than those from the earlier part of the period in arriving at the estimated bases, i.e., weights of .20, .25, .25 and .30 are applied to the observed bases during crop years 1975-76, 1976-77, 1977-78 and 1978-79, respectively.

assumption in the method used to derive the Chicago cash price from the national average cash price received by farmers is that the random price movements occurring at the national level are realized in their entirety at the Chicago market. As inferred below, it is similarly assumed that these vacillating prices affect local cash prices to the same extent. Such assumptions are required in order for a set of market outlook information statements corresponding to a particular set of random price adjustments being applicable regardless of the geographical region being simulated, i.e., the assumptions preserve the sought flexibility in using the model in different regions without over-extensive additional data requirements.

The calculations necessary for deriving of the applicable local cash price for the particular geographical area being simulated are designated in Exhibit 4.14. It is this local cash price that is the amount realized upon the cash sale of a commodity at the off-farm sales site. As previously noted, there are various handling costs associated with a crop following harvest--hauling, drying and/or storage. Expenses so incurred serve to reduce this gross price.

Futures market

The calculations required in deriving prices for those futures market contracts assumed available in IFLMAPS are somewhat complex. It is recognized that, in the real world, local prices tend to be more of a function of Chicago Board of Trade (C.B.O.T.) prices rather than the reverse cause and effect suggested in the calculation procedure outlined herein. However, such logic is required to allow using an Output Price complement data set in the simulation of different geographical regions.

Exhibit 4.14. Derivation of Monthly Local Cash Market Prices in IFLMAPS.

$$LP_{ij} = CP_{ij} - (LB_i \times BI_j)$$

where

i : simulation month; varies from 1 to 12

j : simulation year; varies from 1 to 10

LP_{ij} : local cash price in simulation month i and year j

CP_{ij} : Chicago cash price in simulation month i and year j; calculated as shown in Exhibit 4.13

LB_i : basis between Chicago cash price and local cash price in calendar month i; specified in relevant State/Region data complement set

BI_j : a basis inflation factor for simulation year j; specified in Inputs complement data set

As earlier noted, up to four distinct futures market contracts may exist during a simulation month for each of the three crops included in IFLMAPS. The mathematics required for derivation of corresponding prices for each crop are as illustrated in Exhibit 4.15.

As already noted, futures market contract prices are linked directly to local cash prices. However, the behavior of futures market contract prices in response to fluctuating fundamental market conditions is assumed to be somewhat different from that of local cash prices. As a result, the first step in calculating the respective futures market contract prices involves the elimination of the random element of current local cash prices. These random movements are later reintroduced in modified magnitudes.

The addition of the normal basis between the C.B.O.T. futures market contract prices and the local cash price to the stable equilibrium local cash price results in the stable equilibrium futures market prices for the respective contracts. The appropriate bases are specified by administrators in the relevant State/Region complement data set. It is possible to introduce an inflationary impact on these bases when the desired simulation of general economic conditions under non-stable equilibrium warrants it.

As one of the purposes of IFLMAPS is to provide a dynamic marketing decision environment for users, the introduction of random price movements assumed attributed to changing fundamental market conditions represents this desired feature. The inclusion of such random movements has previously been illustrated with respect to derivation of local cash market prices. Similar adjustments must be introduced for the derivation of futures market contract prices. Rather than introduce a second set

Exhibit 4.15. Derivation of Monthly Futures Market Contract Prices in IFLMAPS.

$$\begin{aligned} \text{FMP}_{ijkl} = & \text{LP}_{ij} - (\text{R}_{ij} + \text{PR}) + (\text{FB}_{km} \times \text{BI}_j) \\ & + (\text{CA}_{ijkl} + \text{PA}_{kl}) + \text{FMB}_{ij} \end{aligned}$$

where

- i : simulation month; varies from 1 to 12
- j : simulation year; varies from 1 to 10
- k : represents contract maturity date; 1 = harvest and 2 = post-harvest month
- l : indicates crop year; 1 = current and 2 = next year
- m : denotes current age of contract; may vary from 1 (first month of availability) to 15 (contract matures)
- FMP_{ijkl} : futures market price for contract k of crop year l in simulation month i and year j
- LP_{ij} : local cash price in simulation month i and year j; calculated as shown in Exhibit 4.14
- R_{ij} : random price adjustment for simulation month i and year j due to changing fundamental market conditions; specified in Output Price complement data set
- PR : sum of previous simulation months' random price adjustments; maintained in user's simulation record on GAMEDTA
- FB_{km} : basis between Chicago Board of Trade futures market prices for contract k in month m specified in State/Region complement data set
- BI_j : a basis inflation factor for simulation year j; specified in Inputs complement data set
- CA_{ijkl} : current adjustment to futures market price for contract k of crop year l in simulation month i and year j due to changing fundamental market conditions; calculated as indicated in Exhibit 4.16
- PA_{kl} : previous simulation months' adjustment to futures market price for contract k of crop year l due to changing fundamental market conditions; maintained in user's simulation record on GAMEDTA
- FMB_{ij} : an administrator supplied bias factor adjusting futures market contract prices upward or downward in simulation month i and year j; specified in the Output Price complement data set

of adj
form so
prices
for mo
respec
of the
percep
W
that
shock
(1980
used
resp
mark
avai
tive
ist.
reg
usi
The
sim
sim
in
cate
whil
whic

of adjustment factors, the same set will be used in a slightly altered form so as to reflect the inherent differences in current cash market prices and futures market contract prices. Two issues are responsible for modelling such random price movements in a different technique with respect to the futures market central prices: (1) the effect of the age of the respective futures market contracts and (2) the effect of current perceptions concerning future fundamental market conditions.

With regard to the first issue, grain marketing specialists concur that the further a contract is from maturity, the less effect a current shock in fundamental market conditions has on its C.B.O.T. price (Dike (1980), Ferris (1981b)). Table 4.6 presents several endogenous indexes used in IFLMAPS to modify the level of price movements assumed with respect to cash market prices according to the proximity of futures market contracts to their maturity date. Due to the lack of readily available supportive empirical data, the indicated indices are subjective estimates based on conversations with two grain marketing specialists (Dike (1980), Ferris (1981b)).

The second issue concerning the effect of current perceptions regarding market behavior in the future is incorporated into IFLMAPS by using data specified as part of the Output Price complement data set. The relevant data concerns forecasted market conditions during the three simulation quarters immediately following the current quarter being simulated. Three basic types of market conditions are assumed possible in IFLMAPS: bullish, bearish and possumish. The first two types indicate conditions of market improvement and deterioration, respectively, while the third relates to stable equilibrium market conditions with which there is only a slight possibility of price movement in either

TABLE 4.6

Estimated Indexes in IFLMAPS Modifying Random Price
Movements in the Futures Market According
To Age of Contract

Contract Age (Months Available)	Index
1	.55
2	.60
3	.65
4	.70
5	.74
6	.78
7	.82
8	.85
9	.88
10	.91
11	.93
12	.95
13	.97
14	.98
15	.99

SOURCE: Based on conversations with Drs. George K. Dike and John Ferris, Michigan State University, East Lansing, MI.

NOTE: A contract's age refers to its assumed life-time of availability on the Chicago Board of Trade--contracts may be available for up to 15 months prior to their maturity in the 15th month, i.e., a contract of 1 month of age is 14 months from maturity while a contract of 13 months of age is 2 months from maturity.

dir

cor

fu

wh

ti

me

ti

fu

i

s

m

s

a

t

r

e

direction away from the normal seasonal pattern. These forecasted market conditions are used to designate the direction of price movement in the futures market according to the germane forecast for the quarter during which the respective contracts mature. Bullish forecasts result in positive price movement and bearish forecasts produce negative price movements. A possumish forecast prompts price movement in the same direction as experienced in the current cash market. Price movements for futures market contracts maturing in the current simulation quarter are in the same direction as experienced in the current cash market. A similar assumption is in effect for price movements affecting futures market contracts maturing during four quarters hence from the current simulation quarter.⁷³

Following from the above discussion, the calculation of the current adjustment to futures market contract prices for each crop may be summarized as represented in Exhibit 4.16. For reasons similar to those expressed concerning the maintaining of a record of previous random price movements experienced in the cash market, an indication of the previous random price movements occurring with respect to the futures market contracts is also noted on a user's simulation record. This record is reinitialized at the beginning of each respective contract's availability and updated monthly through maturity of the contract. One final factor is considered in the calculation of futures market contract prices during each simulation month. Acknowledging that administrators may desire to incorporate a degree of bias, either for or against the

⁷³Market forecast information is made available only for the current quarter and three quarters thereafter. As a result, the noted assumption is made.

Exhibit 4.16. Calculation of Current Adjustment to Futures Market Contract Prices in IFLMAPS.

	$CA_{ijkl} = R_{ij} \times RM_{klm} \times D_{kl}$
where	
i	: simulation month, varies from 1 to 12
j	: simulation year, varies from 1 to 10
k	: represents contract maturity date; 1 = harvest and 2 = post-harvest
l	: indicates crop year; 1 = current and 2 = next year
m	: denotes current age of contract; may vary from 1 (first month of availability) to 15 (contract matures)
CA_{ijkl}	: current adjustment to futures market prices for contract k of crop year l in simulation month i and year j
R_{ij}	: random price movements affecting cash market prices in simulation month i and year j ; data is contained in the Output Price complement data set
RM_{klm}	: the appropriate modification index applicable to the R_{ij} for contract k of crop year l of age m months; refer to Table 4.6
D_{kl}	: a factor representing the applicable direction of change for the futures market price movements* data is contained in the Output Price complement data set

*These factors are either 1 or -1. IFLMAPS internally modifies the factors so as to assure positive price movements and negative price movements for contracts maturing during the forecast quarters.

use of such contracts when compared with the other available market alternatives, a means of specifying such preferences has been included in the Output Price sub-system. Administrators may, by specifying the crop, contract type (futures market or forward cash) and simulation year and month in the Output Price complement data set, interject either a positive or negative price effect into the calculations. Such deviations are brief in duration, i.e., they apply only to the month for which they are designated. Administrators desiring to embrace such deviations over an extended period must specify each of the individual months and associated degree of such aberrations. Information of this type is not required in order for IFLMAPS to function properly. The option has been included for administrators who may desire to use it in teaching, extension or research applications.

Forward cash contracts

Similar to the case of futures market contracts, each of the local forward cash contracts assumed available with respect to each of the crops has a possibility of being available for up to fifteen simulation months, including the month of contract maturity. As a result of this extended availability, the existence of up to four local forward cash contracts is feasible in a particular simulation month.⁷⁴ IFLMAPS utilizes the current C.B.O.T. futures market price to derive the respective local forward cash contract prices as indicated in Exhibit 4.17.

The equation in Exhibit 4.17 assumes an explicit form of behavior on the part of grain buyers in the geographical area being simulated.

⁷⁴ Refer to the earlier discussion concerning the simultaneous availability of four futures market contracts for each crop.

Exhibit 4.17. Derivation of Monthly Forward Cash Contract Prices in IFLMAPS.

$$\begin{aligned} FCP_{ijkl} &= FMP_{ijkl} - (FB_{k15} \times BI_j) \\ &\quad - [(BFE_{kl} + .05) \times BI_j] - CD_{kl} \\ &\quad - FMB_{ij} + FCB_{ij} \end{aligned}$$

where

- i : simulation month; varies from 1 to 12
- j : simulation year; varies from 1 to 10
- k : represents contract maturity date; 1 = harvest and 2 = post-harvest
- l : indicates crop year; 1 = current and 2 = next year
- FCP_{ijkl} : forward cash contract price for contract k of crop year l in simulation month i and year j
- FMP_{ijkl} : futures market price for contract k of crop year l in simulation month i and year j
- FB_{k15} : normal basis between C.B.O.T. futures market price and local cash price for contract k at its maturity; specified in State/Region complement data set
- BI_j : a basis inflation factor for simulation year j; specified in Inputs complement data set
- BFE_{kl} : brokerage fee applicable to contract k of crop year l; calculated as indicated in Exhibit 4.18
- CD_{kl} : current deviation from the normal basis assumed under stable equilibrium economic conditions for contract k of crop year l; calculated as discussed in text
- FMB_{ij} : an administrator supplied bias factor adjusting futures market contract prices upward or downward in simulation month i and year j; specified in the Output Price complement data set
- FCB_{ij} : an administrator supplied bias factor adjusting local forward cash contract prices upward or downward in simulation month i and year j; specified in the Output Price complement data set

The central assumption relates to a direct link between corresponding current futures market contract prices and local forward cash contract prices. The supposition is that local grain buyers will hedge their forward cash contractual obligations in the futures market.

To determine the forward contract price, the first step involves reducing the current futures market contract price by the normal basis at contract maturity. Local grain buyers regard the resulting figure as an indication of the local cash price that might be expected at that time should fundamental market conditions remain unchanged. As previously discussed, IFLMAPS includes a means of inflating such a basis according to the assumed general economic conditions in the current simulation year.

The next step in the calculation process involves reducing the futures market contract price by a brokerage fee and a minimal \$.05 per bushel "protection" fee. The brokerage fee applies to costs actually incurred by the local grain buyers in hedging their purchase in the futures market. IFLMAPS assumes local grain buyers trade in 5000 bushel contracts on the C.B.O.T. The brokerage fee calculations in IFLMAPS consider the round-term cost associated with such a contract as well as opportunity costs associated with this fee and the margin requirements. The opportunity costs are a function of the proximity of the contract to its maturity date. The relative calculations are indicated in Exhibit 4.18. The "protection" fee pertains to an assumed discount applied by the local markets as protection against a change in the respective

Exhibit 4.18. Estimation of Representative Brokerage Fee for Use in Deriving Monthly Forward Cash Contract Prices in IFLMAPS.

$$BFE_{kln} = (BF_n/5000) + \{[(16 - M_{kl})/12.] \\ \times .12 \times [(BF_n/5000) + MR_n]\}$$

where

- k : represents contract maturity date; 1 = harvest and 2 = post-harvest month
 l : indicates crop year; 1 = current and 2 = next year
 n : designates crop; 1 = wheat, 2 = corn and 3 = soybeans
 BFE_{kln} : per bushel brokerage fee for contract k of crop year l for crop n
 BF_n : expense associated with a round-term 5000 bushel contract transaction on the C.B.O.T.; specified internally in IFLMAPS
 M_{kl} : current age (in months) of contract k of crop year l
 MR_n : per bushel margin requirement associated with crop n contracts; specified internally in IFLMAPS

This equation implicitly assumes a 12 percent annual rate of interest is appropriate with respect to opportunity costs. Such costs are considered for the remaining duration of a contract's availability.

The BF_n costs internally located in IFLMAPS are as follows (Kubichek):

Crop	Round-term Brokerage Fee (5000 bushel contract)	Estimated Margin Requirement (per bushel)
Wheat	\$67.00	\$.30
Corn	67.00	.15
Soybeans	67.00	.50

contracts' maturity bases.⁷⁵ These two fees are assumed to be subject to the same inflation factors applicable to the bases.

A third step involves accounting for any observed divergence in the futures market contracts' current basis from its expected level, i.e., CD_{kl} factor in Exhibit 4.17. This deviation is measured by contrasting the current simulation month's basis with the "normal" basis of a contract as supplied by administrators in the State/Region complement data set. The observance of a wider basis than expected results in forward contracts being discounted while a narrower basis prompts inclusion of a premium in the respective contract price. Any observed divergence in the basis is a result of the consideration of fluctuating fundamental market conditions.

The final step required in calculating the respective forward cash contract prices is to delineate any bias specified by administrators with regards to futures market contracts while simultaneously considering any bias similarly specified for forward cash contracts. This feature of the Output Price sub-system allows administrators of IFLMAPS to design output price scenarios in which one marketing alternative may be a preferred strategy relative to the others at selected points within the simulation horizon.

⁷⁵A wider basis than expected would result in a potential loss to the grain buyer, i.e., the gain (loss) and loss (gain) in the futures market and local cash market, respectively would not offset each other to the economic detriment of the grain buyer. Similarly, a narrower basis would result in a profit to the grain buyer. It is customary to discount prices to account for such risk. The magnitude of the discount applicable is a function of location, current age of the contract, and various other factors--a rate of \$.05 per bushel is used in all instances in IFLMAPS as a basis "protection" fee. The CD_{kl} factor in Exhibit 4.17 represents an attempt to model in the variation which occurs in this "protection" fee.

Government commodity programs

Prices for the government commodity loan and reserves programs are determined during each simulation month independently from the determination of prices for the other marketing strategies of IFLMAPS. Information from the Government Commodity Program and State/Region complement data sets is used as indicated in Exhibit 4.19 in arriving at the appropriate prices for the three crops in each simulation month.

Although the technique described in Exhibit 4.19 explicitly disregards the price levels of other marketing strategies, administrators are urged to consider such levels when preparing the data for the Government Commodity Program complement data set (discussed in Chapter 5). It should be desirable to prepare an output price scenario which includes both an effective and ineffective government program over the simulation horizon, i.e., there should be simulation years in which program participation is rewarding while in other years there should be little incentive for program participation. Similarly, low prices and reserve release and call factors may be set so as to reflect varying fundamental market conditions, i.e., reserve program is in both "release" and "call" status during a simulation horizon.

User selection of marketing alternatives

The following discussion applies to the manner in which users of IFLMAPS are allowed to decide upon their preferred marketing strategies, how such decisions are executed and the resulting consequences of such execution.

Exhibit 4.19. Derivation of Monthly Government Commodity Program Price Levels in IFLMAPS.

$$GLP_{ij} = GP_j + A$$

$$RRP_{ij} = GP_j \times RF$$

$$RCP_{ij} = GP_j \times CF$$

where

- i : simulation month, varies from 1 to 12
 - j : simulation year, varies from 1 to 10
 - GLP_{ij} : government loan program price in effect during simulation month i and year j
 - RRP_{ij} : government reserve program release price in effect during simulation month i and year j
 - RCP_{ij} : government reserve program call price in effect during simulation month i and year j
 - GP_j : base government loan program price for simulation year j; specified in Government Commodity Program complement data set
 - A : local adjustment to government loan price; specified in State/Region complement data set
 - RF : an index factor modifying the base loan program price to arrive at the reserve program release price; specified in the Government Commodity Program complement data set
 - CF : an index factor modifying the base loan program price to arrive at the reserve program call price; specified in the Government Commodity Program complement data set
-

Information aids

Several sets of information are presented users of IFLMAPS for the purpose of aiding them in their marketing decision-making processes. The sets provided include: (1) an indication of normal market behavior in the absence of fluctuating fundamental market conditions, (2) an indication of the prices in effect for the various marketing alternatives during each simulation month, (3) possibly quarterly market outlook information,⁷⁶ (4) an inventory of grain currently stored and current marketing obligations and intentions and (5) a denotation of forecasted yields prior to harvest. Users of IFLMAPS are not forced to execute marketing decisions in isolation from the environment being simulated--this is the interactive feature of IFLMAPS discussed in Chapter 3.

Designation of desired strategies

IFLMAPS' users are ordinarily allowed an opportunity to execute marketing decisions during each simulation month.⁷⁷ As indicated by Exhibit 4.20, there are three basic types of marketing alternatives: (1) transactions involving grain currently stored, (2) transactions involving contractual obligations and (3) transactions relating to the

⁷⁶Administrators may, for one reason or another, choose not to provide a user with any market information during the simulation horizon; designation of the selected market outlook information alternatives occurs during the signing-on as a new user process (refer to Appendix B).

⁷⁷As is the case with several of the features of IFLMAPS, the opportunity to market crops is scheduled by administrators in the respective State/Region complement data sets. Normally, this opportunity should be scheduled for each simulation month. However, in selected instances administrators may see fit to exclude it from some months, i.e., allow marketing only once a quarter.

Exhibit 4.20. Codes Representing the Various Marketing Strategies Allowed in IFLMAPS.

Transactions Involving Grain Currently Stored:

Storage Location	On-Farm			Off-Farm		
	Wheat	Corn	Soybeans	Wheat	Corn	Soybeans
Action						
Sell uncommitted stocks	111	121	131	211	221	231
Redeem and sell loan stocks	112	122	132	212	222	232
Switch loan stocks to reserves	113	123	133	213	223	233
Redeem and sell reserve stocks	114	124	134	214	224	234

Contractual Transactions:

Contract Type	Futures Market		Forward Cash Contract
Action	buy	Sell	Sell
Crop and Contract Delivery Date			
Wheat, harvest delivery, current crop year	1111	1211	2211
Wheat, post-harvest delivery, current crop year	1112	1212	2212
Corn, harvest delivery, current crop year	1121	1221	2221
Corn, post-harvest delivery, current crop year	1122	1222	2222
Soybeans, harvest delivery, current crop year	1131	1231	2231
Soybeans, post-harvest delivery, current crop year	1132	1232	2232
Wheat, harvest delivery, next crop year	3111	3211	4211
Wheat, post-harvest delivery, next crop year	3112	3212	4212
Corn, harvest delivery, next crop year	3121	3221	4221
Corn, post-harvest delivery, next crop year	3122	3222	4222
Soybeans, harvest delivery, next crop year	3131	3231	4231
Soybeans, post-harvest delivery, next crop year	3132	3232	4232

Transactions Regarding Handling at Harvesttime of Crops Currently Growing:

A. Storage Alternatives

Storage Location	On-Farm			Off-Farm		
	Wheat	Corn	Soybeans	Wheat	Corn	Soybeans
Type of Storage Plan						
Loan Program	7011	7021	7031	8011	8021	8031
Reserve Program	7012	7022	7032	8012	8022	8032
Uncommitted	7013	7023	7033	8013	8023	8033

B. Sell for Cash

Wheat	9014
Corn	9024
Soybeans	9034

disposal of growing crops upon harvest. The various strategies available with respect to each of these alternatives should be self-explanatory as described in Exhibit 4.20 and from previous discussion. Exhibit 4.20 indicates the codes representing the various marketing strategies allowed in IFLMAPS. In order to execute any particular strategy a user designates the appropriate code along with the number of bushels desired to be marketed in that particular manner.

IFLMAPS endogenously imposes restrictions on the amount of grain that may be marketed via several of the strategies. As might be expected, no more grain than is stored in uncommitted, loan and reserve status may be marketed from such storage. There are limitations in effect, however, regarding the several contractual marketing alternatives available. Users of IFLMAPS are limited to contracting no more than is expected to be produced from planted acreage plus current storage inventory of the respective crops. However, the constraint is applied on an individual basis with respect to the various contracts available for each crop thereby providing some leeway to users. Pertinent constraint levels for each crop's contracts are determined as follows: (1) a user's planted acreage and planting intentions with respect to each land tenure class are multiplied by the appropriate potential yield level and this product is summed across the three land tenure classes to arrive at a tentative constraint; (2) in the case that planted acreage and planting intentions are at zero levels for the crop in question, the above calculations are repeated assuming 20 percent of the acreage controlled is planted to wheat, 40 percent to corn and 40

percent to soybeans⁷⁸ and (3) this last step involves assessment of the amount of the crop currently held in storage in uncommitted status as well as in the loan and reserve programs--should this amount exceed the constraint level previously calculated, the level is raised accordingly. These constraints are calculated at the beginning of each simulation month and updated as transactions are executed within the simulation month. For transactions relating to the storage or cash sale upon harvest of growing crops, no constraints are generally imposed upon the magnitude of transaction. These transactions are mere intentions which are executed as simulation of harvest occurs. Without their presence, IFLMAPS would have to endogenously allocate the harvested crop among the various marketing alternatives. It is important for users to recognize the priority accorded the various marketing intentions for a crop as it is harvested--the endogenous rank of preference is discussed in the next section. Upon completion of harvesting of a crop all intentions left unfulfilled are deleted.

Simulation action resulting from
selection of a strategy

As the various marketing strategies noted in Exhibit 4.20 are executed, several sets of calculations and data management occur endogenously in IFLMAPS. An indication of these operations should serve to clarify the "black box" nature of IFLMAPS' marketing sub-system.

⁷⁸These percentages are totally subjective. The reason for including this step is that it is possible that at some time during the simulation horizon that a user will desire to execute a contractual transaction when he has none of the crop planted--the 15 month lifetime of a contract assures its availability prior to the crop being planted. For lack of a better approach, it was decided to arbitrarily assume a crop mix and proceed as before.

The execution of a cash sale from storage results in three primary actions: (1) credit to cash flow of gross sales amount, (2) credit to net farm income of gross sales amount and (3) removal from storage of the amount of grain designated for sale. As noted before, such sales are limited to the amount of grain currently in storage. When grain is sold from on-farm storage, cash flow and net farm income will be debited for the expense of hauling grain to the off-farm sales site.

Execution of a futures market transaction first results in an internal check as to whether or not it will violate the constraint levels imposed on contractual obligations with respect to the relevant crop. If the constraints are not violated or the transaction is of an opposite position than current market obligations the transaction will be executed. While signing on as a new user one is required to indicate whether both hedging and speculating privileges are desired or only the ability to hedge. Execution of a new contract in the futures market results in a debit to both cash flow and net farm income of the applicable brokerage fee and a debit to cash flow in the amount of the margin requirements. When the contract is closed (bought or sold back), the margin account is credited back to cash flow and any profit or loss is recognized in both cash flow and net farm income.⁷⁹ IFLMAPS internally preserves and maintains in each user's simulation record on GAMEDTA an indication of all futures market transaction regarding each crop.⁸⁰ Such

⁷⁹ Profit or loss in the futures market is recognized only upon lifting of a hedge and/or closing of a speculative position. Market movement in favor of or against a user's position prior to closing of the contract simply results in cash flow accounting actions.

⁸⁰ Due to allocation of file space in GAMEDTA, a maximum of thirty transactions per crop is allowed at any one time.

a record notes the number of bushels contracted, the date of contract maturity, the market position, the contract price and current margin requirements associated with the contract.⁸¹

Transactions involving forward cash contracts are handled similarly to futures market contract transactions. One major difference is that futures market contracts may be canceled out with a transaction of the opposite position while forward cash contracts may not be so canceled--delivery must take place. Execution of a forward cash contract results in recording of the contract size, date of delivery and applicable price or the user's simulation record. When the delivery date is reached within the simulation horizon, IFLMAPS attempts to fulfill the contract. Delivery first occurs from any grain being harvested⁸² and then from any

⁸¹Futures market contracts, and similarly forward cash contracts, must be executed in 1000 bushel increments, i.e., transactions of 1000 or 5000 bushels are acceptable whereas 999 or 1250 bushels are not (in the latter case IFLMAPS would treat the transaction as 1000 bushels). It is acknowledged that C.B.O.T. prices are being used and that the required contract size at that Exchange is 5000 bushels. However, it is conjectured that the 1000 bushel contract size of the Mid-American Commodity Exchange is more conducive to the focus of this model on producer's firm level marketing decisions across a wide spectrum of farm operation sizes, i.e., small operators might use a 1000 bushel contract whereas they would not use a 5000 bushel contract. Maintenance of contracts' date of maturity allows IFLMAPS to endogenously remove contracts upon their maturity. An indication of the current market position (long or short) allows IFLMAPS to internally determine if a new transaction should remove an old contract (new transaction is of an opposite position of old contracts) or enact a new contract (new transaction takes a similar position to old contracts). A record of the contract price when entered into allows for calculation of profit or loss when the contract is closed out as well as maintenance of the margin account. In the latter case, the margin account is always maintained at a minimum level specified in the Inputs complement data set on a per 1000 bushel basis. Should the market move against a user's position, IFLMAPS internally debits cash flow in order to maintain the margin account at its required level. Similarly, should the market move in the user's favor, the user's cash flow is credited. Margin account updating occurs during each simulation month of a contract's existence.

⁸²Such delivery is allowed beginning in the simulation month prior to a forward cash contract's maturity.

uncommitted stocks of the crop stored off- and on-farm, in that order. If contractual obligations remain after all uncommitted storage stocks have been depleted, IFLMAPS endogenously assumes that such obligations are met by purchasing that amount of grain at five percent above the local cash market price. No direct fee is assessed a user for executing a forward cash contract--all applicable fees are implicitly reflected in the quoted forward cash contract price as described in Exhibit 4.17. The delivery of grain to fill a forward cash contract results in a credit to both cash flow and net farm income. Should grain need to be purchased cash flow and net farm income are simultaneously debited in the amount of the purchase price and credited in the amount of the sales price.

Five government commodity program marketing alternatives are available: (1) place grain in the loan program, (2) place grain in the reserves program, (3) switch loan stocks to the reserve program, (4) sell loan stocks and (5) sell reserve stocks. The first two alternatives are addressed subsequently in association with marketing intentions concerning growing crops. The other three alternatives are now addressed.

For the third alternative, three basic distinctions exist between the loan program and the reserve program: (1) the government pays the farmer an annual storage payment on grain held in the reserves and not on grain held in the loan program, (2) there are restrictions on the sale of reserve stocks whereas there are not on the sale of loan stocks and (3) the maximum length grain may be held in the reserves is three years whereas it is nine months for the loan program. The distinctions included in IFLMAPS are similar to those in the real world. Users of

IFLMAPS for one reason or another may desire to switch loan stocks to reserve stocks at some point, i.e., possibly to extend the loan period (the reserve program includes the government loan feature of the loan program), or in order to obtain the government storage payment. For whatever reason a user chooses to do so, execution of this transaction results in a credit to cash flow and net farm income in the amount of the annual government storage payment (specified in the Government Commodity Program complement data set) and a change of status on the user's simulation record regarding the government program the grain is entered in.

For the fourth alternative, the sale of loan grain prior to the maturity of the loan (nine months after initialization) results in repayment of the loan and interest on the loan amount at an annual rate specified in the Government Commodity Program complement data set. Both of these payments result in a debit to cash flow and net farm income--repayment of the loan is debited with respect to net farm income since it was credited therein upon receipt. Simultaneously, cash flow and net farm income are credited for the sales amount. Any grain remaining in the loan program for nine months is assumed to be forfeited to the government and is endogenously removed from the user's simulation record.

The fifth alternative of selling grain from the reserves program may occur under one of two conditions: either the national average monthly price received by farmers is above or below the calculated release price. Sale of grain when prices are above the release price

result in simple repayment of the loan and interest on the loan⁸³ and receipt of the sales amount. However, when sales price is below the release price, a penalty is incurred. The loan must be repaid, interest on the loan for its entire duration must be paid and all government storage payments must be repaid along with interest on such storage payments--such repayment may not exceed the release price level. All of these items result in debits to cash flow and net farm income while credit is simultaneously received for the sales amount. A third possible case exists when the national average price received by farmers is above the reserve call price. In such a case, reserve stocks are automatically converted to uncommitted stocks at the beginning of the simulation month in addition to the loan and interest on the loan being debited to cash flow and net farm income. Should grain remain in reserve stocks at the end of three years, IFLMAPS assumes the government takes over such stocks in a manner similar to that of the loan program, i.e., all grain is removed from a user's simulation record and no cash flow or net farm income transaction occurs.

⁸³Interest is due only on the period the grain was held solely in the loan program and up to a maximum of 12 months while it was in the reserve program, i.e., interest is never assessed for more than 21 months.

User declared intentions for the disposal of growing crops upon harvest may include:

1. Forward cash contracts
2. Loan program
3. Reserve program
4. Cash grain sales
5. Storage as uncommitted stocks
6. Cash grain sales

Intentions 1-3 and 5 are first honored with respect to on-farm storage and then with respect to off-farm storage. Any harvested grain leftover after fulfillment of these intentions is automatically sold on the cash market (refer to Figure 4.4). Commitments are reduced as grain is harvested and allocated where appropriate. The storage of grain in the loan program results in a credit to cash flow and net farm income in the amount of the loan and the designation on the user's simulation record of the number of bushels, loan price, applicable government interest rate and an indication of program status as being the loan program. For income tax purposes, government loan receipts are treated as income in the year received. If the grain is subsequently redeemed from the loan program, repayment of the loan is treated as a tax-deductible expense. Grain entering the reserve program receives similar treatment except that an annual government storage payment is also received and the status is noted as the reserve program rather than the loan program. The first opportunity for cash sales allows for fulfillment of any desired sales prior to the honoring of uncommitted storage intentions.

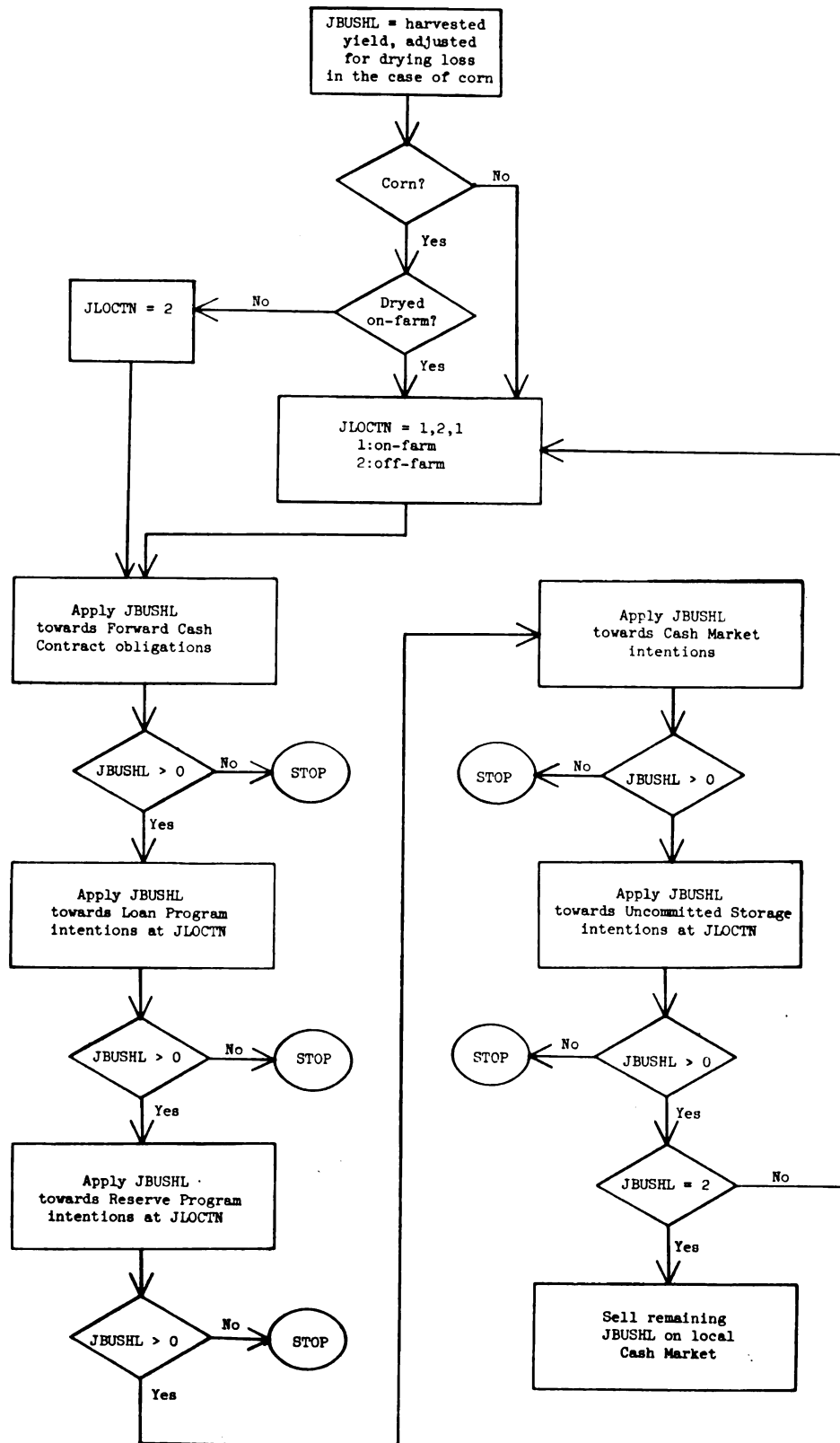


Fig. 4.4. Disposal of harvested crop in IFLMAPS

This enables some cash inflow being realized by the business if desired. Users are free to sell uncommitted storage stocks at any time during the post-harvest season.

Financial Component

The general nature of a farm management simulation game such as IFLMAPS is that user results are measured, ultimately, in terms of annual Net Farm Income and changes in Owner's Equity. Measurements of this type require an accurate monitoring of cash flow transactions and their impacts on Net Farm Income and Owner's Equity.

Cash flow accounting

This section addresses the cash flow implications of (1) transactions enacted by users within a particular simulation month and (2) transactions endogenously performed in IFLMAPS on a monthly basis. The manner in which cash flow is balanced during each simulation month is illustrated as is the scope of the information sets available for monthly and annual cash flow transactions.

User prompted transactions

User executable transactions having cash flow repercussions in IFLMAPS are generally concerned with either the growing of crops, the marketing of crops or one of the investment opportunities allowed.

Growing of crops. In the process of simulating the growth of wheat, corn and/or soybeans, IFLMAPS accounts for the variable expenses associated with purchasing inputs and performing field operations. In addition, the expense associated with any part-time labor employed during a field operation time period is accounted for. Variable inputs are defined to include the requisite seed, fertilizer, herbicides and

insecticides. The total per acre expense of such items for each of the three crops is specified in the Inputs complement data set. It is possible for users to maintain an inventory of inputs for each of the crops as a tax management strategy. Such inventories for a crop are depleted prior to additional units being purchased as planting is simulated. The use of inputs out of inventory results in only a debit to net farm income whereas the purchase of additional inputs prompts a debit to both cash flow and net farm income. Variable costs associated with performance of field operations include fuel, lubrication and repair costs. The expensing of full-time labor costs is included among those transactions which are endogenously performed each month. Recognition of these expenses results in a debit to both cash flow and net farm income.

Marketing of crops. The cash flow and corresponding net farm income consequences of crop marketing actions are addressed in the marketing component section presented previously in this Chapter.

Investment opportunities. The three investment opportunities allowed in IFLMAPS include the procurement of variable inputs, the construction of on-farm grain drying and storage facilities and a chance to buy, sell or trade machinery units designed to perform the three required types of field operations.

The chance to buy or sell variable inputs in December of each simulation year is primarily a tax management strategy. The assumption of cash basis accounting for tax purposes in IFLMAPS allows for some shifting of income and expenses between tax years to reduce one's tax liabilities, i.e., grain sales may be delayed until January or later in order to shift taxable income from the current year to the next. Similarly, variable inputs may be purchased in December of this year rather than

wait until planting time of the next year in order to increase this year's tax-deductible expenses. Users are provided with a preliminary tax analysis of the current year at the end of the November simulation month. Based on this information, they decide whether or not to purchase inputs in December for use during the next crop year.

Variable inputs are assumed available for purchase, in one acre units, for each of the three crops included in IFLMAPS. The execution of such a purchase by a user results in a debit to cash flow and a simultaneous credit and debit to net farm income variable input inventory and net farm income variable input expense, respectively.⁸⁴ Some caution is to be urged in the use of this option. There are implicit opportunity costs associated with the purchase of variable inputs prior to their being needed at planting time. In addition, should a user ultimately decide to not plant as much acreage to a crop as he or she has already purchased variable inputs, such opportunity costs are increased.

This last point, i.e., the possibility of variable inputs remaining unused at the end of a crop's planting season, is the reason for allowing a disinvestment option for variable inputs at the same time as the December investment opportunity. Should a user desire, he or she may dispose of such unwanted inputs at 15 percent below the current cost.⁸⁵

⁸⁴For tax purposes, the transaction is handled as a deductible expense. However, for the purpose of determining annual Net Farm Income, the net effect of such a purchase is zero in the current simulation year. Variable inputs held in inventory are expensed for Net Farm Income purposes only upon their removal from inventory for either use at planting time or as subsequently addressed, disposal by resale, i.e., Net Farm Income is calculated on an accrual basis.

⁸⁵This discount is meant to reflect the added expense and difficulties associated with such a disinvestment. Its magnitude is a subjective estimate.

A transaction of this nature results in (1) a credit to cash flow of the sales amount, (2) a debit to variable input inventory of the original purchase price and a credit to variable input expense in the amount of the final sales price. The overall effect of such accounting will ordinarily be both a tax loss and a net debit to net farm income. However, when inflated variable input costs are recognized in the applicable Inputs complement data set, it is remotely possible that a gain rather than a loss would be incurred as a result of such a transaction.

Both on-farm grain drying and storage facilities and machinery units are regarded as capital assets in IFLMAPS. Transactions regarding their purchase and/or sale are somewhat different from those concerning ordinary assets such as variable inputs. Consider first the case of an on-farm grain drying and storage facility. A user's Initial Firm Structure complement data includes an identification of any such facilities assumed to be owned at the beginning of the simulation horizon. During January, June and December of each simulation year, an opportunity is provided to expand such owned facilities.⁸⁶ No opportunity exists for a user to divest or sell such facilities. The Inputs complement data set allows for specification of up to six different sizes (in bushel units)

⁸⁶The observance of a disparity in marketing actions between real world farmers who own their own facilities as opposed to those who do not prompts inclusion of this feature in IFLMAPS. Opportunities for such investments are allowed in both December and January as a tax management strategy. Just as in the case of variable inputs, a user may wish to be discriminative for the year in which such a purchase takes place due to the additional depreciation expense and investment credit associated with such a purchase. The June investment opportunity is allowed so as not to require users to invest in such facilities prior to their actual need. In Michigan, the erection of new storage facilities can be delayed until immediately prior to harvesting wheat in July. However, the January investment opportunity is included to allow for earlier construction in southern states where wheat harvest may begin as early as April or May.

of facilities and associated purchase prices. It is possible for administrators to increase these prices by an annual inflation factor.

The ownership of such facilities, as discussed previously on the marketing component, will ordinarily allow a user to dry and store his or her crops at somewhat cheaper rates than those in effect at off-farm commercial facilities.⁸⁷ In addition, any facilities so owned are depreciated on the basis of a twenty year life and zero salvage value, for the purpose of deriving both taxable income and Net Farm Income during each simulation year. For tax purposes, the purchase of on-farm grain drying and storage facilities is assumed to qualify for investment tax credit. The purchase of such facilities initially results in only a debit to cash flow. The realization of associated ownership expense is assumed to occur at year end.

With respect to the financing of investments in grain storage facilities or machinery, users are allowed to choose among two available methods: (1) use surplus cash available in the checking account and/or borrow necessary funds via a current loan (principal and interest due in one year) or (2) obtain an intermediate seven year loan, repayable in equal annual principal payments. Interest accrued to date is also payable at the time of each principal payment.⁸⁸ IFLMAPS internally rations

⁸⁷ Administrators specify the applicable rates for these activities at facilities separately for on- and off-farm facilities. It is possible that no difference in costs will exist.

⁸⁸ It is acknowledged that another means of calculating such repayments is to use an amortization approach. The approach selected, however, gives the maximum tax advantage of the deductible interest expense during each year. It is recognized that somewhat of a heavier cash flow burden is borne in the early years of the repayment horizon under such an approach. The interest rates applicable to both current and intermediate loans are specified by administrators as part of the Inputs complement data set.

the availability of intermediate credit according to a Debt/Equity ratio specified in the Initial Firm Structure complement data set. Whenever a user's current Debt/Equity ratio is over or would surpass the specified ratio with the purchase of the capital asset being considered, such credit is denied. If the user insists on buying the asset nonetheless, he may do so using the first financing alternative. However, as subsequently discussed, there are restrictions applicable to such financing also.

In the case of machinery units, users are similarly provided an opportunity to buy, sell and/or trade such assets during January, June and December. As suggested, contrary to the case of grain drying and storage facilities, users may divest themselves of unwanted machinery units.⁸⁹ Users are allowed the opportunity to purchase machinery for two primary purposes: (1) to improve upon their ability to simulate the performance of required field operations on a timely basis and (2) in order to increase the capacity of their owned machinery as additional land is rented during the course of a simulation horizon. These are two fundamental management decisions confronting farm managers in the real world. The cash flow implications of such decisions are hypothesized to have an impact on marketing decisions. In addition, the provision in the Inputs complement data set to decrease performance capability as a machinery unit ages allows for the consideration of replacement of machinery in order to achieve more reliable performance at possibly a cheaper cost.

⁸⁹ An implicit assumption of IFLMAPS is that grain facilities are more of a fixed asset than are machinery units. Salvage value of the former is assumed to be zero while the latter's salvage values are a function of the respective unit's age as denoted explicitly in the Inputs complement data set.

Automat

Th

ically

whether

month.

to the

ity of

D

obtain

assume

Accrue

presen

media

simul

stand

outst

addit

loans

ture

ment.

rema
one.

tion
ning
nual
IFLM
tion
tran
inter
incom

Automatic endogenous transactions

This section concerns those transactions which are handled automatically by IFLMAPS at the close of each simulation month, regardless of whether or not a user has personally executed a transaction during the month. Such automatic calculations are necessary on a monthly basis due to the intermittent usage feature of IFLMAPS coupled with the availability of a monthly decision period.

Debt repayments. Current loans (mature 12 months after being obtained) are identified in IFLMAPS on a monthly basis. Such loans are assumed to be paid along with any accrued interest during the month due. Accrued interest is also updated on current loans not due during the present simulation month. As IFLMAPS is currently programmed, intermediate loans are assumed to be due in only June and December of each simulation year. Payment of a proportional principal payment⁹⁰ on outstanding intermediate loans along with interest accrued on the entire outstanding principal amount are allowed in these two months only. In addition, accrued interest is updated with respect to those intermediate loans due in six months. Also, as identified in the Initial Firm Structure complement data set, long term mortgage principal and interest payments are executed when due.⁹¹

⁹⁰IFLMAPS calculates such principal payments by dividing the remaining principal balance by the number of years to loan maturity plus one.

⁹¹The Initial Firm Structure complement data set includes information pertaining to any long term mortgage assumed to exist at the beginning of a user's simulation horizon (the total principal amount, the annual amortization payment and the applicable annual rate of interest). IFLMAPS computes the principal and interest portions of such amortization payments based on this information. With respect to all of these transactions, principal payments result in only cash flow debits whereas interest payments are recorded as a debit to both cash flow and net farm income as well as qualifying as a tax-deductible expense.

Full-time labor. Any full-time labor hired during a simulation year is assumed payable on a monthly basis. Payments include a pro-rated salary and the employer's share of social security. Both of these items are treated as debits to cash flow and net farm income as well as qualifying as a tax-deductible expense.⁹²

Grain storage. As discussed in the marketing component section of this Chapter, monthly storage payments are assessed at the beginning of each simulation month for grain stored during the previous month at both on- and off-farm locations. Such payments are treated as a debit to both cash flow and net farm income as well as qualifying as a tax-deductible expense.

Income taxes. Federal and state income taxes (if applicable in the geographical region being simulated--discussed subsequently) are calculated for each simulation year at the end of the December simulation month. However, so as to correspond to actions in the real world, the cash flow associated with such taxes is assumed to occur in March of the subsequent simulation year. During the subsequent January and February simulation months, such tax liabilities are reflected as a line item in the Current Liability section of the Net Worth Statement. Any self-employment tax due on the part of the farm operation is added to the federal tax liability. Payment of these liabilities is a cash flow transaction only. It does not affect net farm income.⁹³

⁹²The employee's share of social security is implicitly assumed to be withheld and paid to the IRS along with the employer's share. However, for ease of calculation, IFLMAPS treats the former as part of the payment to the employee.

⁹³An implicit assumption made in IFLMAPS is that such tax liabilities are an additional cash flow drain on the farm business besides those cash flow requirements affiliated with family living expenses.

Reserve programs storage payments. In the process of determining whether or not any of the grain held in the government commodity reserve program is scheduled to be taken over by the government as discussed previously in the marketing component section, IFLMAPS simultaneously resolves if a new storage year is beginning for any of the grain so stored. In the case that the second or third storage year is commencing for any of the grain to be held in the reserve program, the user is assumed to receive an additional annual storage payment from the government. Any such payments received are treated as a credit to cash flow and net farm income in addition to being regarded as taxable income.

Futures market margin requirements. IFLMAPS endogenously closes out any futures market contracts maturing during the current simulation month should a user not do so. With respect to those contracts not yet matured, IFLMAPS evaluates the appropriate current futures market contract price against a user's position and the price at which the contract was opened. In all cases, a user's margin account is maintained at the minimal required level. However, in the case that the market has moved against a user's position, IFLMAPS automatically debits cash flow so as to maintain the requisite funds in the margin account. Conversely, if the market moves in the user's favor, all excess funds above those required are credited back into the user's checking account. As noted in the marketing component section, a gain or loss for net farm income and tax purposes is noted only upon final closing of a contract.

Family living. The Initial Firm Structure complement data set identifies the number of families assumed to be sharing in the Net Farm Income associated with the farm operation being simulated. The initial per family cash flow requirements for annual living expenses are also

specified. IFLMAPS endogenously prorates these cash flow requirements on a monthly basis. Living expenses are assumed to have no effect on net farm income or taxable income. Also included in the Initial Firm Structure complement data set are an indication of the minimal and maximal annual living expense levels allowed per family. These levels establish bounds on a user's family expenditures after the first simulation year. Such expenditures are adjusted each year according to the relationship of after tax Net Farm Income to family expenditures requirements during the previous year. In the case that a positive difference is observed, IFLMAPS assumes that each family sharing in the Net Farm Income increments its annual family living expenditures by its proportionate share of 25 percent of the observed difference. Assuming somewhat more downward rigidity in family living expenditures when a negative difference is observed, IFLMAPS reduces per family expenditure levels by only a proportionate 15 percent share of such a negative difference. In either case, annual family living expenses are constrained at the maximal and minimal levels, i.e., any adjustment which would result in more or less than such bounds is truncated at the bound level.

IFLMAPS allows for inflation effects to be incorporated into family living expenses. When included in an Inputs complement data set by administrators, such factors are assumed to have an equal impact on actual expenditure and minimal and maximum levels.

Miscellaneous. Three classes of miscellaneous expenditures included in the cash flow accounting are: property taxes, insurance and miscellaneous repairs. Property taxes are assumed collectible one time a year during a month indicated in the Initial Firm Structure complement

data set. Property taxes are assumed assessable against 50 percent of the current market value of owned machinery, grain drying and storage facilities, owned land, improvements and residence.⁹⁴ The property tax rate applied against each \$1000 of assessed market value is specified as part of the applicable Inputs complement data set. Property tax payments are assumed to constitute a debit to cash flow and, except for that part representing residential property taxes, a debit against net farm income and a tax deductible expense.

Insurance premiums are assumed to be due twice a year. The Initial Firm Structure complement data set identifies the months in which such premiums are due. "Insurance" is defined to include fire, theft, liability and any other type of coverage ordinarily associated with a farm operation. The applicable rate per \$1000 of asset value is contained in the Inputs complement data set. All assets except owned land, checking account balance, variable inputs in inventory, and grain in storage are subject for insurability at 75 percent of current market value. As in the case of property taxes, insurance premiums are assumed to constitute a debit to cash flow and, except for that part representing residential insurance premiums, a debit against net farm income and a tax deductible expense.

The remaining miscellaneous item is repairs on assets classified as "improvements." Such assets will normally consist of buildings and miscellaneous machinery and equipment items. The Inputs complement data set includes a rate per \$1000 which is prorated on a monthly basis

⁹⁴In the simulation of Michigan geographical locations, the value of owned machinery and grain drying and storage facilities are excluded from such calculations so as to correspond to the state taxing policy (Harsh (1981), Schwab (1981)).

against the current market value of such improvements. The assessed amount is handled as a debit to both cash flow and net farm income in addition to being treated as a tax-deductible expense.

"Balancing of the books"

After the performance of all user prompted and automatic transactions within a simulation month, IFLMAPS "balances the books" with respect to cash flow for the month. There are two basic possibilities--either cash flow is positive or negative for the month.

Consider first the case of negative cash flow, i.e., more was spent than was received during the month. IFLMAPS first attempts to cover the deficit by using surplus funds from a user's checking account subject to a mandatory \$1000 minimum balance requirement on this account. In the case that surplus funds do not exist or are not sufficient to cover the deficit occurring within the month, any additional funds needed are automatically borrowed via a current loan, due in 12 months. This, in effect, allows for a continual "rolling over" of debt as it comes due in those instances that a user's simulated farm operation is not generating enough income to handle cash outflow needs. In order to place some bounds on the availability of current loans, IFLMAPS assumes a "step function" on applicable interest rates. So long as the additional debt requirement will not result in a violation of the maximum allowed Debt/Equity ratio,⁹⁵ such loans will be obtainable at the current short-term interest rate, as specified in the Inputs complement data set. However, in those cases in which a user has overextended himself to the point where the maximum allowed Debt/Equity ratio is exceeded,

⁹⁵Specified in the Initial Firm Structure complement data set.

IFLMAPS levies a heavy surcharge on the loan by designating the applicable interest rate for additional short-term loans as the current short term rate plus 10 percent, i.e., if the current interest rate is 12 percent, the applicable rate will be 22 percent. External credit rationing of this sort is needed in IFLMAPS so as to realistically influence user's marketing decisions⁹⁶ as well as restrict the usage of current loans for the purchase of capital assets. When users have managed their simulated farm operations in such a style that they are currently insolvent (net worth is negative) IFLMAPS makes current credit available at a 20 percent surcharge above the short-term interest rate. In effect, the simulated farm business is no longer a viable one. However, in this way, users are allowed to continue the simulation horizon.

The simulation process is quite different whenever a positive cash flow is realized during a particular simulation month. In such instances, users are allowed to designate how such funds are to be utilized. One available option consists of leaving the surplus funds in the checking account and accrue interest on them. The applicable interest rate is five percentage points below the current short term rate. This approach, in effect, assumes a facsimile of the money market is being used as a short-run investment strategy. Users may choose to use this option when they have accumulated cash and wish to reserve it for use in subsequent months for anticipated cash outflow requirements, either of an ordinary nature or for the purchase of capital assets.

⁹⁶As noted in Chapter 2 regarding the real world, farmers are often forced or otherwise encouraged by their financiers to market their crops prior to what they (the farmers) perceive to be an opportune time (Dillon).

Acknowledging the interest costs associated with outstanding debt, IFLMAPS includes an alternative option for the use of surplus funds which allows for the repayment of current and intermediate loans prior to their maturity. If this option is chosen all current debt and associated accrued interest liabilities are repaid prior to any outstanding intermediate loans being retired. In both cases, loans are repaid in order of their proximity to maturity, nearest first, i.e., on a FIFO basis--first in, first out.

Cash flow statement

At the conclusion of each simulation month users are allowed an opportunity to retrieve a Cash Flow statement summarizing the various transactions which have occurred within the month. Where appropriate, such transactions are categorized in terms of the three crops included in IFLMAPS along with a total across such crops. In addition, during the January simulation month (except during the first simulation year), users are provided with a chance to receive an annual Cash Flow statement for the previous simulation year. These opportunities to retrieve these statements are provided so as to keep users informed of the consequences of their decisions in the simulated farming environment.

Federal and State income taxes

The availability of cash basis accounting in the calculation of federal income tax liabilities allows farmers some flexibility in shifting income and expenses between tax years. To accurately represent the environment in which farmers execute their marketing decisions, a facsimile of certain features of the federal tax code are incorporated into IFLMAPS. Also, in addition to receiving an assessment of taxes due at

the end of the simulation year, users are provided with a preliminary tax analysis at the end of the November simulation month.

Description of taxation features

Representation of the federal taxation process in IFLMAPS is heavily dependent upon the software of TELPLAN 05 by Harsh and Kelsey at Michigan State University. The software comprising this decision-making aid has been modified slightly so as to allow for its use in IFLMAPS.

Primary federal tax features. IFLMAPS calculates federal income tax liabilities first on an ordinary basis and then using the income averaging approach. A user's tax liability is the lesser of the two. A possible exception to the latter statement may exist when the minimum tax section of the Internal Revenue Code is applicable. The effect of capital asset depreciation is allowed for in such calculations as is the influence of investment tax credit. Any investment credit remaining unused at the end of one year is rolled over into the next year. All necessary information relating to income averaging and the applicable investment credit as well as the possibility of investment credit recapture resulting from the premature sale of a machinery unit is maintained as part of a user's simulation record.

State income tax. Three options allowed for state income taxation are: (1) calculate in the manner Michigan state income taxes are assessed, (2) calculate as a percentage of federal income tax liabilities and (3) no state income tax liability.⁹⁷ The technique used to calculate Michigan state taxes is adopted from Harsh and Kelsey while the

⁹⁷The applicable approach is designated in the relevant State/Region complement data set.

other two approaches are included as simple alternatives for use in states other than Michigan.

Self-employment tax. At the time of assessing federal tax liabilities, IFLMAPS uses the IRS rates applicable in 1980 to assess any self-employment tax liability, i.e., a rate of 9.3 percent on the first \$29,700 of taxable earnings.

Cash flow considerations. As previously related, all tax liabilities are debited to a Net Worth Statement account where they remain until their removal during March of the following simulation year.

Sharing of taxable income

Among the various features incorporated into IFLMAPS for the sake of constructing a "flexible" model is the possibility of designating more than one family to share in the Net Farm Income associated with the operation. Information contained in the Initial Firm Structure complement data set indicates the number of families assumed to be sharing in the profit associated with the farm operation being simulated. Cash flow for family expenses as discussed previously is assumed to be required for all such families and the taxable income and any available investment credit associated with the operation is assumed to be split equally among all partners. All partners are assumed to file a similar form of tax return, as specified in the Initial Firm Structure complement data set, i.e., (1) married, filing jointly, (2) married, filing separately or (3) single.

Tax liability information sets

At the conclusion of the November simulation month, users are automatically presented with an assessment of their farm operation's tax

position for the current year, ignoring the events to come during the December simulation month. Such as assessment denotes federal and state income tax liability as well as any associated self-employment tax. In addition, the marginal tax rate and amount of expense that may be incurred before dropping down into the next lower marginal tax bracket is indicated as is the per partner taxable income. In those cases that taxable income is less than zero, users are informed of the amount of income that may be realized prior to any taxes being levied. The provision of this information along with the opportunity to invest in variable inputs, purchase machinery and/or grain drying and storage facilities or alternatively market additional grain during the December simulation month should confront users with a realistic tax management problem.

Following completion of the December month of the simulation year, another information set indicating the actual tax liabilities and associated marginal tax bracket as well as the per partner taxable income is provided to users. Also, each partner's share of remaining investment tax credit is indicated.

Performance measures

As noted earlier in this section, the primary measures used in IFLMAPS to reflect users' proficiency in making "good" managerial decisions are annual Net Farm Income and annual changes in Owners' Equity. IFLMAPS endogenously registers the impact of the various possible transactions upon these measures and, at the end of each simulation year, provides an opportunity to retrieve information sets describing both of them for the completed simulation year. In addition, at the end of a

user's requested simulation horizon, an opportunity is allowed to retrieve a summary of information concerning these measures.

Net Worth Statement

IFLMAPS maintains most of the required information for presentation of each user's Net Worth Statement on file GAMEDTA. The use of the current market value approach to valuing some of the assets necessitates a merging of this information with the current effective simulation parameters in order to prepare this statement. IFLMAPS' users are allowed to retrieve a Net Worth Statement during January of each simulation year, so as to mark progress made during the previous year. An opportunity to retrieve this statement is also provided at the beginning of each simulation session in order to briefly reacquaint users with their simulated farm operation's current financial position.

Asset categories and valuation techniques used. The specific assets taken into consideration while preparing a Net Worth Statement are: (1) current checking account, (2) variable inputs, (3) uncommitted grain in storage, (4) growing crops, (5) owned machinery units, (6) owned grain drying and storage facilities, (7) owned land, (8) residence and (9) improvements. The calculated value of these nine classes of assets represents the total asset value of the simulated farm operation.

Several valuation techniques are used to arrive at the current value of these assets. The checking account is valued simply at its current balance. Variable inputs held in inventory are valued on the

basis of their historical cost. Uncommitted grain held in storage is valued at the current local cash market price.⁹⁸ Crops growing at the time of preparation of a Net Worth Statement are valued on the basis of current cash prices and 75 percent of historical average yield.⁹⁹

Owned machinery units are valued at their current market value. Such calculations take into account the loss of value due to age and the effect of any applicable inflation factors (related factors are contained in the applicable Inputs complement data set). IFLMAPS considers on-farm grain drying and storage facilities to be somewhat more of a fixed asset than are the other assets included in IFLMAPS. As a result, such facilities are valued at their book value, adjusted for inflation. The three classes of "long-term assets" (owned land, residence and improvements) included in IFLMAPS are included in the Net Worth Statement at their inflated value and are assumed not to be subject to depreciation.

⁹⁸ Grain entered in the government loan and/or reserve program is excluded from valuation for the Net Worth Statement due to the receipt of associated government loans having already been treated as income. In the case that the local cash market price has risen above the loan price, it is possible that this valuation approach will under-represent the value of a user's assets, i.e., upon redemption of grain out of the government program in such a case, a net return will ordinarily be realized--the possibility of such a return is not included in the Net Worth Statement.

⁹⁹ This is meant to be a conservative approach to taking into consideration the value of growing crops in the process of preparing a Net Worth Statement. How credit is rationed in IFLMAPS warrants inclusion of such a value so as to not unrealistically constrain credit availability. In the case that a yield history has not been developed for a crop, 50 percent of the yield potential is used. Local cash market prices are used for valuation purposes rather than forward cash contract prices due to the programming structure of IFLMAPS not always having the latter price calculated when a Net Worth Statement is being prepared. The current local cash price is maintained as part of a user's simulation record.

The liability portion of a user's Net Worth Statement consists of (1) tax obligations, (2) short-term loan and associated interest obligations, (3) intermediate loans and associated interest obligations and (4) long term mortgage principal.

Owner's Equity or Net Worth is calculated simply by subtracting the sum of the liabilities from the sum of the assets.

No ratios. IFLMAPS restricts its function concerning the Net Worth Statement to simply preparing and presenting the above discussed information--no effort is made to calculate the various financial ratios normally associated with such a statement as related in Harsh et al. (Chapter 6), Penson and Lins (Chapter 3), and Lee et al. (Chapter 8). It is considered to be a useful exercise to have students prepare such ratios on their own when IFLMAPS is used in a teaching mode.

Net Farm Income Statement

Net Farm Income is accounted for in IFLMAPS on an accrual basis, i.e., changes in inventories are taken into account. Users are allowed to retrieve a Net Farm Income Statement at the completion of each simulation year. The requisite information for preparing such an information set is maintained on each user's simulation record.

Primary elements. The Net Farm Income Statement is subdivided into several pertinent categories: (1) cash receipts,¹⁰⁰ (2) other income,¹⁰¹

¹⁰⁰This category includes income associated with forward cash contract grain sales, sale of grain at harvest on the local cash market, sale of grain out of the government loan program, sale of grain out of the government reserves program, sale of uncommitted stored grain or the local cash market, receipt of government grain loans, receipt of government diversion payments, receipt of government storage payments, gain in the futures market and interest on surplus cash funds.

¹⁰¹This category includes income (or losses) associated with changes in inventory and other miscellaneous items. Included among the

(3) operating expenses¹⁰² and (4) fixed expenses.¹⁰³ Categories (1) and (2) sum to represent Gross Farm Income and categories (3) and (4) added together represent Total Expenses. The dollar difference between these two general categories is Net Farm Income.

The various items included in these categories are segregated, where possible, according to the particular crop they are associated with. Such differentiation along with other information provided in IFLMAPS should allow users to make some determination of the relative profitability of the three allowed crops, i.e., comparative analysis with earlier endogenously generated enterprise budgets. As was the case with the Net Worth Statement, no empirical analysis of Net Farm Income is conducted at the conclusion of each simulation year. Whenever IFLMAPS is used in a teaching application, it is advised that analysis of the type suggested by Harsh et al. (Chapter 6), Penson and Lins (Chapter 3) and Lee et al. (Chapter 9) be encouraged.

items accounted for on an inventory basis are variable inputs, uncommitted grain storage and growing crops. An account is also made with respect to the sale of machinery and gain or loss realized on the salvaging of unwanted variable inputs.

¹⁰²Farm operating expenses include costs associated with labor, variable inputs, land preparation, fuel and repairs, planting fuel and repairs, harvesting fuel and repairs, drying of corn, hauling, monthly grain storage, the return of government grain loans and associated interest, the return of government storage payments and associated interest, brokerage fees on futures market transactions, losses suffered on the futures market, the purchase of grain for the purpose of satisfying a forward cash contract, rental of land on a cash basis and interest on short-term loans.

¹⁰³Fixed expenses include property taxes, repairs on improvements, insurance, employers' share of social security on employee wages, interest on intermediate and long-term debt and depreciation.

Summary of performance

Regardless of whether or not users take advantage of the opportunity to received the annual Net Worth and Net Farm Income Statement, IFLMAPS executes the necessary calculations and maintains a record of the relevant key figures on each user's simulation record throughout his or her simulation horizon. At the end of the requested simulation horizon, such information is supplied each user as a summary of his or her performance over the entire simulation horizon. In addition, provided a user's simulation horizon was 3 or more years in length, a brief statistical analysis of his or her performance is provided.

Net worth Statement information. Users are provided with a summary of their simulated farm operation's initial Net Worth Statement as well as those prepared at the end of each simulation year. The designated key figures include current, intermediate, long term and total assets along with current, intermediate, long term and total liabilities; net worth, debt/equity ratio and annual changes in total assets and net worth are also noted.

Net Farm Income Statement information. Summary information concerning this statement includes identification of each simulation year's cash, other and gross farm income as well as operating, fixed and gross farm expenses; the resulting net farm income and net farm income per dollar of assets and per dollar of net worth are also noted.

Statistical summary. This entire summary of performance is included so as to facilitate evaluation of user's performance in association with the proposed research application of this model constituting the second objective of this research study. Such an evaluation may also have a useful purpose in specific teaching and/or extension applications of the model.

The brief statistical summary provided in IFLMAPS is elementary in its approach. More advanced techniques for analyzing the available data are addressed in Chapter 8. Three basic statistical standards (mean, standard deviation and coefficient of variation) are calculated for eight key measures of performance during each year of a user's simulation horizon. The key measures of performance are: net worth, change in net worth, total assets, change in total assets, debt/equity ratio, net farm income, net farm income per dollar of total assets and net farm income per dollar of net worth. Exhibit 4.21 indicates the calculations associated with these statistical standards. As is the usual interpretation, the mean of the measures over the simulation horizon indicates the average of all observations. The standard deviation is an indication of relative variability of this measure over the simulation horizon. The coefficient of variation is an absolute measure of variability of the measure over the simulation horizon (Anderson et al., pp. 26-27). It is acceptable to compare coefficient of variation standards for different measures but not acceptable to compare the respective standard deviations.

Exhibit 4.21. Calculation of Statistical Standards in IFLMAPS.

(a) Mean (X):

$$X = (x_1 + x_2 + \dots + x_N)/N$$

where

x_i : relevant performance measure in simulation year i

N : number of years simulated

(b) Standard deviation (s):

$$s = \{[(x_1 - X)^2 + (x_2 - X)^2 + \dots + (x_N - X)^2]/(N - 1)\}^{0.5}$$

where

x_i : relevant performance measure in simulation year i

N : number of years simulated

X : as designated in (a)

(c) Coefficient of variation (C.V.):

$$C.V. = s/X$$

where

s : as designated in (b)

X : as designated in (a)

SOURCE: Anderson et al., pp. 26-27.

Other summary information

Additional information regarding annual planting intentions, government program participation, record of annual yields and planted acreage, chosen marketing strategies and tax liabilities is also maintained in each user's simulation record on GAMEDTA. It is intended that this information be used during research applications of IFLMAPS concerning behavioral studies of farmers' decision-making processes. Presently, such information is obtainable only through manual editing of each user's simulation record.

CHAPTER 5

IFLMAPS' DATA REQUIREMENTS

Introduction

This Chapter relates an in-depth analysis of the data needs associated with IFLMAPS and the manner in which such data is placed in on-line storage. Unlike the usual method of identifying parameters for a computer model in a solitary data set, the data requirements of IFLMAPS are segregated into seven distinct "complement data sets":

1. Initial Firm Structure
2. State/Region
3. Output Prices
4. Inputs
5. Government Commodity Program
6. Yields
7. Field Time

The "direct access file" feature of the MTS operating system at the University of Michigan computer facilities greatly enhances the ability of administrators to identify and store several different data sets for each of the complement types. This possibility plus the ability of new users to specify their preferred sets of simulation parameters (refer to Appendix B) permits great flexibility in assembling a realistic decision-making environment for IFLMAPS. The desired user-orientation of IFLMAPS is enhanced by the flexibility to choose among the available complement data sets rather than requiring individual specification of

the numerous requisite parameters associated with a model of IFLMAPS' scope. As noted in Appendix B, IFLMAPS allows for input-by-exception in the case of the Initial Firm Structure complement data set. That is, should a user desire to do so, he or she can specify a new Initial Firm Structure complement data set rather than select one of those currently existing in on-line storage on file DTABANK.

The remainder of this Chapter examines the data requirements associated with each of the aforementioned complement data sets. A software program called LOADATA when used in correspondence with the input forms contained in Appendix C facilitates the storage of such data on the on-line storage file DTABANK. Appropriate illustrative complement data sets are presented in Chapter 6. In most instances, an effort is made to not repeat the extensive discussion of IFLMAPS contained in Chapter 4. Should a particular data requirement be unclear, the appropriate section of Chapter 4 should be referenced.

Initial Firm Structure¹⁰⁴

A user of IFLMAPS may complete his or her desired simulation horizon in one or several sessions. Because of the on-line direct access file storage feature of the MTS operating system at the University of Michigan computer facilities, it is possible to preserve each user's simulation record unaffected by others' use of IFLMAPS during the same time period. IFLMAPS endogenously generates, processes and records on file GAMEDTA the relevant information necessary for maintaining each

¹⁰⁴Exhibit C.1 in Appendix C indicates the applicable input form for this complement data set. The input form is applicable regardless of whether the new complement data set is being specified by a user exercising the input-by-exception option or by an administrator designating a general set of initial farm operation parameters.

individual user's simulation record throughout the course of his or her desired simulation horizon.

Prior to beginning simulation of a time horizon, each user must identify an Initial Firm Structure complement which contains several initial parameters of the grain farm operation to be simulated. Such specification may be accomplished by completing a detailed input form or by selecting an Initial Firm Structure complement from among those previously specified by administrators and former users of IFLMAPS. Each Initial Firm Structure complement specified by administrators and users is maintained in its original form for subsequent access by other users. IFLMAPS references separate storage files when retrieving current users' Firm Structure complements and Initial Firm Structure complements for new users, i.e., GAMEDTA and DTABANK, respectively.¹⁰⁵

Each user's complement includes information summarizing the organizational structure, current financial position, and physical characteristics of his or her simulated farm operation as well as a summary record of performance for each simulation year completed.

¹⁰⁵All Initial Firm Structure complement data sets, whether specified by administrators or users, are maintained in unblemished form on the data file DTABANK. Upon the selection of a particular Initial Firm Structure complement data set by a user, IFLMAPS copies the appropriate data from DTABANK to GAMEDTA, thereby establishing a user's initial simulation record on GAMEDTA. It is this record which is altered and updated over the course of a user's simulation horizon. The information contained on DTABANK is left intact for others' use. Administrators are responsible for frequently monitoring GAMEDTA and physically deleting any longstanding dormant simulation records. Similar monitoring is conducted with respect to the file DTABANK to remove antiquated complement data sets.

Structural organization

The capability of designating the "structural organization" traits within the Initial Firm Structure complement data set enhances the personalization of the simulated decision-making environment for each individual user. These traits relate to income tax calculations and affiliated cash flow accounting, family living expenses and sundry financial parameters.

Income tax considerations

IFLMAPS allows either individual or partnership entities. The cash flow consequences of such flexible organizational structure is facilitated by specification of the number of families (partners) assumed to be involved in the operation. Related to this matter, it is also necessary to specify the "average" number of tax exemptions affiliated with each such family for the purpose of calculating annual income taxes. Families in partnership arrangements are assumed to have an identical number of exemptions. Similarly, it is necessary to designate the type of tax return being filed by all families involved--married and joint, married and separate or single. The calculation of income taxes during the first few years of the simulation horizon is augmented by the identification of the "average partner's" most recent four years' taxable income (for income averaging purposes) as well as his or her share of current investment credit carryover.

The effect of off-farm income cash flow is incorporated into IFLMAPS by allowing the designation of such income on an aggregate basis from all involved partners during each month of the year. These amounts are assumed to be available for cash operating expenses, debt service, family living expenses and/or investment purposes.

Family living expenses

The cash flow drain on a farm operation associated with family living expenses is considered in IFLMAPS on a composite monthly basis. Such aggregated expenses are defined to include all those cash outflows normally observed with respect to family living, i.e., shelter, food, clothing, education, entertainment, etc. Administrators and/or users are required to designate an initial annual level of such expenditures for the "average" family involved in the simulated farm operation. Cash flow is debited by the aggregate of all partners' family living expenses during each simulation month assuming an equal distribution throughout the year of such expenses. The specification of minimal and maximal levels for such per family annual expenditures is also required.

Miscellaneous financial parameters

It is also necessary to indicate a few miscellaneous items relating to cash flow and the availability of off-farm financing as part of the Initial Firm Structure complement input. By using the appropriate numerical code (01 = January, 02 = February, etc.), the month during which annual property taxes are due and the two months during which semi-annual insurance payments are due must be designated. Also required is the maximum allowed debt/equity ratio. This ratio is used in determining the availability of intermediate loans for capital asset purchases (machinery and drying/storage facilities) and the interest rate applicable to short-term loans.

Financial position

IFLMAPS utilizes both a Net Worth Statement and a Net Farm Income Statement in monitoring users' financial progress during each simulation

year. It is necessary to designate several data requirements associated with a preliminary Net Worth Statement in the Initial Firm Structure complement data set. IFLMAPS endogenously generates and processes the data and information necessary to provide the annual Net Worth Statements and Net Farm Income Statements during the course of each users' simulation horizon.

The information requirements associated with the preliminary Net Worth Statement include both the initial financial position and several physical characteristics of the farm operation to be simulated. A representation of these features is paramount to the simulation nature of IFLMAPS. The capability of exogenously specifying their initial parameters rather than endogenously establishing such values enables administrators and/or users to designate a simulated farm operation which closely resembles a real world operation. Application of this attribute allows users to more quickly familiarize themselves with the simulation environment in which they must make decisions, thereby enhancing the value of the model's use in teaching, extension and research activities.

The information requirements affiliated with each section of a conventional Net Worth Statement are outlined below. Those values normally associated with a Net Worth Statement which are not explicitly required as input are endogenously calculated in IFLMAPS.

Current assets

IFLMAPS maintains a cash (checking) account for each user, facilitating cash flow accounting associated with income and expenses. It is necessary to identify the initial balance of an individual user's cash account in the Initial Firm Structure complement.

Also included in the Initial Firm Structure complement is the identification of the current inventory of crop variable inputs assumed to be possessed on January 1 of the first simulation year. Crop variable inputs are defined on a per acre basis for each crop and include all necessary fertilizer, seed, herbicides and insecticides associated with growing the respective crops. All fuel, lubrication, and repair costs associated with machinery operation as well as any necessary drying and hauling expenses are accounted for elsewhere in IFLMAPS. It is necessary to identify both the number of acres of inputs held in inventory and their aggregate value for each of the three crops simulated in IFLMAPS--wheat, corn and soybeans.

Another class of current assets which must be described is crops currently stored in both on- and off-farm storage facilities. It is necessary to designate the number of bushels of each crop stored at each location (on- and off-farm) on an individual basis. Caution is urged in designating the number of bushels of all crops currently stored at the on-farm storage location. Their summed total should not exceed the capacity of such facilities designated as initially existing in the simulated farm operation (the required identification of this capacity is described below in the intermediate assets section). IFLMAPS endogenously calculates the value of such stored crop inventories, using the current local cash market prices calculated as discussed in the marketing component of Chapter 4.

Intermediate Assets

The two primary classes of intermediate assets considered in IFLMAPS are: machinery and on-farm drying/storage facilities. The information requirements concerning these assets are both financial and

physical in nature. The simulation nature of IFLMAPS necessitates some generalization of the relevant real world parameters and requires consolidating such input.

IFLMAPS' simulation of field operations requires ownership of at least one unit of each of three machinery complement types--land preparation, planting and harvesting. Similarly, no more than ten units of each complement type may be owned. Each machinery complement type is defined as being composed of the power unit and the auxiliary equipment required to perform the designated field operation in the State/Region being simulated. A description of the several sizes of each complement type available for purchase and use during the duration of the simulation horizon is contained in the Inputs complement being used. It is suggested that administrators and/or users reference this description while designating the required parameters regarding their own machinery assets.

It is necessary to designate the number of units of each complement currently owned as well as several parameters describing each owned unit. The parameters requiring specification for each unit include: (1) current book value, (2) current market value, (3) age of unit, (4) acre per hour capacity of unit when new, (5) horsepower per hour rating of unit and (6) size rating. The current book value of a unit is its initial purchase price less depreciation claimed to date. The current market value reflects the realizable proceeds if the unit were to be sold and/or traded in on another asset. The age of the unit simply reflects the number of years the unit has already been owned by a user. The acre per hour capacity rating of a unit indicates the number of acres that can be processed during an hour of use when the unit is

new. IFLMAPS endogenously adjusts this capacity according to the age of the unit by using the reliability coefficients specified in the Inputs complement data set. The horsepower per hour rating of a unit indicates the drawbar (for land preparation and planting complement units) or engine (for harvesting complement units) horsepower of the power unit associated with the complement unit. This information is used in calculating the fuel requirements during the unit's operation. The size rating of a unit indicates the comparable sized new unit available in the Inputs complement data set for purchase during the simulation horizon. This identification facilitates calculation of the unit's salvage value during each simulation year.

For drying/storage facilities, administrators and/or users are requested to specify (1) the total bushel capacity of these facilities, (2) their current aggregated book value and (3) their average age (years). It is implicitly assumed that drying capacity is sufficient for the indicated storage capacity. The book value figure should take into consideration the value of the primary components such as bins and dryers as well as that of peripheral equipment such as augers, cleaners, spreaders, etc. The age of such facilities is used in calculating the appropriate associated depreciation allowance during each simulation year. IFLMAPS assumes a usable life of twenty years for drying/storage facilities. The straightline depreciation method and a zero salvage value is used in making the calculations.

Fixed assets

Three separate assets classified as fixed in IFLMAPS are: 1) owned cropland, 2) farmstead buildings and improvements and 3) personal residence. The required input regarding these assets is limited to

their individual current market values. It is also necessary to indicate the number of cropland acres owned in conjunction with the designation of the status of owned and rented cropland. A value for personal residence should be entered only if the intentions are to allow its consideration while computing the debt/equity ratio for the purposes of ascertaining external credit availability and interest rates.

Current liabilities

Current liabilities in IFLMAPS include federal and state income tax due for the previous year as well as loan repayment obligations due during each of the next twelve months for loans of one year duration or less. It is necessary to denote only the liability amounts associated with the two classes of income taxes (aggregate of all partners assumed to be involved in simulated farm operation). However, the data requirements regarding current loan obligations are somewhat greater. The specific variables requiring designation include the outstanding loan principal balance due during each of the next twelve months as well as any interest accrued to date and the annual interest rate associated with each loan.

Intermediate liabilities

IFLMAPS explicitly defines intermediate liabilities as loans of seven years duration with an equal principal payment due each year as well as payment of interest on the entire outstanding principal balance during the previous year. Loans classified as intermediate liabilities are assumed to be applicable to the purchase of machinery and on-farm grain drying/storage facilities in either June or December of each year. The data needs regarding intermediate liability loans currently in

existence for the farm operation to be simulated are identical to those mentioned above for current liability loans, i.e., total principal amount, accrued interest to date and applicable annual interest rates. It is necessary to provide this information for both a set of loans maturing in June and another set maturing in December.

Fixed liabilities

The only fixed liability considered in IFLMAPS is an existing mortgage on owned land and/or farmstead buildings and improvements. It is necessary to designate (1) the total outstanding mortgage principal balance, (2) the numerical code of the month during which an annual mortgage payment is due, (3) the applicable annual interest rate and (4) the annual amortized land mortgage payment (total of both principal and interest).

Physical characteristics

Several features of the acreage currently controlled require specification in the Initial Firm Structure complement. As indicated on an individual basis in the following discussions, some of these features maintain their initially specified values throughout the course of the simulation horizon while others are endogenously altered as a result of the interaction of a user's decisions and the simulated decision-making environment.

Land tenure contracts

Three possible land tenure arrangements exist in IFLMAPS--owned, cash-rented and share-rented. In the case of owned land, a user is the sole party involved in sharing the associated income and expenses, thereby eliminating the need to specify any input values concerning this

land tenure arrangement. However, in the other two instances, the user must in some manner distribute the income and possibly the expenses among themselves and the owners of such property. The relative tenure arrangements are required to be spelled out in the Initial Firm Structure complement. Such terms are assumed to be applicable throughout the course of the simulation horizon to all land rented in the respective modes. An exception exists when inflation effects are incorporated into IFLMAPS by administrators. In such a case, the initial cash rental rate is modified by the appropriate compounded inflation rates specified in the applicable Inputs complement.

For cash rented land, it is necessary to specify only the current per acre cash rent. The user is assessed this amount for each acre cash rented in the spring prior to the commencement of planting during the administrator scheduled RENT function. As noted above, both land initially cash rented and any additional land cash rented during the simulation horizon are subject to the same cash rental terms.

The input requirements associated with share-rented land are somewhat more extensive. IFLMAPS allows for substantial flexibility in the manner in which income and expenses are distributed among the tenant and owner of such land. The relative input value must be specified in terms of the proportion of the item borne by the landowner--acceptable values range from 0.00 to 1.00. On the income side, it is necessary to indicate on an individual basis, the landowner's share of (1) government diversion payments, (2) wheat yield, (3) corn yield and (4) soybean yield.

In the case of expenses, input values relate to a landowner's part of four classes of expenses--(1) land preparation cash operating

expenses, (2) planting cash operating expenses, (3) harvesting cash operating expenses and (4) variable inputs (seed, fertilizer, herbicides and insecticides). The specified values are assumed to be applicable to all three crops. Cash operating expenses for the three simulated field operations are defined to include fuel, lubrication and repairs and are incurred as such operations are simulated. Similar to cash rented land, land initially share rented as well as any additional land share rented throughout the course of the simulation horizon is assumed to be subject to the same rental terms.

Yield potential

To recognize differing yield levels on dissimilar land tracts, IFLMAPS allows for the individual specification of the yield potential of each crop on all three land tenure classes. Yield potential is defined to be the highest yield one would normally expect when planting and harvesting field operations occur on a timely basis. IFLMAPS endogenously considers the effect of untimely field operations and weather conditions in ascertaining the realized yields during each simulation year.

Priority of land tenure classes

Another decision-making opportunity incorporated into IFLMAPS concerns the order of priority for field operations to be accorded acreage controlled in each of the three land tenure classes. Users are allowed to indicate this priority ranking at the beginning of each simulation year. Such an opportunity is allowed rather than the priority schedule being endogenized into IFLMAPS due to the possibility of inconsistent relative yield potentials among land tenure classes across several users

and/or geographical locations. If such a priority scheduling was embodied in IFLMAPS, users would conceivably be susceptible to suffering undue yield penalties as a result of untimely field operations on their choice land tenure class acreage. It is necessary to include an initial priority schedule of the three land tenure classes as part of the Initial Firm Structure complement input.

Acreage status

Similar to the state variables associated with other simulation models it is essential that those several variables representing land acreage status in IFLMAPS be initialized prior to the commencement of the simulation horizon. Only three of the acreage status variables must be exogenously specified. Other initial state variables will be endogenously assigned appropriate values. The three states requiring identification with respect to each land tenure class are the number of acres planted to wheat, the number of acres fall plowed (prepared to be planted to either corn or soybeans) and the number of acres remaining to be plowed in the spring prior to the planting of either corn and/or soybeans. As noted in the workspace incorporated into the Initial Firm Structure complement input form, the sum of the acres assigned these three states should represent the total number of acres of each land tenure class currently controlled by the farm operation to be simulated.

All acreage initialized as being planted to wheat is assumed to be planted in the first possible wheat planting period. As a user progresses through his simulation horizon, state variables representing acreage status are altered from their initial values as a result of users' decisions and the impact of these decisions realized in the simulated decision-making environment of IFLMAPS.

State/Region¹⁰⁶

Full benefit of IFLMAPS in extension, teaching and research applications is contingent upon users readily identifying with the decision-making environment simulated in the model. Disparities in field operations, yield relationships, seasonality of commodity prices and availability of marketing alternatives exist throughout the United States. Administrators are able to incorporate these dissimilarities into IFLMAPS by specifying a State/Region complement data set for each geographical area to be simulated, thereby providing an appropriate decision-making problem for all users regardless of their location. Administrators may also simultaneously schedule several required operations of IFLMAPS as well as include or exclude several optional features.

Data requirements associated with the specification of a new State/Region complement data set are segregated into four sections: (1) general information, (2) field operations and yields, (3) scheduling of events and (4) price information.

General information

The "general information" requirements associated with the State/Region complement data set are twofold: geographical location identification codes and an indication of the applicable state tax rates.

¹⁰⁶Exhibit C.2 in Appendix C indicates the applicable input form for this complement data set.

Geographical identification codes

Each State/Region complement data set prepared by administrators must be identified by both a state and a region code reflecting the geographical area in which it is applicable. Exhibit 5.1 indicates the respective state codes to be used. These codes are those identified for extension management information (EMIS) and systems such as TELPLAN.

Administrators of IFLMAPS determine the regional codes. It is not necessary to coordinate these codes with other regional codes used in TELPLAN, AGNET, CMN, etc. Regional codes may range from 0 to 99 within each state. Administrators determine the codes when considering the geographical area within the state that the data set will be used in as well as any peculiar attributes associated with the data set relative to other data sets prepared for the same region. Administrators may desire to identify up to ten geographical regions within each state corresponding to the region codes of 0-9, 10-19, 20-29, etc., thereby allowing up to 10 complement data sets for each region, i.e., possible complement data sets in the second region would include 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19 under such a scheme. Yield relationships on heterogeneous soil types and discriminative desired scheduling of field operations are among the attributes administrators may be inclined to differentiate while preparing data sets for a specific region within a state.

State income taxation

Three possibilities regarding state income taxation are allowed for in IFLMAPS: (1) a code of 1 results in the Michigan state income tax law being applied, (2) a code of 2 results in state income tax being assessed at $x\%$ of the calculated annual federal income tax with x to be specified by administrators and (3) a code of 3 results in no state

Exhibit 5.1. State Codes Appropriate for Geographical Identification of IFLMAPS' State/Region Complement Data Set.

<u>STATE</u>	<u>CODE</u>	<u>STATE</u>	<u>CODE</u>
Alabama	01	Missouri	24
Alaska	50	Montana	25
American Samoa	52	Nebraska	26
Arizona	02	Nevada	27
Arkansas	03	New Hampshire	28
California	04	New Jersey	29
Colorado	05	New Mexico	30
Connecticut	06	New York	31
Delaware	07	North Carolina	32
District of Columbia	08	North Dakota	33
Florida	09	Ohio	34
Georgia	10	Oklahoma	35
Guam	53	Oregon	36
Hawaii	51	Pennsylvania	37
Idaho	11	Puerto Rico	54
Illinois	12	Rhode Island	38
Indiana	13	South Carolina	39
Iowa	14	South Dakota	40
Kansas	15	Tennessee	41
Kentucky	16	Texas	42
Louisiana	17	Utah	43
Maine	18	Vermont	44
Maryland	19	Virgin Islands	55
Massachusetts	20	Virginia	45
Michigan	21	Washington	46
Minnesota	22	West Virginia	47
Mississippi	23	Wisconsin	48
		Wyoming	49
		WES	56

SOURCE: Extension Management Information System State Codes, mimeograph located in TELPLAN files of Stephen B. Harsh, Department of Agricultural Economics, Michigan State University, 1981.

income tax being assessed. Whenever the applicable codes are 1 or 3, administrators should designate the applicable percent of federal income tax as 00.

Field operations and yield relationships

Administrators are able to identify, in the State/Region complement data set, the allowed planting and harvested periods for wheat, corn and soybeans, respectively, along with associated harvest yield and moisture (corn only) relationships. It is also possible to designate the time periods during which various field operations are assumed to occur.

Planting/harvesting periods and corresponding yield relationships

IFLMAPS is capable of simulating up to five separate time periods for both the planting and the harvesting of an individual crop. Yields for the various possible combinations of such planting/harvesting periods are determined as illustrated in Exhibit 4.1 of Chapter 4.

Administrators are required to specify the number of planting and harvesting periods allowed for each of the three crops considered in IFLMAPS. In addition, the corresponding calendar dates for each of these periods must be designated in numeric form.¹⁰⁷ Inasmuch as yields are assumed to be a function of planting and harvesting dates in IFLMAPS, administrators must also identify the timeliness adjustment factors for the various combinations of such periods, i.e., A_{jk} 's in Exhibit 4.1. IFLMAPS is programmed to plant and harvest crops as quickly as resources permit, i.e., as much as possible of a crop is

¹⁰⁷For example, the numeric representation of a period extending from March 3 to March 10 is 03/03-03/10.

planted in the first planting time period, given the available labor and machinery resources. Acknowledgement of this programming feature should encourage the designation of the earlier planting/harvesting period combinations as being close to the optimal. It would be permissible to define the optimal planting and/or harvesting period as the second or third period, respectively, provided the reduced yield effect(s) during the earlier such periods assigned for such operations are not substantial.

It is also necessary, for corn only, to specify the moisture content corresponding to the various planting/harvest period combinations. IFLMAPS uses this information to endogenously calculate the expense incurred in drying the grain to 15.5% moisture. The yield relationships required to be designated as discussed above are assumed to be based on "dry" corn (15.5% moisture), not "wet" corn. IFLMAPS assumes that there are no drying requirements associated with either wheat or soybeans.

Field operation time periods

Administrators are allowed to specify up to 47 distinct calendar time periods within a single simulation year for the performance of field operations.

The identification of several parameters is required with respect to each included time period:

1. Identification number
2. Beginning and ending calendar dates
3. Set of field operations to be simulated
4. Average expected hours suitable for field operations
5. Planting and harvesting periods to be simulated for each of the three crops during the period (first, second, etc.) as well identification of the total number of planting and harvesting periods allowed for each crop over the entire year
6. Alphanumeric description of field operations being simulated

The respective identification numbers for each time period are noted on the associated input form. It is necessary that these numbers be entered by administrators along with the other required parameters. As noted above with respect to the identification of the planting/harvesting periods, the requisite dates information should be specified in numeric form. Administrators are advised to refer to Table 4.2 in Chapter 4 while designating the appropriate set of field operations to be performed during the time period.

It is recommended that administrators designate the time periods in chronological order. Information from this complement data set is used to solicit labor availability during each time period at the beginning of each simulation year from users. For sake of clarity, the first time period designated should relate to the first field operations ordinarily performed after January 1 in the geographical region being characterized. In northern states this may be as late as April while in some of the southern states administrators may desire to allow field operations during January. The duration of a single time period is largely a function of how long administrators desire to maintain the simulation of the

designated field operation set. A new time period should be designated when they wish to alter the type of field operations to be simulated.

Field operations are simulated in IFLMAPS by merging the labor and machinery hours available during each time period with the acre per hour capacities of machinery complement units owned and the states of each land tenure class' acreage. Provided resources are available, acreage will be converted from an unprepared to prepared state, prepared to planted state and/or planted to a harvested (unprepared) state depending upon the operations being simulated and the acreage remaining in each state. The hours suitable for field operations during each time period are a product of the "average" hours suitable (specified in the State/Region complement data set) and a random factor reflecting the effect of varying weather conditions (designated in the Field Time complement data set). "Average" field time should reflect the number of hours normally expected to be suitable for field operations during each time period, based on either an evaluation of a historical weather data series or subjective estimates on the part of IFLMAPS' administrators. "Hours realizable" refers to the amount of actual field time as permitted by ground conditions. Administrators are responsible for ascertaining the average number of suitable days within a time period¹⁰⁸ and incorporating an assumed length of workday and number of workdays per week in the process of deriving such "average" hours.

It is also necessary to denote the respective planting and/or harvesting period being simulated for each crop during each period. Such

¹⁰⁸Rosenberg and Black at Michigan State University are currently developing a FORTRAN software package capable of deriving such information, based on historical weather series data.

information allows for the identification of the planting/harvesting period combination during the simulation of harvesting. As a result, the timeliness effect of field operations may be accurately reflected in the determination of harvested yields.

The alphanumeric descriptors required for each simulation period are used in the solicitation of labor availability from users at the beginning of each simulation year. IFLMAPS endogenously generates a directory of the time periods and associated field operations to be simulated during each simulation year. The 48-character descriptors serve the function of identifying the field operations being simulated to allow users to allocate their available labor according to their perceptions of the importance of the tasks being simulated.

Scheduling of events

IFLMAPS' administrators are permitted to include or exclude several optional features of the model. Simultaneously, they are allowed to designate the timing of occurrence during each simulation year of these features as well as others. The scheduling of events is required on a monthly basis and is accomplished via usage of 4-digit codes. It is necessary to specify a schedule of events for one simulation year; the same sequence holds for all years of the simulation horizon. A brief explanation of each feature and the appropriate code(s) follows. They are addressed in the preferred order for scheduling during each month.¹⁰⁹

¹⁰⁹This order facilitates the sequential decision-making environment sought in the designing of IFLMAPS, as discussed in Chapter 3.

Inventory

Administrators may provide users with an opportunity during each simulation month to view a description of their current stored grain holdings, marketing obligations and intentions as well as a detailed disclosure of the states of each land tenure class' acreage. The availability of such information alleviates users from having to maintain a detailed record of their decisions and/or reinforces any notes that they might maintain during each simulation month.

It is recommended that this feature be included at least once a quarter. More frequent scheduling would be unharmed since the feature is an opportunity to retrieve the cited information rather than its automatic presentation, i.e., users indicate whether or not they desire to have the information presented. The appropriate code is 0200.

Anticipated cash flow

The interactive simulation environment of IFLMAPS precludes users from identifying with "their farms" as they ordinarily do in the real world. It is difficult to completely assemble and digest the entirety of the simulated events as they occur. One of several optional supplemental sets of information provided in an attempt to surmount this dilemma is the statement of cash inflow and outflow expected during the current simulation month. This feature assembles and divulges cash flow information relating to off-farm income, loan repayments, taxes and insurance payable, etc. The code for including this feature is 0300.

Input prices

The grounds for presenting several of the various input prices applicable during each respective simulation month are similar to the

reasoning associated with the presentation of anticipated cash flow. This feature is an opportunity for users to retrieve such input prices rather than their automatic presentation. Its inclusion as a scheduled event is recommended at least once a quarter. The appropriate code is 0400.

Enterprise budgets

IFLMAPS allows for the presentation of enterprise budgets for each crop by land tenure class. These enterprise budgets should assist in deciding upon the acreage of each crop to be planted. It is recommended that enterprise budgets be presented in the simulation month prior to the month during which users are required to announce their planting intentions (addressed subsequently). The codes for issuing such budgets are 0501, 0502, and 0503 for wheat, corn and soybeans, respectively.

Potential yields

To recognize that farmers in the real world are aware of how their crops are progressing and are able to use such information in their marketing decisions, IFLMAPS allows for the presentation of information pertaining to the potential yield by the planting/harvesting period combinations of each crop prior to the crop being harvested. It is suggested that this information be presented for each crop in the simulation month preceding the one in which harvest begins. The actual yields realized during harvesting are correlated with these "potential yields" according to the corresponding data specified in the applicable YIELDS complement data set. A report summarizing actual yield levels is automatically provided upon completion of the last harvesting period for

a crop. The codes for presenting potential yield information are 0601, 0602, and 0603 for wheat, corn and soybeans, respectively.

Land procurement

A user's initial land holding are specified in the Initial Firm Structure complement with respect to owned land, cash rented land and share rented land. Users are not allowed to alter their owned land acreage during the simulation period. However, they may be offered an opportunity at some time during each simulation year to rent any available acreage of each rental tenure class and/or terminate the lease on part or all of their current rented acreage. It is recommended that this opportunity be offered during the simulation months prior to the one in which planting intentions are required to be specified. This event is required to be scheduled at least once a year since it also accounts for the payment of any cash rent due on the part of the farm operation being simulated. The code which implements this option is 0700.

Government commodity program participation

IFLMAPS includes an imitation of the current U.S. Department of Agriculture government commodity programs. Administrators are required to designate the simulation month in which users are afforded the option to participate or not participate in such programs. It is suggested that this option be provided in the simulation month during with the specification of planting intentions for corn and soybeans is scheduled. It must be included at some point during the simulation year. The appropriate code for this feature is 0800.

Planting intentions

Users are allowed to indicate the desired number of acres by land tenure class to be planted to each crop. Such intentions will be fulfilled subject to the availability of field time, labor and machinery within the designated planting periods. Users are allowed an opportunity to revise their planting intentions at the conclusion of each planting period prior to the last allowed period for each crop. Any corn intentions not satisfied by the end of the last corn planting period are automatically converted to soybean intentions. Soybean planting intentions remaining after soybean planting periods have expired are converted to idle acres. Any wheat planting intentions left unfulfilled are simply ignored.

It is recommended that planting intentions for each crop be elicited during the month in which the first planting period for the crop is scheduled. The appropriate codes for this feature are 0901, 0902, and 0903 for wheat, corn and soybeans, respectively,

Execution of marketing strategies

It is strongly recommended that users be allowed an opportunity to utilize the several marketing alternatives included in IFLMAPS during each simulation month. This event should follow any of those discussed above which are included in a simulation month's scheduled activities while preceding any of the subsequent events. The code for designating inclusion of this event is 1000.

Field operations

The previous discussions of the different field operations simulated in IFLMAPS alluded to the fact that administrators are required to

schedule their occurrence during each simulation month. For those operations spanning more than one simulation month it is recommended that they be scheduled during the last simulation month included in the calendar time period. Administrators are cautioned to preserve the order of the operations as they occur throughout the year. The appropriate codes for the field operations are 11ii ... 11jj where ii ... jj refer to the respective time periods during which the operations are to be simulated, i.e., scheduling of time periods 1 through 47 would be coded as 1101, 1102, ... , 1147.

Reactivation of unplanted acreage

IFLMAPS includes two state categories for acreage of each tenure class remaining unplanted during a simulation year. The first state contains acreage unplanted due to participation in the government commodity program while the second state includes acreage remaining idle upon completion of the last soybean planting period. Administrators are required to specify the simulation month during which such acreage is reactivated, becoming available for planting of the subsequent simulation year's crops. It is recommended that acreage be reactivated in the late summer or early fall prior to the beginning of winter wheat planting. A code of 1201 reactivates government commodity program diverted acreage. A code of 1202 reactivates idle acreage. A code of 1203 reactivates both unplanted acreage states.

Output price information

The output price data requirements of the State/Region complement data sets are responsible for localizing these prices to a particular geographical location. The following discussion of price data is rather

brief due to the extended explanations offered in the marketing component of Chapter 4 regarding the derivation of output prices. Only those data needs previously not discussed are examined in detail.

Cash prices

IFLMAPS requires national average, Chicago and local monthly cash prices for each crop included in the simulation model. The first two sets of prices are endogenously derived in IFLMAPS using data from other complements. However, it is necessary for administrators to provide the respective average or expected local monthly bases for each commodity with respect to Chicago as part of the State/Region complement data set. It is also necessary to indicate any within state adjustment factors needed to localize the bases in the case that they are for a primary region of the state being simulated.¹¹⁰

Futures market prices

Administrators are required to indicate in numerical form, as part of the State/Region complement, the maturity months of each crop's harvest and post-harvest future market and forward cash contracts. In order to allow for the endogenous calculation of the monthly futures market contracts' prices it is necessary to provide data indicating the

¹¹⁰The MTS operating system at the University of Michigan facilitates the copying of one section of a file to another section. By using this feature coupled with the ability to directly access and edit files it is relatively easy to create a new State/Region complement data set for a different geographical location of a state without having to reenter all of the data. This is advised only when the other data requirements associated with the State/Region complement data set are applicable in more than one geographical location of the state. This feature also facilitates the use of a general set of bases for a central area of a state, allowing for their uniform modification according to the particular region of the respective state to which the particular State/Region complement data set applies.

normal bases (Chicago B.O.T. price less local cash price) for each commodity's futures market contracts during a fifteen month horizon. It is assumed that month 1 is the first month during which a contract is available and month 15 is the contract's maturity month. In the case that it is not desirable to offer a contract in any of the fifteen months, a basis of 99.99 should be entered.

Forward cash contracts

There are no data requirements regarding forward cash contracts associated with the State/Region complement data set. As explained in the marketing component of Chapter 4, the calculation of forward cash contract prices is driven off of the futures market contract prices and their maturity month's bases as well as assumed brokerage and "protection" fees.

Government commodity program prices

The only State/Region complement data requirement associated with the government commodity program prices are local adjustments to the national loan level. Administrators are able to adjust the loan price in a manner similar to that occurring in the real world by specifying the price differential normally observed between local loan prices and national loan prices for each commodity.

Output Prices¹¹¹

IFLMAPS' focus on farm level marketing decisions requires substantial modelling detail with respect to the derivation of monthly output

¹¹¹Exhibit C.3 in Appendix C indicates the applicable input for this complement data set.

prices.¹¹² Administrators, through use of the Output Prices complement data set, are allowed to specify many of the characteristics of the market place environment which will confront users during their simulation horizon, i.e., they are able to determine, to a great extent, the direction and magnitude of the monthly price changes for each of the three crops in IFLMAPS on an individual basis. This approach allows for considerably more control on the part of IFLMAPS' administrators than would be possible if such prices were endogenously generated in a stochastic fashion, i.e., a quasi-"black box" approach. Such control enables administrators to develop market outlook information corresponding to the marketplace environment of IFLMAPS in a manner analogous to that used by forecasters concerned with the real world.

The specific data requirements of this complement data set fall within four categories:

1. Base prices
2. Monthly quasi-random price movements
3. Price movements in futures and forward cash contract markets
4. Identification of corresponding market outlook information

Base prices

Administrators are allowed to specify the initial annual national average cash price received by farmers for each of the three crops considered in IFLMAPS. This price is, in turn, seasonally adjusted and modified to derive the monthly price levels for the various allowed

¹¹²Little detail is provided in this section on how the Output Price complement data set is used in this derivation process. Refer to the marketing component of Chapter 4 for a discussion of the calculation procedures.

marketing alternatives. The permitted designation of these prices on an individual basis allows for some flexibility in establishing an output price scenario in which the initial year's prices are compatible with current real world conditions. This should be beneficial in terms of providing a realistic form of reference for the user of IFLMAPS.

Caution is urged in arriving at these initial price levels as well as in deriving the remaining data requirements associated with this complement data set. The calculation procedure used in IFLMAPS to derive the respective marketing alternatives' monthly prices assumes independence among crops. It is the responsibility of administrators to exogenously develop the requisite data in a manner that assures the simulation of realistic price relationships among the three crops' various marketing alternatives. The subsequential quasi-random monthly price movements that will occur over a simulation horizon must be considered when setting the initial base prices less an unlikely marketing scenarios of wheat prices below corn prices and/or corn prices greater than soybean prices might result.

Monthly quasi-random price movements

The random monthly price adjustments required in this data set are intended to represent market fluctuations due to non-equilibrium fundamental market conditions. They are termed "quasi-" since the absolute levels are exogenously specified by administrators rather than being endogenously generated within IFLMAPS in a stochastic fashion. It is this data which ultimately is responsible for representation of a dynamic marketing environment in IFLMAPS. The methodology used in

developing the data should be complementary to the development of corresponding market outlook information.¹¹³

In specifying the requisite quasi-random price movements for each month of a ten year simulation horizon, administrators should be conscious of the application intended for the given Output Price complement. In most instances, especially in those cases involving users first exposure to IFLMAPS, it is suggested that no random price movements be specified during the first one to three years of the simulation horizon, i.e., designate the corresponding requisite values at zero levels. This approach should augment the ability of users to familiarize themselves with the simulation environment of IFLMAPS prior to being presented with relatively more complex decision-making problems in the marketing area. With this initial simplification, users need only concern themselves with the normal seasonal price patterns that might be expected in a particular geographical location under general equilibrium economic conditions.

Price movements in the futures market
and forward cash contract market

Direction of price changes

The futuristic nature of futures market contracts and forward cash contracts along with the interaction of biological processes and sundry risk factors necessitates some distinction in the market behavior of current cash prices vis-a-vis the more distant marketing alternatives. The technique used to provide this distinction should allow for non-mutual price movements in the temporal-distinct markets.

¹¹³The illustrative Output Price complement data set developed in Chapter 6 demonstrates how this can be accomplished in the case of PMI.

The procedure discussed in Chapter 4 accomplishes this feat. It is necessary for administrators to specify the direction of anticipated market movement during the three calendar quarters following each current simulation quarter to facilitate this calculation technique. IFLMAPS implicitly assumes three possible classifications can be accorded to current perceptions regarding futuristic fundamental market conditions: bullish, bearish and possumish. The first two categories are accepted in the commodity trade as being indicative of rising and falling prices, respectively. However, the third category--possumish--represents the introduction of a new term into the marketing jargon. Similar to the interpretation accorded the other two qualifiers, the meaning of "possumish" follows from the characteristics of the animal with which it is associated, i.e., the opossum or possum (Guralnik, p. 466). A "possumish" market is defined as one in which conditions are tending to be in somewhat general equilibrium with the greatest likelihood of only normal seasonal price movements with much less probability of relatively large market movements in either a positive or negative direction. The codes indicative of bullish, bearish and possumish forecasts are 1, -1, and 0, respectively.

This methodology assumes administrators will provide users with some form of market outlook information describing the current simulation quarter as well as the next three quarters. The data specified concerning the anticipated direction of market movement should correspond to such forecasts. The basic underlying assumption is that current quasi-random price movements occurring with respect to the price levels of the futuristic marketing alternatives allowed for in IFLMAPS (futures market and forward cash contracts) will be in the direction of

the fundamental market conditions anticipated during the simulation quarter during which such temporal market alternatives mature, i.e., the simulation quarter during which futures market contracts are removed from the C.B.O.T. and forward cash contracts are deliverable. This assumption simply allows for the integration of the effect of current perceptions on future fundamental market conditions into the determination of price levels for marketing alternatives existing with respect to those temporal periods. This procedure is intended to be analogous to that occurring in the real world.

Administrators' biases

Commensurate with the desire to enable administrators a great deal of flexibility and control in establishing the relationships among the various marketing alternatives allowed for in IFLMAPS, it is possible to introduce bias factors applying to futures market contract or forward cash contract monthly price levels. Such bias factors are assumed to be effective only during the simulation month for which they are designated. To allow for either an extended favorable or disadvantageous marketing situation for a particular contracting alternative, it is necessary to individually specify the pertinent information for each of the respective simulation months during which such conditions are desired. The requisite information includes the identification of the crop, contract type, the simulation month and year during which the bias should be introduced and the magnitude of the bias factor. It is assumed that any such biases introduced during a particular simulation month apply to all of the contracts available during that month with respect to the designated contract type, i.e., futures market or forward cash contract.

Market outlook information

The desirability of preparing market outlook information corresponding to the marketing environment associated with a simulation horizon has previously been acknowledged. The file structure of the on-line storage file has been allocated to handle up to nine sets of quarterly outlook statements, each corresponding to a distinct Output Price complement data set. This allocation allows for at least two forms of information within each set.¹¹⁴

Market outlook statements are not considered to be an explicit part of any Output Price complement data set. The possibility of such information sets being provided exogenously to IFLMAPS' users led to including them as a separate data set. Administrators are required to enter such information directly on DTABANK in a manner specified in the documentation of IFLMAPS' software. The requisite data in the Output Price complement data set is the specification of the appropriate information set.¹¹⁵ In the case that such outlook market statements are to be supplied exogenously to IFLMAPS' users by administrators, the relevant code is 0.

¹¹⁴The methodology developed in association with the second objective of this research study requires for the delivery of either TMI or PMI to farmers participating in such a research application of IFLMAPS. The modelling structure of IFLMAPS is currently arranged to facilitate this need, through use of the direct file access feature available in the MTS operating system at the University of Michigan computer facilities. If necessary, it would easily be possible to extend the number of different forms possible to up to nine per set, with only slight modifications to IFLMAPS. If desirable, other types and/or forms of information than the previously defined TMI and PMI can be stored in the two available file slots.

¹¹⁵Values will range from 1 to 9, accordingly.

Inputs¹¹⁶

The data requirements associated with an Inputs complement data set are responsible for characterizing, for the most part,¹¹⁷ the general economic conditions of IFLMAPS' simulation environment. The requisite data falls within four general categories:

1. Variable costs parameters
2. Capital investment possibilities
3. Inflation factors
4. Other technical parameters

Specification of the sundry data requirements are generally allowed in either of two manners: (1) on a monthly, semi-annual or annual basis for each of the ten simulation years or (2) initial values for simulation time zero (0) accompanied, in some cases, by cumulative or compounded inflation factors corresponding to the respective simulation months/years. This type of data specification allows for considerable flexibility in establishing the environmental conditions to be in effect over a simulation horizon. The possibility of dynamic conditions is well beyond what is capable with the normal approach of specifying an initial value and a general annual inflation rate to be compounded over the entire simulation horizon. An alternative approach to modelling such dynamic conditions would be to endogenously generate them in a stochastic fashion. This technique is rejected for reasons similar to those responsible for the storing of quasi-random monthly price

¹¹⁶Exhibit C.4 in Appendix C indicates the applicable input form for this complement data set.

¹¹⁷The Output Price complement data set designates the majority of the data requirements associated with the determination of commodity price levels throughout a simulation horizon.

movements in the Output Price complement data set. The latter approach is perceived as both more manageable on the part of administrators and less expensive.

Variable costs parameters

Labor

Costs are required for each of the ten simulation years for both an annual man-year of full-time labor and an hour of part-time labor. When no inflationary effects are desired, the respective rates should be the same for each of the ten simulation years.

Variable inputs

Initial costs are required, on a per acre composite basis, for the requisite seed, fertilizer, herbicides, insecticides and any miscellaneous items deemed necessary for the growth of each of the three crops in IFLMAPS. Factors applied to these initial cost levels to arrive at the respective simulation years' costs are discussed subsequently in the inflation factors section.

Grain handling costs

Three types of grain handling costs specified in the Inputs complement data set: hauling, drying and storage. In each case, the applicable rates must be specified for each of the ten years in a simulation horizon. Commercial hauling costs must be designated on a per bushel basis for three possible transportation routes: (1) from field to on-farm drying/storage facilities, (2) from field to off-farm drying/storage facilities as well as local sales location and (3) from on-farm storage facilities to off-farm local sales location. Drying costs should be indicated on a per bushel per point of moisture removed

at both on- and off-farm drying facilities. Monthly storage costs must be noted on a per bushel basis for both on- and off-farm storage facilities.

Fuel

An initial per gallon cost must be designated for diesel fuel. This cost in conjunction with the variable inputs' inflation factors allows for representation of the per gallon fuel costs for machinery operation during each simulation year.

Miscellaneous

Initial costs per \$1000 of value are required for annual property taxes, insurance and miscellaneous repairs. Any desired inflationary effects are incorporated into the value of assets subject to these costs during the respective simulation years. Property taxes are assessed on the basis of 50% of current market value, insurance on 75% of current market value and miscellaneous repairs on the current market value of improvement property alone.

Futures market transaction costs

The brokerage fees associated with executing a round term 1000 bushel contract in the futures market are required for wheat, corn and soybean contracts, respectively. Also required are the minimal margin requirements for each 1000 bushel contract executed with respect to each of the three commodities. These cost factors are assumed to be constant throughout the ten year simulation horizon.

Interest rates

Interest rates must be specified individually for both short term and intermediate loans during each month of the ten simulation years possible. Even though intermediate loans are currently allowed only in January, June and December in IFLMAPS, such extensive data specification is required in the case of both types of loan in planned anticipation of expanding the capital investment opportunities in IFLMAPS to more than in just these three months.

Capital investment possibilities

Several parameters must be identified for the two types of capital investments allowed for in IFLMAPS: machinery and drying/storage facilities.

Machinery

Administrators are allowed to identify up to ten different units of machinery available for purchase with respect to each of the three types of field operations considered in IFLMAPS, i.e., land preparation, planting and harvesting. The equipment included in such machinery units must be sufficient for completing the field task(s) assumed to comprise the respective field operations in the geographical location being modelled. As a result, it may be necessary for administrators to recommend the use of Inputs complement data sets in only those State/Region geographical locations for which they have been designed.

The data requirements associated with the specification of each unit of machinery available for purchase include: (1) horsepower size of power source, (2) acre per hour capacity when new and (3) initial purchase price. The design of these machinery units should necessarily

include a power source for each unit so as to allow for the simultaneous simulation of field operations within a single time period, i.e., it is assumed that a tractor cannot plow and plant simultaneously. In order to calculate the fuel usage of such units, the size of the power unit must be noted--drawbar horsepower in the case of tractors and engine horsepower in the case of combines. While designing these units, administrators should be conscious of the field task(s) assumed to be included in the respective field operations so as to include all the necessary implements along with the power sources, i.e., it may be necessary to include both a moldboard plow and a disk harrow in each land preparation unit or a planter, drill and light disk harrow in each planting unit. Also, fractional amounts of miscellaneous capital items such as pickups, welders, wrenches, chains and jacks should be accounted for in arriving at the initial purchase prices corresponding to each unit. The identification of acre per hour capacity of such units must occur on a composite basis, accounting for multiple tasks within a single field operation, i.e., each acre per hour of capacity represents the performance of all such tasks on an acre. IFLMAPS requires that losses due to field efficiencies of less than 100% be exogenously considered while arriving at these capacities.

Three general sets of data which apply to all units designed for each type of field operation must also be identified: (1) salvage value factors, (2) reliability factors and (3) efficiency factors. The salvage value factors are required on a "by age of unit" basis for ages 1 to 10+. They represent the proportion of initial purchase price a unit is to be valued at, in the absence of inflation, after having been owned for the respective number of years. Similarly, the reliability factors

are meant to reflect the proportion of new capacity remaining as the machinery units age.¹¹⁸ Because the respective machinery units must be used in performing the respective field operations on acreage relating to each of the three crops, IFLMAPS allows for some modification in capacity according to which of the three crops is currently on the acreage. Specification of these factors allows for increasing or decreasing the performance of the respective units above their designated capacities according to the crop of concern. The illustrative Inputs complement data set presented in Chapter 6 provides a more enlightening discussion of the feature.

Drying/storage facilities

Concerning the availability of on-farm drying and storage facilities, administrators are allowed to designate six different sizes of such facilities. All such facilities are assumed to be self-contained, i.e., they include all of the necessary peripheral equipment required to perform both the drying and storage functions without any other such facilities being present. This assumption facilitates the purchase of such lumpy assets in discrete units of the users' choice.

Inflation factors

As noted in Exhibit 4.8 of Chapter 4, it is generally not advisable to include inflationary effects in the decision-making environment of IFLMAPS. However, the modelling format of IFLMAPS allows for their

¹¹⁸It is generally acknowledged that the reliability of machinery degenerates with age, i.e., it is more susceptible to breakdown and resulting downtime. IFLMAPS captures this aspect of machinery performance by lowering the capacities of the respective owned machinery units according to their age.

incorporation when deemed necessary. The format allows for the specification of such factors on an individual basis for several of the different income and cost values included in IFLMAPS.

Unless otherwise noted, the specification of inflation factors must occur on a compounded cumulative basis, i.e., an annual inflation rate of 10% during the nine simulation years subsequent to the first year should be represented with the following factors: 1.00 for the first year, 1.10 for the second year, 1.21 for the third year, 1.33 for the fourth year, and so forth.

Variable inputs

IFLMAPS allows for the discrimination of variable input costs between planting time (in the spring for corn and soybeans and in the fall for wheat) and December purchases. Recall that purchases are allowed in December as a tax management strategy. Such discrimination occurs by entering different values for the respective required inflation factors for each simulation year. In the absence of any desired inflation effects, administrators might desire to specify a value of .95 for December purchases and 1.00 for planting time purchases. This approach assumes some discount is obtainable for early purchases.

Cash rent

Administrators are allowed to designate the inflationary effects that will be incorporated into the annual cash rent associated with land so rented.

Capital assets

Administrators are able to identify separately the annual inflation to be experienced in the machinery and on-farm drying/storage facilities

markets, respectively. These rates are also used in assessing the value of owned capital assets, thereby influencing the Owner's Equity and credit availability of an operation.

Output prices

Acknowledging that inflation on the cost side of the simulation market will result in somewhat of a lagged inflationary effect on output prices, IFLMAPS allows for the effects to be identified separately. Annual factors must be designated for both the initial base annual prices and the various bases used in the calculation of marketing alternative prices.

Value of fixed assets

The effect of inflation on fixed assets is also allowed to be designated on a separate basis. The factors are used to modify the initial values of owned land, improvements and residence.

Family living expenditures

The sole exception to the requirement of entering inflationary effects in a compounded cumulative format concerns the effects applicable to annual family living expenditures. Such factors should be designated in terms of the marginal inflation to be experienced from one year to the next, i.e., a 15% inflation rate would be entered as 0.15. This approach facilitates the procedure laid out in the financial component of Chapter 4 for determining family living expenses in each simulation year.

Other technical parameters**Machinery operating costs**

The procedure described in the production component of Chapter 4 for the determination of machinery operating costs requires an assumed level of annual usage (in hours) and expected lifetime (in hours) on a per unit basis for each of the respective machinery types. Administrators are allowed to specify these basic assumptions in the Inputs complement data set.

Availability of rental acreage

The procedure described in the production component of Chapter 4 with respect to the offering of additional land for rent during each simulation year requires two sets of ten random observations from a uniform distribution of 0-99. These observations are required as data in the Inputs complement data set.

Government Commodity Program Complement¹¹⁹

An approximation of the current government commodity program is included in IFLMAPS as a subsystem. Specific attributes of the subsystem include compliance and diversion requirements, diversion and storage payments, interest rates and loan and reserve release and call prices.¹²⁰

¹¹⁹Exhibit C.5 in Appendix C indicates the applicable input form for this complement data set.

¹²⁰Although there is no current effective soybean program in the real world, IFLMAPS includes the possibility of such a program as part of the Government Program subsystem. Administrators not desiring to include such a program should input 0's in the pertinent data lines.

Administrators are required to provide data regarding each of these attributes in the Government Commodity Program complement data set.

Compliance

The Government Program subsystem assumes cross-compliance across all crops is required if one chooses to participate in the program, i.e., a user must abide by the program guidelines for wheat, corn and soybeans if he chooses to participate in the program during a simulation year. However, administrators are allowed to determine whether or not cross-compliance across the three land classes included in IFLMAPS (owned, cash- and share-rented) is required during the respective simulation years. The requirement of cross-compliance implies that a user must satisfy the requirements of the program on all of his acreage should he choose to participate in the program. Non-compliance requirements, conversely, allow a user to decide whether or not to participate in the program on each land class on an individual basis, i.e., a user may choose to participate in the program on owned land and not on cash-rented or share-rented land. Administrators should code their intentions regarding such compliance by using a "1" to designate when cross-compliance is required and a "2" to infer if non-compliance is required.

Diversion requirements

Another facet of the Government Program subsystem requiring data input by administrators is diversion requirements. Such requirements are defined as the percentage of planted acres required as set-aside in those simulation years a user participates in the program. In the spring during the planting of corn and soybeans, the required acreage is set aside in an unplanted state as each additional acre is planted.

Since wheat acreage is already planted at the time of electing to participate in the program, users are allowed to choose whether to set aside the required acreage from unplanted acreage and/or plow up as much wheat as necessary. Different diversion requirements may be assigned to each crop during each simulation year. A level of .00 is permissible, i.e., diversion requirements may be set at 0 percent.

Diversion payments

As in the real world, a payment may or may not be associated with set-aside acreage. Administrators are allowed to specify the level of these payments on an individual crop basis for each year of the simulation horizon. Receipt of diversion payments for wheat occurs in the spring at the time program participation is elected and for corn and soybeans as requisite acreage is set aside during planting of these crops.

Storage payments

The current government reserve program includes an annual storage payment to farmers for each bushel of grain they have entered in the program. Payments are made in advance and are refundable only when farmers sell reserve grain when the national average price received by farmers is below the crops' "release" price. Farmers receive the full storage payments regardless of where they have the grain stored and irrespective of the magnitude of the costs associated with such storage. Administrators are required to specify the per bushel level of these payments for each simulation year. It is assumed that the same level of payment applies to all crops.

Interest rates

Administrators are also required to specify the annual government interest rate in effect during each simulation year. Interest is paid when a government loan is redeemed and/or interest is assessed on storage payments when reserve grain is sold subject to penalty.

Loan and reserve prices

As in the real world, the Government Program subsystem includes both a loan program and a reserve program for users fulfilling the program participation requirements. Users entering grain in the loan program receive a nine month loan in the amount specified by administrators for the crop during the particular simulation year. The reserve program includes the loan feature of the loan program plus both annual storage payments and restrictions on when such grain can be sold without incurring a substantial financial penalty. The magnitude of the loan to be received by users for each bushel of a crop entered in the loan and reserve programs is specified by administrators for each simulation year as part of the Government Commodity Program complement data set. IFLMAPS endogenously calculates the reserve "release" and "call" prices for each crop on the assumption that these prices are administrator specified percentages of the crop's loan price during each simulation year. The same percentages are assumed to apply to all simulation years.

Yields¹²¹

Two sets of yields are required in IFLMAPS during each simulation year: forecast and actual. Forecast yields are presented during one of the months prior to harvest as an aid to users in their marketing decisions concerning the respective crops. This is meant to represent farmers' "real world" observations of their crops prior to harvest. The hypothesis embodied in providing these forecasts is that producers use such information in their pre-harvest marketing decisions. Actual yields are representative of the yield levels realized during harvesting of the respective crops.

Both sets of yields are calculated as indicated in Exhibit 4.1 in Chapter 4. The RY_1 factors indicated therein are to be designated by administrators as the data comprising the Yields complement data set.

Two RY_1 's are required for each crop during each of the ten simulation years. These parameters are meant to reflect the effect of weather on yields. Their values should generally range somewhere between .50 and 1.25 with the relative probabilities over such a range assigned in whatever manner considered appropriate by the administrators. Some means of correlating the RY_1 's for use in determining a specific crop's forecast and harvested yields during each simulation year should be incorporated into the technique used by administrators in arriving at such values. This correlation should be fairly high (.7 to .9) and of a positive nature to represent the fact that actual yields usually correspond very closely to farmers' perceptions of such yields during the latter part of the growing season.

¹²¹Exhibit C.6 in Appendix C indicates the applicable input form for this complement data set.

Field Time¹²²

The impact of weather and other exogenous factors on the availability of field time for land preparation, planting and harvesting field operations is a source of uncertainty confronting farmers. Their perceptions of the time available during specific periods of the year influence their investments in machinery. Cash flow is thereby affected, resulting in a possible influence on output marketing strategies. This reasoning serves as the premise for introducing a range of variability into the amount of time available for the simulated field operations in IFLMAPS.

Administrators are allowed to specify up to a maximum of 47 time periods per simulation year for field operations in each geographical region to be simulated. The amount of time suitable for field operations during each of these periods is determined as illustrated in Exhibit 4.2 in Chapter 4. The RF_1 factors indicated therein are the data which comprise the Field Time complement data set. Administrators are required to specify ten sets of 47 such factors for use during each of the simulation years. Administrators should derive these factors in a manner conducive to reflecting the desired variability about the "average" expected hours contained in the State/Region complement data set for the respective time periods. A RF_1 value of 1.0 results in the "average" expected hours being realized while lower or higher values result in less than or more than the average number of hours.

¹²²Exhibit C.7 in Appendix C indicates the applicable input form for this complement data set.

Also, recognizing that the weather influences in one time period are somewhat correlated with those time periods preceeding and succeeding it, an attempt should be made to maintain some consistency in the factors for successive time periods, i.e., if the factor for the sixth time period indicates less than the average number of hours are available during a year, the RF_1 factors for the fifth and seventh time periods should have a higher probability of being below 1.0 than above 1.0.



RETURNING MATERIALS:
Place in book drop to
remove this checkout from
your record. FINES will
be charged if book is
returned after the date
stamped below.

--	--	--

ated

These

expla

poss

thes

ment

inpu

pure

real

poss

data

farm

data

6/11/07

CHAPTER 6

ILLUSTRATIVE COMPLEMENT DATA SETS

Introduction

This Chapter presents an illustration of the requisite data associated with each of the seven complement data sets discussed in Chapter 5. These illustrative complement data sets are intended to more fully explain the nature of the essential data as well as proffer examples of possible procedures to be used while developing some of the data. Also, these data sets are used in the validation stage of IFLMAPS' development. In each case, the illustrative data is noted on the corresponding input form contained in Appendix C.

Initial Firm Structure¹²³

The illustrative Initial Firm Structure complement data set is of a purely hypothetical nature. It is not knowingly representative of any real world farm operation. It characterizes a solvent farm operation possibly faced with near-term liquidity problems. The various assumed data exemplify the latitude available in specifying the parameters for a farm operation to be simulated.

¹²³Refer to Exhibit C.1 in Appendix C for an indication of how this data is entered on the appropriate input form.

Structure

Two

farm op

complete

assumed

most rec

\$3000.,

each is

assumes

involve

ture do

To

is ass

\$1500.,

through

spouses

operate

Ar

Althou

unreal

growth

assume

family

A

while

1

during

Structural organization

Two partners and their families are assumed to be involved in the farm operation described in this illustrative Initial Firm Structure complement data set. Each family has five tax exemptions and it is assumed that they both file married, joint returns. Each partner's four most recent years' taxable income are assumed to be (oldest first) \$3000., \$1500., \$0.0 and \$5000. Current investment credit carryover for each is assumed to be \$1000. It should be reiterated that IFLMAPS assumes these specified characteristics to be identical for all partners involved in a single simulated farm operation. The programming structure does not allow for dissimilar values.

Total off-farm income coming into the operation from all families is assumed to be (on a monthly basis) \$3000., \$3000., \$3000., \$1500., \$1500., \$0., \$0., \$0., \$1500., \$1500., \$1500. and \$3000. for January through December, respectively. This income possibly reflects the spouses teaching school except for the summer months along with the farm operators doing some off-farm work during the winter months.

An annual family living expense of \$24,000 per family is assumed. Although it may appear somewhat high, this amount is not a totally unrealistic value, depending upon the families' current position in the growth cycle.¹²⁴ Maximum per family annual living expenditures are assumed to be \$48,000 while minimal annual levels are set at \$12,000 per family.

Annual property tax payments are assumed to be due in November while insurance premiums are payable in March and September. The

¹²⁴ Refer to Barry and Brake for a discussion of farmers' behavior during different stages of the growth cycle.

maximum

partners

dollars

Financial

The

balance

25 acres

respecti

wheat, 1

farm fa

and 3000

The

is summ

made to

items no

the impr

assumed

were ere

\$10,500.

Fix

per acr

equipmen

tively a

Cur

of fede

Several

\$20,000

maximum debt/equity ratio allowed is 2.0. This indicates that the partners must invest at least one dollar of their own money for each two dollars of outside credit obtained during the simulation horizon.

Financial position

The farm operation is assumed to have an initial checking account balance of \$500. The current inventory of crop variable inputs includes 25 acres of wheat and 50 acres of corn valued at \$2000 and \$5000, respectively. Previous crops held in storage include 5000 bushel of wheat, 10,000 bushels of corn and 5000 bushels of soybeans in owned on-farm facilities as well as 1000 bushels of wheat, 5000 bushels of corn and 3000 bushels of soybeans in commercial off-farm facilities.

The machinery assumed to be currently owned by the farm operation is summarized in Table 6.1. Several simplifying assumptions have been made to describe the owned equipment in the prescribed manner. Those items not explicitly included in these complement units are valued under the improvements category of the fixed asset section. Also, it is assumed that 35,000 bushels of on-farm drying and storage facilities were erected seven years ago with their current book value being \$10,500.

Fixed assets include 1) 100 acres of owned cropland valued at \$1000 per acre, 2) sundry improvements, farmstead buildings and miscellaneous equipment valued at \$25,000 and 3) two personal residences conservatively assessed at \$90,000.

Current liabilities of the farm operation include \$10,000 and \$2500 of federal and state income taxes owed, in total, by the two partners. Several short-term notes are also due during the next twelve months--\$20,000 in January, \$15,000 in July and \$25,000 in November. The

TABLE 6.1

Description of Currently Owned Machinery; Illustrative Initial
Firm Structure Complement Data Set for IFLMAPS

Machinery Type	Current Book Value	Current Market Value	Unit's Age (Years)	Capacity When New (Acres/Hour)	Horse- power Rating	Size Rating*
Land preparation	\$ 0.	\$40000.	8	2.5	95.	4
Land preparation	30000.	50000.	2	3.0	125.	6
Planting	5000.	50000.	7	2.5	89.	3
Planting	25000.	60000.	4	3.1	115.	5
Harvesting	55000.	80000.	1	4.4	145.	2

*These ratings correspond to the machinery unit sizes described in the illustrative
Inputs complement data set presented subsequently in this Chapter.

applica

respect

since a

In

rate)

in Dece

of the

sixth y

ities.

Lo

acres

annual

of each

Physica

L.

requir

and 40

govern

bean y

T

tified

ferred

land f

T

acres--

rented

and 10

applicable annual interest rates on these loans are .10, .12 and .15, respectively. There is no accrued interest to date on any of the loans since all interest was paid on December 31 of the previous year.

Intermediate liabilities include a \$15,000 note (7% annual interest rate) maturing in June of the first year, a \$27,000 note (9%) maturing in December of the third year, a \$35,000 note (15%) maturing in December of the fifth year and a \$66,000 note (18%) maturing in December of the sixth year. No accrued interest is associated with any of these liabilities.

Long-term liabilities are limited to an \$85,000 mortgage on the 100 acres of owned land. The applicable annual interest rate is .085 and annual payments (principal and interest) of \$12,000 are due in November of each year.

Physical characteristics

Land may be cash rented at \$75 per acre. Share-rent contracts require the landlord to pay 50% of the harvesting cash operating costs and 40% of the crop variable input expense while sharing in 50% of government diversion payments and corn yields and 40% of wheat and soybean yields.

The yield potential of the respective land tenure classes is identified in Table 6.2. Following from these yield relationships, the preferred priority of field operations within a single time period is owned land first, then share-rented land and finally, cash-rented land.

The acreage currently controlled by the farm operation totals 800 acres—100 of owned land, 400 of cash-rented land and 300 of share-rented land. Acreage currently planted to wheat is 25 acres, 200 acres and 100 acres, respectively on the three land tenure classes. Fall

Pro

Wheat

Corn

Wheat

TABLE 6.2

Identification of Yield Potential by Land Tenure
Arrangement; Illustrative Initial Firm Structure
Complement Data Set for IFLMAPS

Crop	LAND TENURE ARRANGEMENT		
	Owned Land	Cash-Rented Land	Share-Rented Land
	bushels		
Wheat	50	43	45
Corn	120	90	110
Soybeans	48	40	42

plowing ha
cash-rente
rented to

The i
section i
tions with
Black, et

General in
Geographic

As in
for Michi
Michigan t
complement
the first
region "O"

State inco

The a
Geographic

125 Re
data is ex
126 Re
sets may b

plowing has been completed on 50 acres of owned land and 200 acres of cash-rented land leaving 25 acres of owned land and 200 acres of share-rented to be plowed in the spring prior to planting.

State/Region¹²⁵

The illustrative State/Region complement data set presented in this section is meant to be representative of southwest Michigan. Conversations with Harsh, Schwab and Ferris as well as reference to TELPLAN 18 (Black, et al.) were beneficial to the development of this data set.

General information

Geographical identification codes

As indicated in Exhibit 5.1 of Chapter 5, the relevant state code for Michigan is 21. Figure 6.1 illustrates an arbitrary division of Michigan into 10 regions. The region of interest with respect to this complement data set (southwest Michigan) is region "1." Since this is the first data set designed for this region it will be designated as region "01."¹²⁶

State income taxation

The appropriate code for state income taxation is "1" since the geographical area being simulated is located in Michigan.

¹²⁵ Refer to Exhibit C.2 in Appendix C for an indication of how this data is entered on the approximate input form.

¹²⁶ Refer to the discussion in Chapter 5 regarding how several data sets may be identified for the same region.

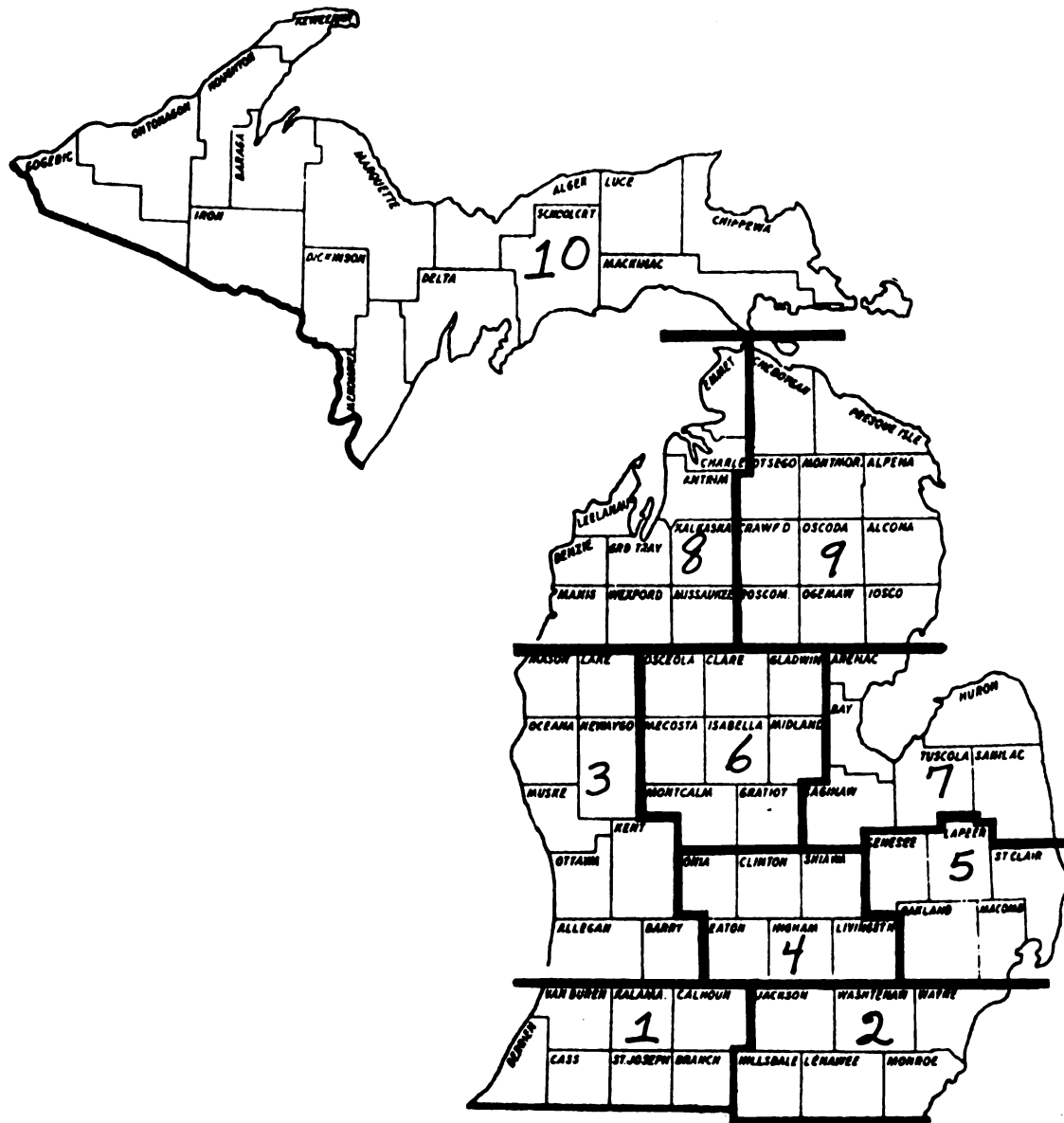


Fig. 6.1. Example of geographical regions within Michigan for IFLMAPS

Field

Plant:
corres

speci:

in Ex

TEPL

Conno

cases

time

crop

antic

manne

they

amoun

The a

orien

from

fifth

used

corre

IFLMA

dryin

defin

of A

level

the s

Field operations and yield relationships

Planting/harvesting periods and corresponding yield relationships

Table 6.3 indicates the respective planting/harvesting time periods specified for each crop along with the appropriate A_{jk} factors mentioned in Exhibit 4.1 of Chapter 4. The relationships in Table 6.3 evolve from TELPLAN 18 (corn and soybeans) and a research effort by Benjamin and Connor (wheat) (p. 43). The experimental data sources cited in all cases allowed for harvesting through only four time periods. The fifth time period was added to increase the probability of harvesting of each crop being completed within IFLMAPS' simulation environment. It is anticipated that users may be slow in acclimating themselves to the manner in which field operations are simulated in IFLMAPS. As a result, they may not adequately match their labor and machinery resources to the amount of acreage controlled within their simulated farm operations. The addition of the fifth harvesting period seeks to offset such user orientation problems without unduly penalizing yield levels resulting from such delayed field operations. The yield relationships during the fifth harvesting periods are arbitrarily set at 50 percent of the levels used in the fourth harvest period.

Also noted in Table 6.3 is the assumed moisture content of corn corresponding to each of the planting/harvesting periods. Recall that IFLMAPS uses this information to calculate the expense associated with drying corn to the No. 2 grade level moisture content of 15.5% as defined in a USDA bulletin on grain standards (United States Department of Agriculture). TELPLAN 18 is the source of these moisture content levels except for the fifth harvesting periods--they are assumed to be the same as those for the fourth harvest periods.

South

Planting
Dates

WHEAT

05/20-05/21
05/21-05/22
05/22-05/23
05/23-05/24

BARLEY

05/25-05/26
05/26-05/27
05/27-05/28
05/28-05/29

SWEDEN

05/29-05/30
05/30-05/31
05/31-06/01
06/01-06/02

*Source
Black, et
Agricultural
Bary L. B.
Systems of
Total Food
for wheat
in one-hal

*Model

TABLE 6.3

Southwestern Michigan Yield Relationships for Allowed
Planting/Harvesting Periods:* Illustrative
State/Region Complement Data Set
for IFLMAPS

Planting Dates	Harvesting Dates				
<u>WHEAT</u>	07/15-07/22	07/23-07/31	08/01-08/15	08/16-08/30	09/01-09/26
10/04-10/10	1.00	.96	.86	.56	.28
10/11-10/17	.96	.92	.83	.54	.27
10/18-11/07	.87	.84	.75	.49	.24
<u>CORN</u>	10/04-10/10	10/11-10/17	10/18-11/07	11/08-11/28	11/29-12/12
04/25-05/10	1.00 @ .28*	.99 @ .26	.98 @ .23	.88 @ .21	.44 @ .21
05/11-05/18	.92 @ .30	.91 @ .28	.90 @ .25	.80 @ .23	.40 @ .23
05/19-05/26	.84 @ .32	.83 @ .30	.82 @ .27	.71 @ .25	.35 @ .25
05/27-06/03	.76 @ .35	.75 @ .33	.74 @ .30	.62 @ .27	.31 @ .27
<u>SOYBEANS</u>	09/27-10/03	10/04-10/10	10/11-10/17	10/18-11/07	11/08-11/28
05/19-05/26	1.00	.95	.87	.68	.34
05/27-06/03	.96	.91	.84	.64	.32
06/04-06/11	.93	.87	.79	.61	.30
06/12-06/19	.82	.76	.69	.50	.25

*Sources of yield relationships for harvest periods 1-4 are J. Roy Black, et al., Crop Farm Planning Guide--TELPLAN 18, Department of Agricultural Economics, Michigan State University for corn and soybeans; Gary L. Benjamin and Larry J. Connor, Economics of Size of Machinery Systems on Southern Michigan Cash Grain Farms, Department of Agricultural Economics Staff Paper AER 112, Michigan State University, 1968, for wheat. The fifth harvest period yield factors are arbitrarily set at one-half the fourth period levels due to lack of experimental data.

*Moisture content at harvest.

Field operat

A total

operation en

correspondi

designation

during the

correspondi

represent a

within the

planting an

Table

number of

periods. R

bit 4.2 of

operations

year.

Table

lated for

also necess

periods ove

Scheduling

Table

respective

when a spec

These code

unique situ

ferent geog

Field operation time periods

A total of 19 time periods were modelled to reflect the field operation environment of southwestern Michigan. These periods and their corresponding calendar dates are noted in Table 6.4 along with the designation of the associated type of field operations to be performed during the period. Also presented are the alphanumeric descriptions corresponding to each of the respective time periods. The descriptors represent an attempt to indicate the type of field tasks being simulated within the time period as well as an identification of the current planting and/or harvesting period for each crop.

Table 6.5 describes a technique for ascertaining the "average" number of hours suitable for field operations during each of these time periods. Recall that this information is used as indicated in Exhibit 4.2 of Chapter 4 to determine the number of hours suitable for field operations during the respective time periods during each simulation year.

Table 6.6 identifies planting and harvesting periods being simulated for each crop in each current time period. As indicated, it is also necessary to designate the total allowed planting and harvesting periods over the entire year for each crop.

Scheduling of events

Table 6.7 designates the optional events scheduled during each respective simulation month. The appropriate codes are used to indicate when a specific event is scheduled during a particular simulation month. These codes can be changed by administrators of the model to reflect unique situations, i.e., different timing of field operations in different geographic locations, etc.

TABLE C.4
Time Periods and Associated Field Operations in Southwestern Michigan
Illustrative State/Region Complement Data Set for IPMAI

TABLE 6.4

Time Periods and Associated Field Operations in Southwestern Michigan;
Illustrative State/Region Complement Data Set for IFILMAPS

Time Period	Calendar Dates	Field Operation Codes	Descriptor
01	04/01-04/24	01	Land prep only
02	04/25-05/10	03	Land prep & plant corn(1)
03	05/11-05/18	03	Land prep & plant corn(2)
04	05/19-05/26	05	Land prep & plant corn(3) and soybeans(1)
05	05/27-06/03	05	Land prep & plant corn(4) and soybeans(2)
06	06/04-06/11	04	Land prep & plant soybeans(3)
07	06/12-06/19	04	Land prep & plant soybeans(4)
08	07/15-07/22	06	Land prep & harvest wheat(1)
09	07/23-07/31	06	Land prep & harvest wheat(2)
10	08/01-08/15	06	Land prep & harvest wheat(3)
11	08/16-08/30	06	Land prep & harvest wheat(4)
12	09/01-09/26	06	Land prep & harvest wheat(5)
13	09/27-10/03	08	Land prep & harvest soybeans(1)
14	10/04-10/10	12	Land prep, harv soys(2) and corn(1), plt wheat(1)
15	10/11-10/17	12	Land prep, harv soys(3) and corn(2), plt wheat(3)
16	10/18-11/07	12	Land prep, harv soys(4) and corn(3), plt wheat(3)
17	11/08-11/28	09	Land prep & harvest soys(5) and corn(4)
18	11/29-12/12	07	Land prep & harvest corn(5)
19	12/13-12/31	01	Land prep only

"Average"
Illustra

Period

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

for the
proper
exchange
period
any one
each of

the
day of

experience
for the
allowing
allowing
are not
readily
Harris &
data be
for sev

the
will not
to incre
likelhood

the
suitable
time per

TABLE 6.5

"Average" Suitable Field Time Available in Each Time Period;^a
 Illustrative State/Region Complement Data Set for IFLMAPS

Period	Calendar Dates	Work Days/ Total Days ^b	70% "Go" Days ^c	Work Hours/Day ^d	"Average" Hours ^e
01	04/01-04/24	20/24	1.98	9	15
02	04/25-05/10	13/15	4.65	10	40
03	05/11-05/18	7/8	3.04	11	29
04	05/19-05/26	7/8	6.00	12	63
05	05/27-06/03	7/8	5.04	12	53
06	06/04-06/11	7/8	6.00	12	63
07	06/12-06/19	7/8	5.04	12	53
08	07/15-07/22	7/8	4.00	12	42
09	07/23-07/31	8/9	6.03	12	64
10	08/01-08/15	13/15	10.05	12	105
11	08/16-08/30	13/15	7.95	12	83
12	09/01-09/26	22/26	13.00	15	165
13	09/27-10/03	6/7	3.01	12	31
14	10/04-10/10	6/7	3.99	12	41
15	10/11-10/17	6/7	3.99	12	41
16	10/18-11/07	18/21	10.92	11	65
17	11/08-11/28	18/21	5.04	15	65
18	11/29-12/12	11/13	.99	15	13
19	12/13-12/31	16/19	1.01	9	8

^aThe procedure used to determine the "average" number of hours suitable for field operations during each time period involves 1) determining the proportion of the period that work would occur if it was dry enough, i.e., exclude Sundays and some Saturdays, 2) determine number of days in time period field conditions are conducive to field operations, i.e., ground is dry enough to support machinery, 3) determine number of hours to be worked each day and 4) multiply results of 1, 2 and 3 together.

^bRoughly speaking, one out of every seven days has been set aside as a day off for all labor.

^c"70% 'Go' Days" refers to the minimal number of days that should be expected to be suitable for field operations 7 years out of 10. "Suitable for field operations" refers to ground conditions being dry enough to allow tillage. These numbers were developed by Rosenberg using a methodology first developed by Tulu and improved upon by Rosenberg and Black. They are representative of Shiawassee County in mid-Michigan due to the lack of readily available data regarding southwestern Michigan. Conversations with Harsh and Schwab indicate they should be sufficient for the purposes of this data set. Efforts are underway by Rosenberg and Black to develop such data for several points in Michigan.

^dThese numbers represent assumptions concerning the hours per day labor will work during each of the respective time periods. Such hours are assumed to increase during the last available harvest periods so as to increase the likelihood of all acreage being harvested in IFLMAPS simulation process.

^eThese hours, based on the assumptions noted above, are assumed to be suitable for field operations 7 years out of 10 during each of the respective time periods.

TABLE C-6
 Current and Maximum Allowed Planting and Harvesting Periods by Time Periods
 Iterative State/Region Complement Data Set for F18M13

TABLE 6.6

Current and Maximum Allowed Planting and Harvesting Periods by Time Periods;
 Illustrative State/Region Complement Data Set for IFMAPS

Time Period	Calendar Dates	Current Periods						Maximum Periods					
		Planting			Harvesting			Planting			Harvesting		
		Wheat		Soys	Wheat		Corn	Soys	Wheat		Corn	Soys	
01	04/01-04/24	0	0	0	0	0	0	3	4	4	5	5	5
02	04/25-05/10	0	1	0	0	0	0	3	4	4	5	5	5
03	05/11-05/18	0	2	0	0	0	0	3	4	4	5	5	5
04	05/19-05/26	0	3	1	0	0	0	3	4	4	5	5	5
05	05/27-06/03	0	4	2	0	0	0	3	4	4	5	5	5
06	06/04-06/11	0	0	3	0	0	0	3	4	4	5	5	5
07	06/12-06/19	0	0	4	0	0	0	3	4	4	5	5	5
08	07/15-07/22	0	0	0	1	0	0	3	4	4	5	5	5
09	07/23-07/31	0	0	0	2	0	0	3	4	4	5	5	5
10	08/01-08/15	0	0	0	3	0	0	3	4	4	5	5	5
11	08/16-08/30	0	0	0	4	0	0	3	4	4	5	5	5
12	09/01-09/26	0	0	0	5	0	0	3	4	4	5	5	5
13	09/27-10/03	0	0	0	0	0	1	3	4	4	5	5	5
14	10/04-10/10	1	0	0	0	0	1	3	4	4	5	5	5
15	10/11-10/17	2	0	0	0	0	2	3	4	4	5	5	5
16	10/18-11/07	3	0	0	0	0	3	3	4	4	5	5	5
17	11/08-11/28	0	0	0	0	0	4	3	4	4	5	5	5
18	11/29-12/12	0	0	0	0	0	5	3	4	4	5	5	5
19	12/13-12/31	0	0	0	0	0	0	3	4	4	5	5	5

TABLE C-7
 Schedule of Optional Monthly Events: Illustrative State/Region
 Complement Data Set for TELNAT

TABLE 6.7

Schedule of Optional Monthly Events; Illustrative State/Region
Complement Data Set for IFIMAPS

Event	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inventory	0200	0200	0200	0200	0200	0200	0200	0200	0200	0200	0200	0200
Anticipated cash flow	0300	0300	0200	0300	0300	0300	0300	0300	0300	0300	0300	0300
Input prices	0400			0400			0400			0400		0400
Enterprise budgets			0502						0501			
			0503									
Potential yields						0601			0602			
									0603			
Land procurement				0700								
Government program participation				0800								
Planting intentions					0902					0901		
					0903							
Marketing intentions	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Field operations				1101	1102	1105	1108	1110	1112	1113	1116	1118
					1103	1106	1109	1111		1114	1117	1119
					1104	1107				1115		
Reactive unplanted acreage									1203			

This

inventor

month (c

market

informat

during t

An

and soy

wheat du

schedule

or reject

code 08

and soyb

The

follows:

August,

in Decem

during Ju

beans (oc

be plant

Output p

Cash pric

Fac

tive com

Transmuc

This illustrative complement data set will allow users to retrieve inventory and projection of monthly cash flow during each simulation month (codes 0200 and 0300). Similarly, it will allow an opportunity to market grain during each of the simulation months (code 1000). An information set describing applicable input prices is available only during January, April, July and October (code 0400).

An opportunity to retrieve enterprise budgets is provided for corn and soybeans during March (codes 0502 and 0503, respectively) and for wheat during September (code 0501). A land rental opportunity is scheduled during April of each year (code 0700) as is a chance to elect or reject participation in the current Government Commodity Program (code 0800). Initial planting intentions are required in April for corn and soybeans (codes 0902 and 0903) and in October for wheat (code 0901).

The field operations first denoted in Table 6.4 are scheduled as follows: 1 in April, 2-4 in May, 5-7 in June, 8-9 in July, 10-11 in August, 12 in September, 13-15 in October, 16-17 in November and 18-19 in December (codes 1101 through 1119). Yield forecasts are presented during June for wheat (code 0601) and during September for corn and soybeans (codes 0602 and 0603). All unplanted acreage is made available to be planted to wheat during September (code 1203).

Output price information

Cash prices

Table 6.8 relates monthly bases to be used in deriving the respective commodities' local cash prices from the Chicago cash prices. Inasmuch as the cited monthly bases are representative of mid-Michigan

12

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Att

Lat

bas
Wei
.50

TABLE 6.8

Mid-Michigan Local Cash Price Bases Relative To
Chicago with Adjustments for Southwestern
Michigan;* Illustrative State/Region
Complement Data Set for IFLMAPS

Month	Crop		
	Wheat	Corn	Soybeans
January	\$.46	\$.36	\$.37
February	.54	.37	.34
March	.56	.36	.36
April	.53	.39	.35
May	.59	.37	.30
June	.55	.33	.33
July	.46	.32	.35
August	.42	.33	.38
September	.44	.31	.38
October	.42	.41	.39
November	.33	.41	.40
December	.43	.36	.34
Adjustment factors	-.10	-.10	-.10

SOURCE: John Ferris, Michigan State University, East Lansing, MI, 1981.

*These bases represent weighted averages of calculated bases of mid-weekly data for the calendar years of 1975-1979. Weights used for years 1975-1979 were .10, .15, .20, .25 and .30, respectively.

markets rat

is designat

to Figure 6

Futures man

Table

dity futu

delivery m

Table

illustrate

prices for

discussion

to localiz

Government

Mille

below the

corn. The

The

substanti

an Output

markets rather than southwestern Michigan, an adjustment factor of \$-.10 is designated for the purpose of localizing the bases to Region 1 (refer to Figure 6.1 in this Chapter) of Michigan (Ferris, 1981b).

Futures market prices

Table 6.9 indicates the months of maturity selected for each commodity futures market contracts. As discussed in Chapter 4, similar delivery months are assumed for forward cash contracts.

Table 6.10 relates the respective monthly bases to be used, as illustrated in Exhibit 4.15 of Chapter 4, in the calculation of monthly prices for the contractual marketing alternatives. Similar to the above discussion relative to cash bases, adjustment factors of \$-.10 are used to localize mid-Michigan bases to southwestern Michigan.

Government commodity program prices

Miller indicates that loan prices in the state of Michigan are \$.05 below the national level for wheat and \$.01 above the national level for corn. The differential is set at \$.00 for soybeans.

Output Prices¹²⁷

The focus of IFLMAPS on firm level marketing decisions requires substantial effort on the part of administrators in the specification of an Output Price complement data set. The illustrative data presented in

¹²⁷Refer to Exhibit C.3 in Appendix C for an indication of how the data is entered on the appropriate input form.

Matu

On

Whea

Comm

Boys

TABLE 6.9

Maturity Months for Contractual Alternatives Relevant To
 Southwestern Michigan; Illustrative State/Region
 Complement Data Set for IFLMAPS

Crop	Type of Contract Delivery	
	Harvest	Post-Harvest
Wheat	September (09)	May (05)
Corn	December (12)	July (07)
Soybeans	November (11)	May (05)

VI-10
Michigan

March &

January,
February,
March, t
April, t
May, t-1
June, t-

July, t-
August,
September
October,
November
December

January,
February
March, t
April, t
May, t
June, t

July, t
August,
September
October,
November
December

Michigan

800
M, 1991
of Trade
market o

The
10-week
the year

111, 11
1-1 repn

TABLE 6.10

Mid-Michigan Futures Market Bases with Adjustments for Southwestern Michigan;* Illustrative State/Region Complement Data Set for IFLMAPS

Month & Year**	Crop and Contract Maturity Month					
	Wheat		Corn		Soybeans	
	September	May	December	July	November	May
January, t-1						
February, t-1						
March, t-1		\$.65				\$-.14
April, t-1		1.00				-.23
May, t-1		.89		--		-.28
June, t-1		.85		\$.58		.13
July, t-1	--	1.02		.49		.35
August, t-1	\$.90	1.02		.57		.55
September, t-1	1.01	.95		.61	--	.70
October, t-1	.95	.89	\$.59	.70	\$.64	.73
November, t-1	.75	.74	.58	.63	.40	.59
December, t-1	.71	.61	.47	.50	.23	.51
January, t	.70	.58	.52	.52	.28	.52
February, t	.66	.55	.51	.50	.25	.55
March, t	.67	.58	.48	.46	-.09	.52
April, t	.68	.56	.44	.42	-.45	.48
May, t	.70	.59	.36	.37	-.40	.40
June, t	.66		.39	.37	.02	
July, t	.57		.38	.37	.12	
August, t	.48		.36		.31	
September, t	.46		.39		.44	
October, t			.53		.60	
November, t			.48		.55	
December, t			.35			
Adjustment factor	-.10		-.10		-.10	

SOURCE: John Ferris, Michigan State University, East Lansing, MI, 1981, contributed the mid-Michigan cash prices; Chicago Board of Trade, Statistical Annual Cash and Futures Data, the futures market contract prices.

*These bases represent weighted averages of calculated bases of mid-weekly data for the calendar years of 1976-1979. Weights used for years 1976-1979 are .20, .25, .25 and .30, respectively.

**t represents calendar year during which contract matures while t-1 represents calendar year during which contract first is available.

this se

tion o

not rec

data.

Base pr

In

establi

beans,

resulti

nized.

levels

greater

horizon

monthly

and cro

in the f

Monthly

price ad

Thr

for each

disputed

market co

standard

conjuncti

120

terms.

this section is developed using techniques which facilitate the preparation of corresponding TMI and PMI. When both forms of information are not required, simpler procedures can be used to develop the required data.

Base prices

Initial annual national average cash prices received by farmers are established at levels of \$3.00, \$2.50 and \$9.00 for wheat, corn and soybeans, respectively. The non-correspondence of these price levels and resulting relationships to current real world prices is readily recognized. However, as should subsequently become evident, such initial levels are necessary in order to preserve a ranking of soybean prices greater than wheat prices greater than corn prices over the ten year horizon. This necessity results from the methodology used to derive the monthly quasi-random independent price movements for the three individual crops. The reasoning for utilizing such a methodology is discussed in the following section.

Monthly quasi-random price adjustments

Three alternative sets of fundamental market conditions are defined for each crop--bullish, possumish and bearish.¹²⁸ Price movements anticipated over a quarter (3 simulation months) for each of these sets of market conditions are represented in Table 6.11. These definitional standards are subjective measures established for IFLMAPS. They, in conjunction with the techniques used to determine the direction of

¹²⁸ Refer to Chapter 5 for further insight on the selection of these terms.

Quasi-Pa
Ch.

Crop

Wheat

Corn

Soybeans

TABLE 6.11

Quasi-Random Price Movements Corresponding to General
 Characteristics of Designated Market States
 Of Nature; Illustrative Output Price
 Complement Data Set for IFLMAPS

Crop	State of Nature		
	Bull	Possum	Bear
Wheat	>+10.5¢	-10.5¢ to +10.5¢	<-10.5¢
Corn	>+ 7.5¢	- 7.5¢ to + 7.5¢	<- 7.5¢
Soybeans	>+15.0¢	-15.0¢ to +15.0¢	<-15.0¢

r

a

s

f

r

r

z

c

a

z

f

s

c

i

c

a

re

ff

at

cc

al

ca

ca

ure

re

ca

ca

random price adjustments during each simulation quarter, are designed to allow market outlook information to have a potential impact as a decision aid in IFLMAPS. The Chicago Board of Trade daily trading limits for the respective crops were utilized along with subjective judgment regarding the desired price fluctuations in arriving at these standards.

Three sets of alternative market conditions and associated price movements comprise the marketplace environment of IFLMAPS as represented by this Output Price complement data set. In reality, however, market analysts are not always able to accurately forecast the direction and magnitude of future price movements based on observations of the current fundamental market conditions. What is perceived as a bullish market situation at one point in time may eventually emerge as a possumish or bearish one. In order to capture such errors of misconception and the fact that fundamental market conditions are acutely dynamic, normal probability density functions for three perceived states of nature are assumed for each crop (refer to Table 6.12). These distributions represent the possible quarterly price movements and their associated probability of occurrence corresponding to the state of nature perceived at the beginning of the respective simulation quarters. An examination of Table 6.12 in conjunction with Table 6.11 reveals the possibility of all three market conditions occurring in each of the probability density functions. However, the probability density functions corresponding to bull states of nature tend to favor bullish markets, etc. (see Figure 6.2).

These quarterly price movements are dispersed into monthly price changes by assuming a correlated likelihood of random observations from three identical distributions of one-third the magnitude of the density

TABLE 6.12

Probability Density Function Parameters Representing Three
 Perceived Quarterly Market States of Nature for Each
 Crop; Illustrative Output Price Complement Data
 Set for IFLMAPS

Perceived State of Nature	Parameters			
	Mean	Standard Deviation	Lower Bound	Upper Bound
	<u>Wheat</u>			
Bull	\$.21	\$.21	\$-.42	\$.84
Possum	.00	.21	-.63	.63
Bear	-.21	.21	-.84	.42
	<u>Corn</u>			
Bull	\$.15	\$.15	\$-.30	\$.60
Possum	.00	.15	-.45	.45
Bear	-.15	.15	-.60	.30
	<u>Soybeans</u>			
Bull	\$.30	\$.30	\$ -.60	\$1.20
Possum	.00	.30	-.90	.90
Bear	-.30	.30	-1.20	.60

ful

as

th

in

a

ca

pr

si

se

de

th

in

of

with

re

als

each

the

ter

cor

Tac

the

for

size

by

also

rese

functions noted in Table 6.12 (refer to Table 6.13). In effect, it is assumed that the total quarterly price movement is equally divided among the three months, with a slight degree of latitude allowed. The reasoning for correlating the random price movements between the months within a quarter in such a fashion arises because of the provision of market outlook information only on a quarterly basis. Since information is not provided more frequently, users should be able to expect some consistency in the random price movements occurring throughout the quarter.

A Fortran package called MVBETA¹²⁹ permits the construction of several sets of monthly observations corresponding to the above described states of nature. A correlation factor of .75 accomplishes the desired simulated mutuality of fundamental market conditions for an individual crop across the three months within the quarter. This degree of correlation maintains the random price movements for the three months within the limited range of the distributions described in Table 6.13, reflecting similar fundamental conditions throughout the quarter. It also tends to preclude the possibility of identical movements during each month, thereby preventing users from being able to fully anticipate the random price movements during the second and third months of a quarter after having observed the price movements in the first month. No correlation among the respective crops' price movements is assumed. Table 6.14 presents examples of monthly random observations produced

¹²⁹MVBETA is a Fortran software package developed by Rob King for the purpose of generating multivariate beta probability distributions for use in the analysis of decisions under uncertainty. An extended documentation of MVBETA and the underlying statistical theory is provided by King. Hoskin offers a less intensive presentation of the theory along with an illustration of how the software may be used in applied research.

Pro

Perative
of Water

2011
2012
2013

2011
2012
2013

2011
2012
2013

TABLE 6.13

Probability Density Function Parameters Representing Three
 Perceived Monthly Market States of Nature for Each
 Crop; Illustrative Output Price Complement Data
 Set for IFLMAPS

Perceived State of Nature	Parameters			
	Mean	Standard Deviation	Lower Bound	Upper Bound
	<u>Wheat</u>			
Bull	\$.07	\$.07	\$-.14	\$.28
Possum	.00	.07	-.21	.21
Bear	-.07	.07	-.28	.14
	<u>Corn</u>			
Bull	\$.05	\$.05	\$-.10	\$.20
Possum	.00	.05	-.15	.15
Bear	-.05	.05	-.20	.10
	<u>Soybeans</u>			
Bull	\$.10	\$.10	\$-.20	\$.40
Possum	.00	.10	-.30	.30
Bear	-.10	.10	-.40	.20

TABLE 6.14
*Example of MVRFA Produced Monthly Random Observations From
 Probability Density Functions Described in Table 6.13.*

TABLE 6.14

Examples of MVBETA Produced Monthly Random Observations From
Probability Density Functions Described in Table 6.13,
Assuming a Correlation Factor of .75 Between
Months Within a Quarter

Observation Set Number	State of Nature									
	Bull			Possum			Bear			
	Month 1	Month 2	Month 3	Month 1	Month 2	Month 3	Month 1	Month 2	Month 3	
	Wheat			Wheat			Wheat			
1	.06	.22	.11	.01	.07	.02	-.21	-.04	-.14	
2	-.04	-.04	-.08	.03	.05	.04	-.15	-.09	-.15	
3	.26	.32	.23	-.09	-.18	-.11	-.19	-.22	-.24	
4	.03	.03	.00	.06	.20	.08	-.14	-.03	-.10	
	Corn			Corn			Corn			
1	.03	.03	.04	-.07	-.02	-.03	-.05	-.03	-.07	
2	.17	.16	.11	-.04	-.04	-.04	-.03	.00	.03	
3	.04	.08	.08	-.01	-.06	-.02	-.08	-.11	-.03	
4	.05	.02	.00	-.01	.01	-.02	-.04	-.03	.02	
	Soybeans			Soybeans			Soybeans			
1	.09	.16	.16	.10	.15	.05	.10	-.06	-.07	
2	.15	.06	.07	-.31	-.19	-.22	-.31	-.27	-.07	
3	.31	.17	.08	-.12	.04	-.13	.07	.08	.07	
4	-.10	-.07	-.17	-.24	-.11	-.16	-.12	-.10	.01	

with MVB
of obse
respecti
movement
such a t

The
each qu
desirabl
simulati
terns oc
nature
used is
of occur
nature
a set o
the pro
experien
of natu
represen
ter.

To
random
incurrec
the "t

136
ranging
ed on th
Universi

with MVBETA for the above described states of nature. The possibility of observations occurring in the tails of the distributions for the respective states of nature is observable by summing the three months' movements for the individual observations and locating the position of such a total within the distributions of Figure 6.2.

The determination of the appropriate random price movements within each quarter involves several steps. First, recall that it may be desirable to omit random price movements during the first one or two simulation years in order to emphasize the normal seasonal market patterns occurring within the simulated geographical area. The state of nature for each crop during the first quarter random price movements are used is randomly determined with each state having an equal probability of occurring. The determination of the subsequent appropriate states of nature utilizes the Markov transition matrix presented in Table 6.15 and a set of uniform random numbers $(0,1)$.¹³⁰ The transition matrix reflects the probability of moving from the state of market conditions actually experienced in the current quarter into the different perceived states of nature possible during the next quarter. The uniform random numbers represent the general state of nature realized in the subsequent quarter.

To simplify the process of developing the necessary sets of quasi-random price movements and thereby reduce the computational expense incurred, the transition matrix in Table 6.15 is assumed to represent the "true" world for all three crops between all quarters, i.e.,

¹³⁰The necessary observations from the uniform density function ranging from 0 to 1 were obtained using the RANF software package located on the Control Data Corporation computer system at Michigan State University.

$f(x)$

.00

.2

.0
.004

.4

.2

.05
.004

Fig. 6.2

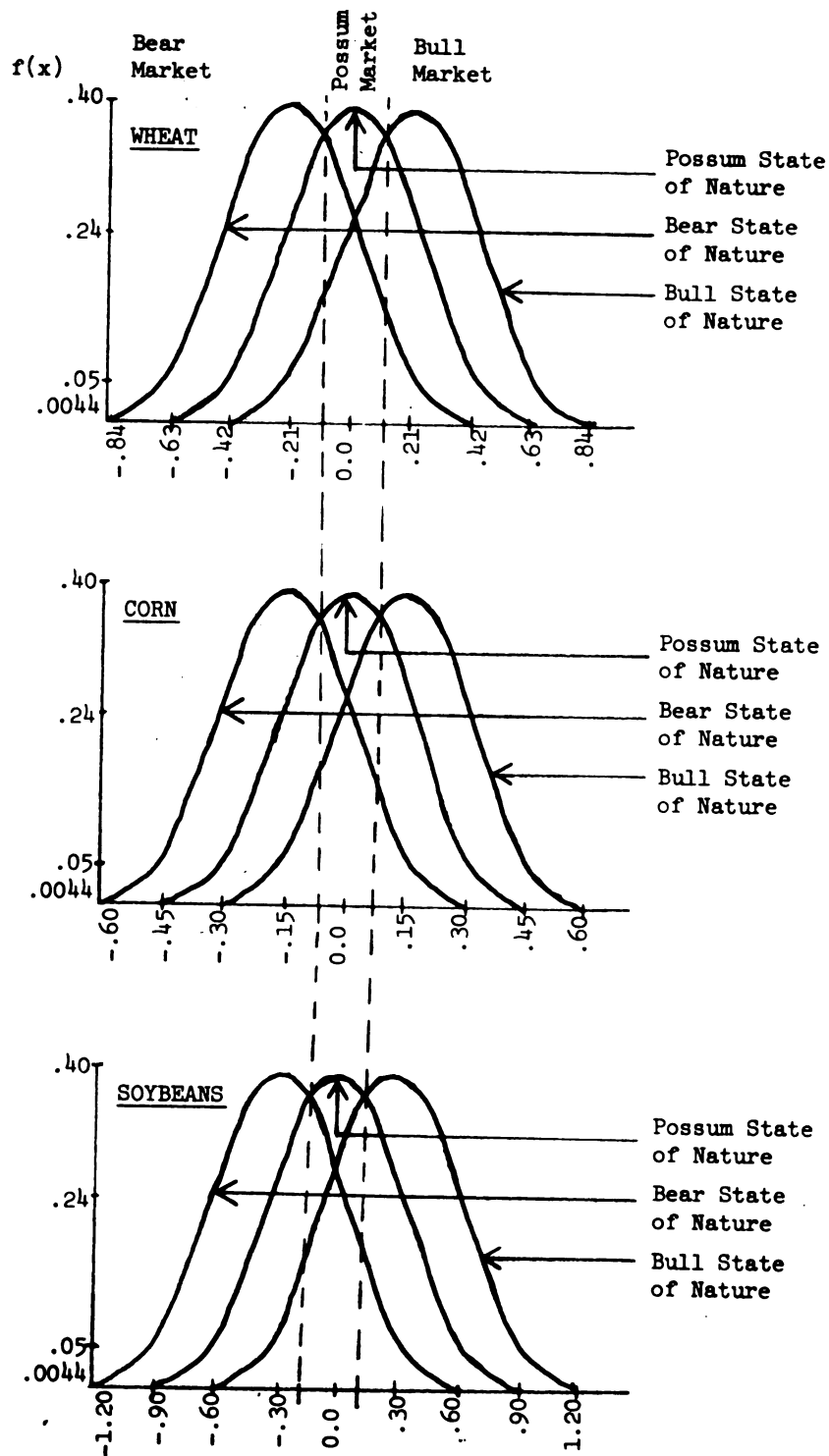


Fig. 6.2 Assumed probability distribution functions for each crop's quasi-random price movements; illustrative Output Price complement data set for IFLMAPS

Current
Quarter
Realized
Market
Condition

TABLE 6.15

Markov Transition Matrix Representing
 Fundamental Market Environment:
 Illustrative Output Price
 Complement Data Set For
 IFLMAPS

		Next Quarter's Perceived Market Conditions		
		Bull	Possum	Bear
Current	Bull	.1	.6	.3
Quarter's	Possum	.4	.2	.4
Realized	Bear	.3	.6	.1
Market				
Conditions				

underlying f
assumed to
in the matri
testing or
confining su
national av
sets of rand
respective
movements fo

Using t
develop the
for the thre
allowed for

1. Using a
nature
conditio
.3334-.6
respecti

2. Randomly
servatio
current
applicab
quarter

3. Sum the
determin
quarter

4. Generate
sition
of nature
on the
in the re
state of

5. Return to
monthly
nature id
for the r

underlying fundamental supply/demand and related market structure are assumed to be identical for all crops. The transition values appearing in the matrix were selected to provide market movement sufficient for testing or assessing the usefulness of market outlook information while confining such movements, on the average, about the base seasonalized national average cash price received by farmers. The use of different sets of random numbers to determine the transition path during the respective simulation quarters assures differing directions of price movements for the three crops.

Using the above information it is a relatively simple task to develop the sequence of states of nature and resulting price movements for the three crops during each month of the 40 simulation quarters allowed for in IFLMAPS. For each crop:

1. Using a uniform random number (0,1) determine the initial state of nature for the first quarter that fluctuating fundamental market conditions are desired. A value lying on the interval 0.00-.3333, .3334-.6667 or .6668-1.000 represents a bull, possum or bear state, respectively
2. Randomly select a set of MVBETA produced monthly price movement observations corresponding to the state of nature assumed in the current simulation quarter. These are the random price adjustments applicable during the respective months of the current simulation quarter
3. Sum the three observations from #2 above, consult Table 6.11 and determine the market conditions actually incurred in the current quarter
4. Generate a uniform random number (0,1) and consult the Markov transition matrix presented in Table 6.15. Assuming the present state of nature is as identified in #3 above, proceed from left to right on the appropriate row of the matrix; when the summed probabilities in the row exceed the value of the random number, the appropriate state of nature for the next quarter has been identified
5. Return to step #2 and observe the next set of unused MVBETA produced monthly price movement observations corresponding to the state of nature identified in #4 above. Continue with steps 2, 3, 4 and 5 for the remaining simulation quarters

Pr

6.1

111

yes

not

203

Pr

111

203

21

21

21

21

21

21

21

21

21

21

21

21

21

A set of fundamental market conditions and the corresponding random price adjustments developed in this manner are presented in Tables 6.16, 6.17 and 6.18 for wheat, corn and soybeans, respectively. In this illustrative Output Price complement data set, only the first eight years' observations are used as data. This allows simulation of the normal seasonal prices during the first two simulation years in the absence of random price adjustments, i.e., in the illustrative Output Price data set, random price movements are set equal to zero during the first two simulation years for all three crops.

As in the case of the initial national average cash prices, administrators are cautioned to consider the relative price adjustments affecting the individual crop prices when establishing the random price adjustments in the manner discussed. The technique demonstrated fails to allow for correlation between the respective crop's monthly quasi-random price movements due to the exponential characteristic of resulting combinations of states of nature. Were such correlation allowed, rather than the nine states of nature consisting of bullish, possumish and bearish for each crop allowed for in the discussed technique, twenty-seven combinations would result. This number of combinations would be cost prohibitive with respect to the development of PMI in the manner subsequently addressed. It may be necessary to develop two or three sets of adjustments for each crop before an acceptable group can be identified. Figure 6.3 illustrates the relationship of the adjustments noted in Tables 6.16, 6.17 and 6.18.

TABLE 6.16

Perceived States of Nature, Random Price Adjustments and Resulting
States of Nature---Wheat; Illustrative Output Price Complement
Data Set for IFLMAPS

Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Realized State*
			1	2	3				1	2	3	
1	1	0	.07	.08	.05	6	1	+	.09	.06	.04	+
1	2	0	.03	.05	.05	6	2	-	-.03	-.07	-.03	-
1	3	0	-.04	-.08	-.04	6	3	0	.07	.09	.10	+
1	4	0	.02	.03	.03	6	4	-	-.16	-.06	-.16	-
2	1	+	-.09	.04	.00	7	1	0	-.04	-.10	-.09	-
2	2	0	.12	.01	.08	7	2	-	-.15	-.04	-.09	-
2	3	0	.14	.16	.14	7	3	0	-.09	-.14	-.17	-
2	4	0	-.05	-.07	-.04	7	4	0	.07	.06	.02	+
3	1	-	-.11	-.09	-.04	8	1	0	.09	.04	.02	+
3	2	+	.02	.03	.03	8	2	-	.02	-.01	.00	0
3	3	+	.11	.11	.09	8	3	-	-.04	.04	.00	0
3	4	+	.13	.14	.20	8	4	-	-.14	-.17	-.14	-
4	1	+	.16	.14	.18	9	1	0	.03	.03	.02	0
4	2	-	.04	-.13	-.03	9	2	-	.02	-.01	.01	0
4	3	+	.01	.06	.01	9	3	+	.11	.09	-.01	+
4	4	+	.01	.06	.01	9	4	-	-.06	-.05	.02	0
5	1	0	.03	-.03	.00	10	1	0	-.09	-.01	-.04	-
5	2	+	.17	.16	.19	10	2	+	.02	.04	.06	+
5	3	0	-.08	-.03	-.07	10	3	0	.03	.05	.06	+
5	4	0	-.13	-.12	-.12	10	4	-	-.07	-.10	-.07	-
*Bull state: +			Possum state: 0			Bear state: -						

TABLE 6.17

Perceived States of Nature, Random Price Adjustments and Resulting
States of Nature--Corn; Illustrative Output Price Complement
Data Set for IFLMAPS

Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Realized State*	Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Realized State*
			1	2	3					1	2	3	
1	1	0	.04	.04	.07	+	6	1	-	-.08	-.08	-.07	-
1	2	-	.02	.02	.03	0	6	2	0	-.07	-.06	-.08	-
1	3	0	-.12	-.09	-.09	-	6	3	0	.01	-.01	.01	0
1	4	+	.13	.05	.08	+	6	4	-	-.04	-.04	-.07	-
2	1	0	-.05	-.01	-.05	-	7	1	+	.03	.04	.06	+
2	2	0	.04	.01	.07	+	7	2	-	-.13	-.13	-.11	-
2	3	0	.10	.05	.07	+	7	3	+	.02	-.01	.01	0
2	4	0	.03	.01	.01	0	7	4	-	-.07	-.04	-.03	-
3	1	0	-.02	.00	.00	0	8	1	+	.05	.10	.09	+
3	2	+	.05	.03	.02	+	8	2	0	.10	.05	.02	+
3	3	0	-.08	-.09	-.06	-	8	3	0	-.01	-.04	-.04	-
3	4	+	.10	.13	.11	+	8	4	0	-.05	-.01	.01	0
4	1	-	-.05	.02	-.05	-	9	1	-	-.04	-.01	-.07	-
4	2	0	.01	-.02	-.03	0	9	2	+	.08	.10	.10	+
4	3	+	.00	-.03	-.06	-	9	3	0	-.09	-.06	-.09	-
4	4	0	.00	.07	.02	+	9	4	+	.03	.04	.07	+
5	1	-	.01	.05	.03	+	10	1	0	.00	.02	.00	0
5	2	-	-.03	-.04	-.01	-	10	2	+	.09	.05	.03	+
5	3	0	-.02	-.04	-.01	0	10	3	+	.06	.12	.09	+
5	4	0	.03	-.01	.04	0	10	4	0	-.03	-.02	-.06	-
*Bull state: +							Possum state: 0						
							Bear state: -						

TABLE 6. 18

Perceived States of Nature, Random Price Adjustments and Resulting
States of Nature--Soybeans; Illustrative Output Price Complement
Data Set, 600 Terms.

TABLE 6.18

Perceived States of Nature, Random Price Adjustments and Resulting
States of Nature--Soybeans; Illustrative Output Price Complement
Data Set for IFLMAPS

Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Sim. Yr.	Sim. Qtr.	Perceived State	Price Adj./Mo.			Realized State#
			1	2	3				1	2	3	
1	1	0	.05	-.03	.08	6	1	+	.05	.08	.01	0
1	2	+	.10	-.01	.19	6	2	-	-.16	-.14	-.18	-
1	3	0	-.10	.08	-.05	6	3	-	-.04	-.06	-.01	0
1	4	+	-.02	.06	.12	6	4	-	-.26	-.28	-.16	-
2	1	-	-.13	-.08	-.13	7	1	-	-.03	-.20	-.07	-
2	2	-	.00	-.07	-.10	7	2	0	-.16	-.06	-.08	-
2	3	+	.12	.10	.13	7	3	+	.24	.30	.22	+
2	4	0	-.14	-.10	.01	7	4	0	-.07	-.05	-.11	-
3	1	0	-.02	-.07	-.03	8	1	0	-.15	-.03	-.19	-
3	2	-	-.15	-.24	-.15	8	2	0	.15	.03	.10	+
3	3	+	-.15	-.01	-.11	8	3	-	-.06	-.02	-.12	-
3	4	0	-.15	-.01	-.11	8	4	0	.10	.09	.13	+
4	1	0	.03	-.02	.04	9	1	0	-.08	-.04	-.10	-
4	2	+	.12	.00	.10	9	2	0	.06	-.04	-.02	0
4	3	-	.03	.09	-.28	9	3	+	.18	.12	.12	+
4	4	0	.03	.01	-.07	9	4	0	-.05	-.08	.00	0
5	1	-	.02	.01	-.07	10	1	-	-.14	-.01	-.14	-
5	2	-	-.04	.01	.04	10	2	0	.08	.09	.12	+
5	3	+	-.04	.06	.10	10	3	-	-.28	-.25	-.28	-
5	4	0	-.21	-.21	-.11	10	4	0	.08	.07	.10	+
*Bull state: +			Possum state: 0			Bear state: -						

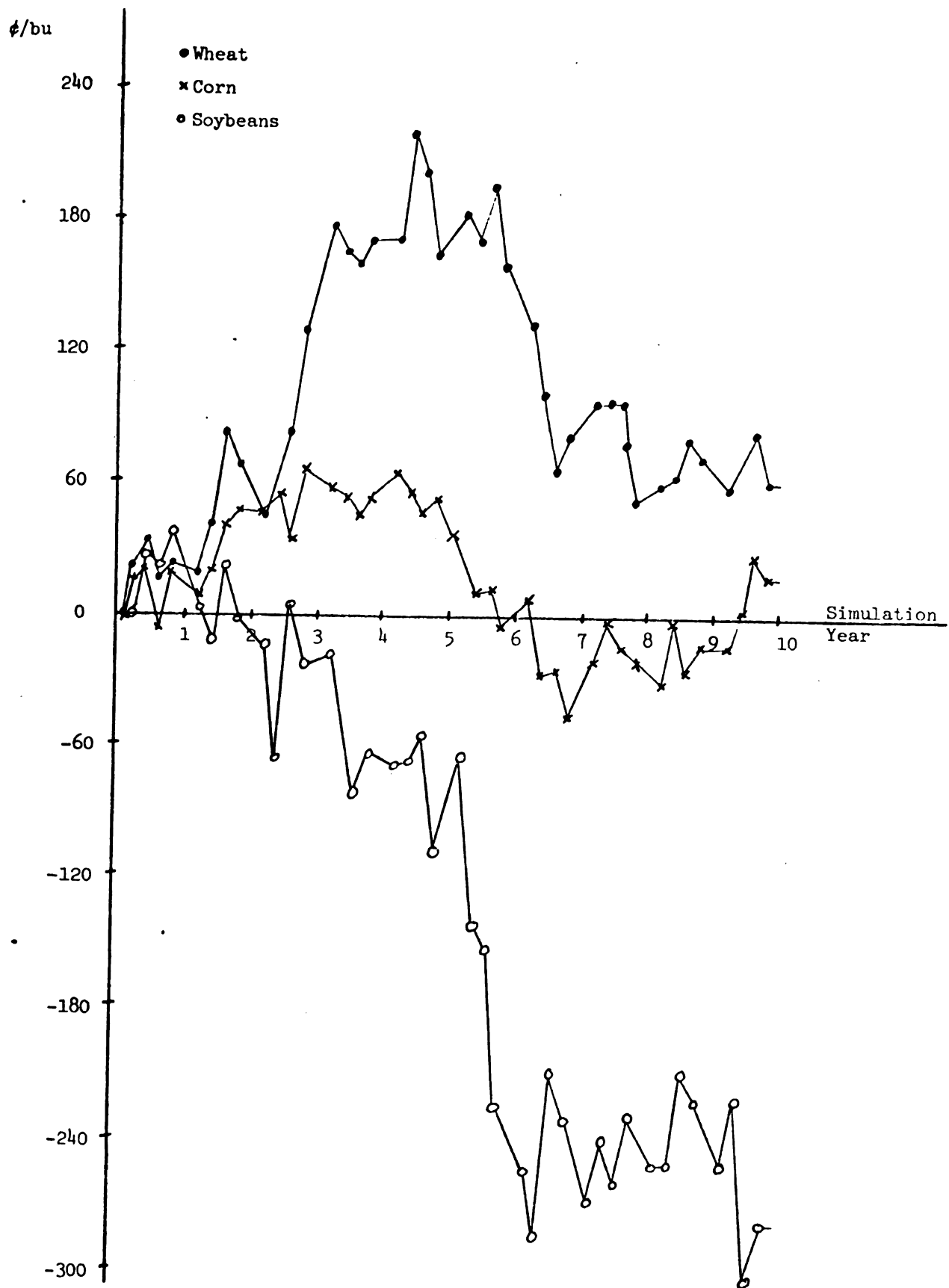


Fig. 6.3. Graphic representation of quasi-random price movements represented in Tables 6.16, 6.17, and 6.18; illustrative Output Price complement data set for IFLMAPS

Price movements in the futures market
and forward cash contract market

Directions of price changes

Current perceptions of future fundamental market conditions partially determine the direction prices will change for the respective contracts. Such perceptions are developed for this illustrative Output Price complement data set using "historical" Markov transition matrices to ascertain the fundamental market conditions that will evolve from the current simulated state of nature. Recognizing that forecasters in the real world do not know the "true" Markov transition matrix which determines how the market actually evolves, several historical or past observations of market performance are used to estimate "historical" Markov transition matrices for forecasting future fundamental market conditions. The appreciation of the greater amount of uncertainty in existence when one attempts to forecast further into the future prompts the use of more past observations when constructing the historical Markov transition matrix to be used in forecasting nearby fundamental conditions as opposed to those matrices used in forecasting the more distant conditions, i.e., 20, 16 and 12 observations for next quarter, two quarters hence and three quarters hence, respectively.

Table 6.19 indicates the historical Markov transition matrices used in preparing the forecasts for each crop. Table 6.20 presents a set of forecasts determined by using these matrices and a set of random uniform numbers (0,1) in a manner similar to that used to generate the conditions occurring in the current quarter. These forecasts are also used in the preparation of the TMI and PMI made available at the beginning of each simulation quarter as subsequently discussed.

TABLE 6.19

Historical Markov Transition Matrices Used to Generate Forecasts
of Future Fundamental Market Conditions; Illustrative
Output Price Complement Data Set for IFMAFS

	Next Quarter			Two Quarters Hence			Three Quarters Hence		
	Bull	Possum	Bear	Bull	Possum	Bear	Bull	Possum	Bear
Wheat									
Bull	.20	.65	.15	.1875	.6875	.125	.167	.666	.167
Possum	.55	.15	.30	.50	.125	.375	.50	.0833	.4167
Bear	.20	.65	.15	.125	.75	.125	.0833	.8334	.0833
Corn									
Bull	.15	.55	.30	.1875	.5625	.25	.167	.583	.25
Possum	.25	.10	.65	.1875	.125	.6875	.083	.67	.75
Bear	.15	.55	.30	.125	.5625	.3125	.0833	.5834	.3333
Soybeans									
Bull	.10	.55	.35	.125	.5625	.3125	.167	.50	.333
Possum	.75	.10	.35	.5625	.0625	.375	.5833	.00	.4167
Bear	.35	.55	.10	.375	.50	.125	.4167	.4167	.1666

A

214.
215.

1

2

3

4

5

6

7

8

9

10

11

12

TABLE 6.20

A Set of Forecast Fundamental Market Conditions;* Illustrative
Output Price Complement Data Set for IFLMAPS

Sim. Yr.	Sim. Qtr.	Crop								
		Wheat			Corn			Soybeans		
		Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence	Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence	Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence
1	1	+	-	0	-	0	-	+	-	+
	2	+	+	0	0	+	-	0	-	0
	3	-	0	+	-	0	-	-	+	-
	4	+	+	0	-	0	-	-	-	0
2	1	0	-	0	-	-	0	+	-	0
	2	-	-	0	-	0	-	0	+	0
	3	+	0	-	-	-	-	0	-	0
	4	+	0	-	-	+	0	+	0	+
3	1	+	0	+	-	0	0	+	0	-
	2	+	0	0	0	-	0	+	0	-
	3	0	-	0	+	0	+	0	+	+
	4	-	0	+	+	-	0	+	-	0
4	1	0	0	-	0	-	+	-	0	-
	2	0	+	0	0	-	0	+	0	+
	3	+	0	0	+	0	-	+	0	-
	4	0	+	-	-	+	0	0	-	0
5	1	-	0	+	+	0	-	+	-	0
	2	0	-	0	-	-	-	0	-	0
	3	+	+	0	-	0	0	0	-	-
	4	+	-	0	0	-	-	+	0	+
6	1	0	-	0	-	0	0	0	-	-
	2	0	+	0	-	-	0	-	0	+
	3	-	0	+	+	0	-	+	0	-
	4	-	0	+	-	-	-	0	+	-
7	1	+	0	-	-	-	+	+	0	-
	2	0	-	0	0	-	+	0	0	-
	3	-	0	-	-	-	0	-	0	+
	4	+	0	+	-	0	-	0	-	-
8	1	+	0	+	-	0	-	0	-	-
	2	0	+	-	-	0	0	+	0	-
	3	0	+	0	+	-	0	-	0	-
	4	0	+	+	-	0	-	+	-	0
9	1	+	0	+	-	-	-	-	0	-
	2	-	0	0	0	-	0	+	-	0
	3	+	0	+	-	+	-	0	+	0
	4	0	+	0	-	-	0	0	+	0
10	1	+	+	0	-	-	0	0	-	0
	2	0	0	0	-	0	-	+	0	-
	3	0	+	0	-	0	-	+	-	+
	4	+	0	+	-	-	0	+	0	-

*Bull forecast: +

Possum forecast: 0

Bear forecast: -

Admin

marke

\$1.10

larly

in the

year.

Market

T

levels

foreca

of na

casts

ple s

to all

Quarter

rates

T

matrix

twenty

struct

each of

describ

culat

ceived

and 16

Quarter

Administrators' biases

In this illustrative Output Price complement data set, futures market contract prices for corn are favorably biased in the amount of \$.10 per bushel during April, May and June of the fourth year. Similarly, forward cash contract prices for soybeans are unfavorably biased in the amount of \$.15 during July, August and September of the fourth year.

Market outlook information

TMI by definition is limited to a point forecast of future price levels. Acknowledging the limited information set facing real world forecasters, a sample of 20, 16, 12 and 8 observations from each state of nature possible for each crop is used to estimate such point forecasts for the current and next three quarters, respectively. These sample sizes, in consideration of the Central Limit Theorem, are perceived to allow for the desired degree of accuracy concerning the respective quarters' forecasts. Table 6.21 indicates the respective point estimates for each crop's bull, possum and bear states of nature.

The more robust PMI utilizes the "historical" Markov transition matrices indicated in Table 6.19 in conjunction with subsets of the twenty observations used in deriving the TMI point estimates to construct a set of cumulative probability density functions (p.d.f.) for each crop. PMI for the current quarter is simply a cumulative p.d.f. describing the twenty sample observations. For subsequent quarters the cumulative p.d.f.'s incorporate the current state of nature, the perceived odds of the different states of nature occurring in the future and 16, 12 or 8 sample price observations for the next, two and three quarters hence, respectively. Table 6.22 indicates the respective

State of
Nature

Bull
Possum
Bear

Bull
Possum
Bear

Bull
Possum
Bear

TABLE 6.21

Quarterly Point Estimates for Quarterly Quasi-Random
Price Movements; Illustrative Output Price
Complement Data Set for IFLMAPS

State of Nature	Current Quarter	Next Quarter	Two Quarters Hence	Three Quarters Hence
Wheat				
Bull	.22	.26	.23	.21
Possum	.06	.06	.02	.05
Bear	-.17	-.20	-.25	-.27
Corn				
Bull	.14	.14	.16	.16
Possum	.05	.07	.08	.08
Bear	-.16	-.18	-.19	-.21
Soybeans				
Bull	.47	.49	.44	.33
Possum	.14	.11	.12	.08
Bear	-.58	-.59	-.52	-.60

2008
2009
2010

10

1

-

—

-

1

•

•

• —

•

•

351

• • •

•

2

2

1

12

2

2

2

1

• 3

•

525

2

'

3

2

1

2

2

1

1

13

•

•

TABLE 6.22

Cumulative Probability Density Observations Representing
Quarterly Quasi-Random Price Movements; Illustrative
Output Price Complement Data Set for IFLMAPS

Crop and Cumulative Probability	Current Perceived State of Nature											
	Bull				Possum				Next			
	Current Quarter	Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence	Current Quarter	Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence	Current Quarter	Next Qtr.	Two Qtrs. Hence	Three Qtrs. Hence
<u>WHEAT</u>												
.01	-.19	-.21	-.17	-.10	-.32	-.19	-.16	-.14	-.74	-.21	-.17	-.10
.10	-.01	-.09	-.08	-.05	-.15	-.06	-.08	-.07	-.49	-.09	-.08	-.05
.20	.07	-.04	-.04	-.03	-.07	-.01	-.04	-.05	-.38	-.04	-.04	-.03
.30	.13	.00	-.02	-.01	-.02	.03	-.02	-.03	-.30	.00	-.02	-.01
.40	.17	.03	.00	.00	.02	.06	.00	-.01	-.24	.03	.00	.00
.50	.22	.06	.02	.01	.06	.09	.02	.00	-.17	.06	.02	.01
.60	.26	.09	.04	.03	.11	.12	.04	.02	-.11	.09	.04	.03
.70	.31	.12	.07	.04	.15	.16	.07	.04	-.05	.12	.07	.04
.80	.37	.16	.09	.05	.20	.20	.09	.06	.03	.16	.09	.05
.90	.45	.21	.13	.08	.28	.25	.13	.08	.14	.21	.13	.08
.99	.63	.33	.21	.13	.45	.37	.21	.15	.40	.33	.21	.13
<u>CORN</u>												
.01	-.16	-.21	-.22	-.17	-.26	-.34	-.17	-.22	-.53	-.21	-.22	-.17
.10	-.03	-.11	-.14	-.11	-.12	-.22	-.09	-.15	-.36	-.11	-.14	-.11
.20	.03	-.07	-.11	-.09	-.06	-.17	-.06	-.12	-.29	-.07	-.11	-.09
.30	.07	-.04	-.09	-.07	-.02	-.14	-.04	-.10	-.24	-.04	-.09	-.07
.40	.11	-.02	-.07	-.06	.02	-.11	-.02	-.09	-.20	-.02	-.07	-.06
.50	.14	.00	-.05	-.04	.05	-.08	.00	-.07	-.16	.00	-.05	-.04
.60	.18	.03	-.03	-.03	.08	-.05	.02	-.05	-.12	.03	-.03	-.03
.70	.21	.05	-.01	-.02	.12	-.02	.04	-.04	-.08	.05	-.01	-.02
.80	.26	.08	.02	.00	.16	.02	.06	-.01	-.03	.08	.02	.00
.90	.31	.12	.05	.02	.22	.07	.09	.01	.04	.12	.05	.02
.99	.45	.22	.13	.08	.36	.19	.17	.08	.21	.22	.13	.08
<u>SOYBEANS</u>												
.01	-.64	-.63	-.29	-.30	-.63	-.59	-.31	-.31	-1.38	-.42	-.34	-.29
.10	-.14	-.39	-.12	-.18	-.28	-.29	-.15	-.19	-1.02	-.15	-.17	-.18
.20	.07	-.29	-.05	-.14	-.14	-.16	-.09	-.14	-.87	-.04	-.10	-.13
.30	.22	-.21	.00	-.10	-.03	-.07	-.04	-.10	-.76	.04	-.05	-.09
.40	.35	-.15	.05	-.07	.06	.00	.00	-.07	-.67	.11	.00	-.06
.50	.47	-.09	.09	-.04	.14	.08	.04	-.04	-.58	.18	.04	-.04
.60	.59	-.04	.13	-.02	.23	.15	.08	-.01	-.49	.24	.08	-.01
.70	.72	.03	.17	.01	.32	.23	.12	.02	-.40	.31	.12	.02
.80	.87	.10	.22	.05	.42	.32	.17	.06	-.29	.39	.17	.06
.90	1.08	.20	.29	.09	.57	.44	.23	.11	-.14	.50	.24	.11
.99	1.58	.44	.46	.21	.92	.74	.39	.23	.22	.77	.41	.22

cumula

states

T

tive

repres

to th

Output

quasi-

nation

price

repres

relati

with r

tion q

resear

sets

tive a

of the

T

tion

repres

13
data is

cumulative p.d.f.'s constructed for each crop based on the assumed states of nature and other related information discussed herein.

The on-line market information set corresponding to this illustrative Output Price complement data set is 01. Exhibits 6.1 and 6.2 represent the TMI and PMI information sets, respectively, corresponding to the first quarter of the third simulation year of this illustrative Output Price complement data set, i.e., the first quarter during which quasi-random price movements are considered. Exhibit 6.3 is the information statement provided during the first two years when quasi-random price movements are not allowed. These information sets are not representative of the type felt necessary for the evaluation of the relative values of TMI and PMI. Exhibits 6.4 and 6.5 relate the style, with respect to corn market conditions during the corresponding simulation quarter, regarded to be necessary in order to use IFLMAPS in such a research application. The time required to develop such information sets for the entire 10 year simulation horizon was regarded as prohibitive at this juncture of IFLMAPS development as well as in recognition of the tentativeness of the nature of the research application.

Inputs¹³¹

This illustrative Inputs complement data set is void of any inflation effects. The various cost factors, for the most part, are representative of the agricultural input market during late 1980.

¹³¹ Refer to Exhibit C.4 in Appendix C for an indication of how this data is entered on the appropriate input form.

Exhib

Exhibit 6.1. TMI Information Set; Illustrative Output Price Complement Data Set for IFLMAPS.

```

*****
TRADITIONAL MARKET INFORMATION
YEAR      3  QUARTER 1
*****
WHEAT
-----
FORECAST FOR CURRENT QUARTER IS POSSUMISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.06
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR NEXT QUARTER IS BULLISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.26
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR TWO QUARTERS HENCE IS BEARISH
EXPECT A QUARTERLY PRICE DEVIATION OF -$0.25
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR THREE QUARTERS HENCE IS POSSUMISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.05
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
*****
*****
CORN
-----
FORECAST FOR CURRENT QUARTER IS POSSUMISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.05
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR NEXT QUARTER IS BEARISH
EXPECT A QUARTERLY PRICE DEVIATION OF -$0.18
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR TWO QUARTERS HENCE IS POSSUMISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.08
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR THREE QUARTERS HENCE IS BEARISH
EXPECT A QUARTERLY PRICE DEVIATION OF -$0.21
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
*****
*****
SOYBEANS
-----
FORECAST FOR CURRENT QUARTER IS POSSUMISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.14
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR NEXT QUARTER IS BULLISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.49
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR TWO QUARTERS HENCE IS BEARISH
EXPECT A QUARTERLY PRICE DEVIATION OF -$0.52
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
FORECAST FOR THREE QUARTERS HENCE IS BULLISH
EXPECT A QUARTERLY PRICE DEVIATION OF $0.33
DUE TO FLUCTUATING FUNDAMENTAL MARKET CONDITIONS
-----
*****
*****

```

Exhibit

PROBABIL

YEAR 3

HEAT - C

FORECAST

CONDITION

.....

CUMULATIVE

.....

THIS QTR

.....

NEXT QTR

.....

IN 2 QTR

.....

IN 3 QTR

HEAT - C

FORECAST

CONDITION

.....

CUMULATIVE

.....

THIS QTR

.....

NEXT QTR

.....

IN 2 QTR

.....

IN 3 QTR

STREANS

FORECAST

CONDITION

.....

CUMULATIVE

.....

THIS QTR

.....

NEXT QTR

.....

IN 2 QTR

.....

IN 3 QTR

Exhibit 6.2. PMI Information Set; Illustrative Output Price Complement Data Set for IFLMAPS.

PROBABILISTIC MARKET INFORMATION

YEAR 3 QUARTER 1

WHEAT - CURRENT MARKET IS POSSUMISH

FORECAST QUARTERLY PRICE DEVIATIONS DUE TO FLUCTUATING FUNDAMENTAL MARKET
CONDITIONS AND THEIR ASSOCIATED CUMULATIVE PROBABILITIES OF OCCURRENCE:

CUMULATIVE PROBABILITIES:

	1%	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
THIS QTR	-.32	-.15	-.07	-.02	.02	.06	.11	.15	.20	.28	.45
NEXT QTR	-.19	-.06	-.01	.03	.06	.09	.12	.16	.20	.25	.37
IN 2 QTRS	-.16	-.08	-.04	-.02	.00	.02	.04	.07	.09	.13	.21
IN 3 QTRS	-.14	-.07	-.05	-.03	-.01	.00	.02	.04	.06	.08	.15

CORN - CURRENT MARKET IS POSSUMISH

FORECAST QUARTERLY PRICE DEVIATIONS DUE TO FLUCTUATING FUNDAMENTAL MARKET
CONDITIONS AND THEIR ASSOCIATED CUMULATIVE PROBABILITIES OF OCCURRENCE:

CUMULATIVE PROBABILITIES:

	1%	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
THIS QTR	-.26	-.12	-.06	-.02	.02	.05	.08	.12	.16	.22	.36
NEXT QTR	-.34	-.22	-.17	-.14	-.11	-.08	-.05	-.02	.02	.07	.19
IN 2 QTRS	-.17	-.09	-.06	-.04	-.02	.00	.02	.04	.06	.09	.17
IN 3 QTRS	-.22	-.15	-.12	-.10	-.09	-.07	-.05	-.04	-.01	.01	.08

SOYBEANS - CURRENT MARKET IS POSSUMISH

FORECAST QUARTERLY PRICE DEVIATIONS DUE TO FLUCTUATING FUNDAMENTAL MARKET
CONDITIONS AND THEIR ASSOCIATED CUMULATIVE PROBABILITIES OF OCCURRENCE:

CUMULATIVE PROBABILITIES:

	1%	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
THIS QTR	-.63	-.28	-.14	-.03	.06	.14	.23	.32	.42	.57	.92
NEXT QTR	-.59	-.29	-.16	-.07	.00	.08	.15	.23	.32	.44	.74
IN 2 QTRS	-.31	-.15	-.09	-.04	.00	.04	.08	.12	.17	.23	.39
IN 3 QTRS	-.31	-.19	-.14	-.10	-.07	-.04	-.01	.02	.06	.11	.23

Exhibit 6.3. Market Outlook Information Sets When Quasi-Random Price
Movements Are Not Allowed For; Illustrative Output Price
Complement Data Set for IFLMAPS.

TRADITIONAL MARKET INFORMATION

YEAR 1 QUARTER 1

DURING THE FIRST TWO SIMULATION YEARS, ALL PRICES FOR WHEAT, CORN AND
SOYBEANS WILL FLUCTUATE MERELY BY NORMAL EXPECTED SEASONAL PRICE
MOVEMENTS, I.E. THERE WILL BE NO RANDOM PRICE MOVEMENTS DUE TO CHANGING
FUNDAMENTAL(SUPPLY/DEMAND) CONDITIONS. RANDOM PRICE MOVEMENTS WILL BEGIN
TO OCCUR IN JANUARY OF THE THIRD SIMULATION YEAR.

PROBABILISTIC MARKET INFORMATION

YEAR 1 QUARTER 1

DURING THE FIRST TWO SIMULATION YEARS, ALL PRICES FOR WHEAT, CORN AND
SOYBEANS WILL FLUCTUATE MERELY BY NORMAL EXPECTED SEASONAL PRICE
MOVEMENTS, I.E. THERE WILL BE NO RANDOM PRICE MOVEMENTS DUE TO CHANGING
FUNDAMENTAL(SUPPLY/DEMAND) CONDITIONS. RANDOM PRICE MOVEMENTS WILL BEGIN
TO OCCUR IN JANUARY OF THE THIRD SIMULATION YEAR.

Exhibit 6.4. Style of TMI Statement Required in IFLMAPS for
Assessment of Relative Values of TMI and PMI.

Fundamental market conditions for corn are currently in a possum state--prices during the current quarter should tend to move slightly up (.05) over and above normal seasonal price improvement. The harvesting of a record U.S. crop during the previous two quarters appears to have rebuilt stocks back to a comfortable level from their depleted position of last year. A bearish market is forecast during the next quarter with an anticipated quarterly price decline of \$.18. Preliminary reports indicate that livestock numbers will be down, softening the demand at that time. In two quarters hence, a possumish state is forecast with no clear direction in the market visible. Look for a slight positive movement in prices (.08). Good world weather should result in revitalized world supplies in three quarters hence prompting a bearish market and an accompanying price decline of \$.21.

Exhibit 6.5. Style of PMI Statement Required in IFLMAPS for
Assessment of Relative Values of TMI and PMI.

The corn market is currently in a possum state--prices will tend to move up about \$.05 this quarter but, as shown below, there is a high probability that price movements will be above or below this level. Supply and demand appears to be currently in equilibrium--however, the revised crop report due out in a couple of weeks could send prices either up or down from their present level. Price movements will tend to be more bearish during the next quarter as it currently appears that livestock numbers are declining. However, there is a slight chance that these declines are temporary and that prices will actually increase next quarter. Two quarters hence is anybody's guess--the market should be somewhat stable with little price movement. However, there is a chance of the market breaking out in either direction. In three quarters, look for the market to decline as revitalized world stocks have an impact on the market--there is only a slight possibility of price improvement at that time. The cumulative probabilities of price movements during the next four quarters are as follows:

<u>Cumulative Probabilities</u>	<u>Current Quarter</u>	<u>Next Quarter</u>	<u>Two Qtrs. Hence</u>	<u>Three Qtrs. Hence</u>
.01	-.26	-.34	-.17	-.22
.10	-.12	-.22	-.09	-.15
.20	-.06	-.17	-.06	-.12
.30	-.02	-.14	-.04	-.10
.40	.02	-.11	-.02	-.09
.50	.05	-.08	.00	-.07
.60	.08	-.05	.02	-.05
.70	.12	-.02	.04	-.04
.80	.16	.02	.06	-.01
.90	.22	.07	.09	.01
.99	.36	.19	.17	.08

Variable costs parameters

Labor

Subjective judgment and inspection of Rates for Custom Work in Michigan (Schwab) and Michigan Agricultural Statistics, July 1980 (Michigan Department of Agriculture) are the bases for assuming an annual full-time wage rate of \$15,000 and an hourly part-time wage rate of \$5.00. These rates reflect both cash payments and fringe benefits. Identical rates are assumed for all ten years of the simulation horizon.

Variable inputs

Table 6.23 presents the respective budgets specified for each crop's composite variable inputs. The costs associated with the medium and high yield enterprise budgets prepared by the Department of Agricultural Economics, Michigan State University in February of 1980 (Schwab, et al.) are the bases of these budgets.

Grain handling costs

Grain hauling rates are subjectively estimated at levels of \$.07, \$.12 and \$.08 per bushel, respectively for hauling from (1) field to on-farm drying/storage facilities, (2) field to off-farm drying/storage facilities and sales location and (3) on-farm drying/storage facilities to off-farm sales location. Recognizing the largely variable aspect of drying costs, rates of \$.015 and \$.020 per bushel per point of moisture removed are specified, respectively, for on-farm and off-farm drying operations related to corn. Monthly storage expenses are established at levels of \$.005 and \$.025 per bushel, respectively, for on- and off-farm

TABLE 6.23

Composite Variable Crop Input Budgets; Illustrative
Inputs Complement Data Set for IFLMAPS

Specific Input Item	Crop		
	Wheat	Corn	Soybeans
Fertilizer	\$24.10	\$41.90	\$19.63
Seed	14.70	13.44	14.00
Herbicides	1.75	10.40	14.40
Insecticide	0.00	1.50	0.00
Miscellaneous*	<u>2.03</u>	<u>3.36</u>	<u>2.40</u>
TOTAL	<u>\$42.58</u>	<u>\$70.60</u>	<u>\$50.43</u>

SOURCE: Gerald D. Schwab, et al., Michigan Crops and Livestock Estimated 1980 Budgets, Department of Agricultural Economics Staff Paper 371, 1980.

*Miscellaneous expenses are estimated at 5 percent of total of other variable expenses.

storage.¹³² For all grain handling costs, the identical rates are in effect for all ten years of the simulation horizon.

Fuel

A per gallon cost of \$1.10 is used for diesel fuel.

Miscellaneous

Property taxes are set at \$20 per \$1000 of assessed value. Inasmuch as IFLMAPS assesses only 50% of property value for tax purposes, this rate amounts to 1% of full market value. Insurance rates are set at \$15 per \$1000 of assessed value. Recall only 75% of property's value is assessed for insurance purposes. Miscellaneous repairs are estimated at \$50 per \$1000 of full current market value.

Futures market transaction costs

The futures market contracts allowed for in IFLMAPS are analogous to the mini-contracts offered on the Mid-America Commodity Exchange, i.e., contract size is 1000 bushels. Table 6.24 indicates the brokerage fees and margin requirements associated with contracts of this size. The stated margin requirements include both the initial and maintenance requirements.

¹³²These subjective estimates of grain handling costs are based on various conversations with Michigan State University agricultural engineers (Bakker-Arkema, Brook), agricultural economists (Dike, Ferris, Schwab) and several Michigan farmers. The latter source are unidentifiable inasmuch as the information was solicited during informal conversations at Marketing Workshops sponsored by Michigan State University during the winter of 1979-80.

TABLE 6.24

Futures Market Contracts' Brokerage Fees and Margin
Requirements;* Illustrative Inputs Complement
Data Set for IFLMAPS

Crop	Brokerage Fee	Margin Requirements
Wheat	\$25.00	\$500.00
Corn	25.00	400.00
Soybeans	30.00	900.00

SOURCE: Jim Gasnier, A. G. Edwards and Sons,
Inc., interview, Lansing, MI, October, 1980.

*Rates specified are for 1000 bushel mini-
contracts offered on the Mid-America Commodity
Exchange.

Interest rates

Based on a subjective analysis of current interest rates, 14% and 12%, respectively, are identified as the appropriate short-term and intermediate interest rates applicable during each month of the ten year simulation horizon.

Capital investment possibilities

As should be evident by the extensive discussion which follows, the specification of capital assets available for purchase during a simulation horizon constitutes the most difficult part of preparing an Inputs complement data set. The techniques described below represent an effort to portray what perhaps may be regarded as "too much" reality in IFLMAPS. It is highly probable that adequate representation of capital asset investment opportunities can be obtained with less effort than required in the development of this illustrative set of information.

Machinery

It is first necessary to identify the tasks assumed to constitute the respective field operations of land preparation, planting and harvesting. This information is used to specify the requisite equipment associated with the machinery units assumed to be available for purchase.

Land preparation is defined as both a heavy tandem discing (six inch depth) of all acreage and subsoiling (shanks located at three foot intervals and pulled at a 20 inch depth) of 25 percent of the acreage twice. These tasks (discing and subsoiling) must be performed on all acreage prior to the planting operation irrespective of its cropping history (wheat, corn, soybeans, idle and diverted acreage). The

programming of IFLMAPS prevents different land preparation treatment according to the previous crop planted. Once an acre of a particular crop is harvested it passes from a crop specific planted state to a general unprepared state containing acreage of other crops already harvested and awaiting the land preparation operation. With respect to preparation of idle and diverted acreage, it is assumed that such land preparation occurs during the off-season. Correspondingly, such acreage passes directly into the prepared state without passing through the unprepared state and competing for scarce field time. As designed herein, a land preparation complement unit is comprised of a tractor, subsoiler, and heavy tandem disk. One-fourth of a one-half ton pickup is also included as is the case with other complement type units. The assumption is that ownership of one unit of each machinery type results in three-quarters of a one-half ton pickup for farm use. The remaining one-fourth pickup is for personal purposes. As additional complement units are obtained, transportation needs are assumed to increase due to the use of hired labor and/or spatial location of field operations.

Planting includes both a seedbed preparation task and the actual planting task. Herbicides are incorporated during the former task while insecticide application is included at planting time. Seedbed preparation is included at planting rather than in the land preparation task to assure its performance close to planting rather than possibly in late fall. It includes a simultaneous spraying, field cultivation (shanks spaced at one foot intervals and pulled at a five inch depth) and a spring tooth harrowing. Planting of corn and soybeans utilizes a 30 inch row planter while planting of wheat requires a drill with a four inch spacing. Although not included as a restriction or use of

available field time, a 30 inch row cultivator is included in this complement for the purpose of cultivating corn and/or soybeans during assumed unconstrained time periods in the spring. The application of fertilizer has not been overlooked. Dry fertilizer is assumed to be custom broadcast and/or applied at planting and anhydrous ammonia is applied using fertilizer dealer supplied equipment during post-plant cultivation. Fertilizer costs in the variable input budget presented previously reflect these assumptions. To summarize, the planting complement includes a tractor, field cultivator, sprayer, spring tooth harrow, planter, drill, row cultivator and one-quarter of a one-half ton pickup.

Harvesting is limited to the function performed by a self-propelled combine using either a 30 inch row cornhead or a conventional grain platform. The design of this complement requires only a self-propelled combine, a 30 inch row cornhead, a grain platform and one-quarter of a one-half ton pickup.

The calculations required to size and rate the performance capacity of several units for each complement type are facilitated by the agricultural engineering equations indicated in Exhibit 6.6. The inclusion of more than one task in a field operation, as mentioned earlier, requires the aggregation of individual task capacity rates (Equation 1 in Exhibit 6.6) in order to arrive at a composite rating for the entire field operation. Both the land preparation and planting operations specified for this illustrative Inputs complement data set include two tasks. The general procedure for arriving at acre per acre capacities for complement units designed to perform these field operations is presented in Exhibit 6.7.

Exhibit 6.6, Agricultural Engineering Equations Applied in Sizing
of Machinery Units; Illustrative Inputs Complement
Data Set for IFLMAPS.

1. Effective field capacity (acre/hour):

$$\frac{\text{speed (mph)} \times \text{width (feet)} \times \text{efficiency}}{8.25}$$

2. Draft (pounds):

$$\text{draft (lb/in}^2\text{)} \times \text{width (inches)} \times \text{depth (inches)}$$

3. Drawbar requirements (horsepower):

$$\frac{\text{draft (lbs)} \times \text{speed (mph)}}{375}$$

SOURCE: American Society of Agricultural Engineers, 1979
Agricultural Engineers Yearbook.

Exhibit 6.7. Procedure for Rating Capacity of Machinery Units Required to Perform Two Tasks in a Field Operation; Illustrative Inputs Complement Data Set for IFLMAPS.

1. Equate a ratio of acreages upon which the respective tasks are to be performed to a ratio of the rated capacity of each task multiplied by the fraction of an hour spent performing that task:

$$\frac{\text{task \#1 acres}}{\text{task \#2 acres}} = \frac{\text{task \#1 ac/hr capacity} \times t}{\text{task \#2 ac/hr capacity} \times 1-t}$$

where t = portion of hour spent performing task #1

2. Solve for t such that the above ratios are equalized:

$$t = \frac{\text{task \#1 acres} \times \text{task \#2 ac/hr capacity}}{(\text{task \#2 acres} \times \text{task \#1 ac/hr capacity}) + (\text{task \#1 acres} \times \text{task \#2 ac/hr capacity})}$$

3. Calculate the complement unit overall capacity by weighting the capacity of task #1 by t and the inverse of task #1 acres

$$\text{_____ ac/hr} = \text{task \#1 ac/hr capacity} \times t \times (\text{task \#2 ac/task \#1 ac})$$

The desirability of a range of complement unit sizes has been justified in terms of allowing for representation of a wide range of farm sizes in IFLMAPS. Tractor sizes of 50, 75, 90, 100, 110, 120, 150, 175, 200 and 250 horsepower are arbitrarily selected to provide this range for the land preparation and planting complements. The corresponding implement sizes are calculated using the techniques presented in Exhibits 6.6 and 6.7. Only four sizes of harvesting units are included due to the discrete increment of size of such equipment. 4, 6, 8 and 12 row cornheads are the chosen sizes. Two and three row equipment are intentionally omitted. Usage of such equipment in conjunction with the smallest new self-propelled combine available (on a wide scale) vastly underutilizes the available power.

Tables 6.25, 6.26 and 6.27 relate the size and performance characteristics of the respective complement units for land preparation, planting and harvesting complements. Exhibits D.1, D.2 and D.3 in Appendix D present an example of the worksheets used to develop this information. Tables D.1, D.2 and D.3 in Appendix D specify the variables used in deriving the performance measures for the respective units.

Table 6.28 presents representative new costs for each of the units identified in Tables 6.25, 6.26 and 6.27. Exhibits D.4, D.5 and D.6 in Appendix D illustrate the worksheets used to arrive at these values. Table D.4 of Appendix D indicates the base prices used in conjunction with these worksheets to derive such cost estimates. The new costs presented in Table 6.28 may seem unordinarily high. However, recall that a user specifies his own machinery costs at the beginning of the

TABLE 6.25
Land Preparation Machinery Units; Illustrative Inputs
Complement Data Set for IFIMAPS

Tractor Size (Drawbar HP)	<u>Subsoiler*</u>			<u>Heavy Disc**</u>			Overall*** Capacity (ac/hr)
	Size (shanks)	Speed (mph)	Capacity (ac/hr)	Size (feet)	Speed (mph)	Capacity (ac/hr)	
50	2	3.61	1.84	5	4.75	2.02	1.30
75	2	5.41	2.75	7	4.95	2.94	1.92
90	3	4.33	3.31	8	5.10	3.46	2.27
100	3	4.88	3.67	9	5.06	3.86	2.53
110	3	5.29	4.04	10	5.03	4.27	2.79
120	3	5.77	4.41	11	5.0	4.67	3.05
150	4	5.41	5.51	14	4.95	5.88	3.83
175	5	5.05	6.43	16	5.0	6.79	4.44
200	6	4.81	7.35	18	5.06	7.73	5.07
250	7	5.15	9.18	23	4.99	9.74	6.36

*It is assumed that shanks are placed at 3 feet intervals and pulled at a depth of 20".

**It is assumed that this is a heavy tandem disc pulled at a depth of 6".

***Each acre/hour in the overall capacity rating of a unit reflects one acre disced and one-quarter acre subsoiled twice.

TABLE 6.26

Planting Machinery Units; Illustrative Inputs
Complement Data Set for IFIMAPS

Tractor Size (Drawbar HP)	Field Cultivator, Sprayer & Harrow*			Planter and Drill**			Overall*** Capacity (ac/hr)
	Size (feet)	Speed (mph)	Capacity (ac/hr)	Size (rows-ft)	Speed (mph)	Capacity (ac/hr)	
50	6	5.13	2.61	4-10	4.5	3.55	1.51
75	9	5.13	3.92	4-10	4.5	3.55	1.86
90	11	5.06	4.72	6-15	4.5	5.32	2.50
100	12	5.13	5.22	6-15	4.5	5.32	2.64
110	14	4.91	5.83	8-20	4.5	7.09	3.20
120	15	4.98	6.33	8-20	4.5	7.09	3.34
150	19	4.93	7.94	12-30	4.5	10.64	4.55
175	22	4.95	9.24	12-30	4.5	10.64	4.95
200	25	4.98	10.55	18-45	4.5	15.95	6.35
250	31	5.01	13.18	24-60	4.5	21.27	8.14

*It is assumed that field cultivator shanks are located at 1 foot intervals and pulled at a depth of 5 inches; the sprayer is located on the field cultivator and a spring harrow is dragged behind for smoothing purposes.

**Due to the minimal draft associated with planting (corn and soybeans) and drilling (wheat), the respective implements were sized according to observations of the real world; the drill was assumed to be the same width as the planter and both operations occur at 4.5 mph.

***Each acre/hour in the overall capacity rating of a unit reflects one acre seedbed prepared, etc. and one acre planted.

TABLE 6.27

Harvesting Machinery Units; Illustrative Inputs
Complement Data Set for IFLMAPS

Combine Size (Engine Horsepower)	Cornhead Size (30" rows)	Grain Platform Size (feet)	Corn Harvesting Capacity* (ac/hr)
100	4	15	2.97
145	6	20	4.45
165	8	24	5.94
200	12	30	8.91

*To calculate effective wheat and soybean harvesting rates, multiply the corn harvesting rate by 1.15 and 1.30, respectively. These factors account for both any difference in platform size and assumed differences in amount of corn harvest day available for harvesting the respective crops.

TABLE 6,28

Machinery Unit Costs; Illustrative Inputs
Complement Data Set for IFLMAPS

Unit Size	Horsepower Size	New Cost
<u>Land Preparation</u>		
1	50	\$ 23,230
2	75	29,391
3	90	37,067
4	100	41,006
5	110	44,945
6	120	50,399
7	150	65,751
8	175	79,689
9	200	88,173
10	250	104,232
<u>Planting</u>		
1	50	34,875
2	75	41,582
3	90	55,656
4	100	59,474
5	110	70,821
6	120	76,154
7	150	104,404
8	175	117,877
9	200	146,122
10	250	181,578
<u>Harvesting</u>		
1	100	64,741
2	145	88,779
3	165	105,848
4	200	134,431

sin

th

be

tr

fa

(i

an

ma

ca

al

t

u

I

e

l

a

p

f

t

w

t

T

n

I

simulation period. The new costs apply only to machinery purchased throughout the course of the simulation period.

Sales prices or salvage values as a function of machinery age must be included to account for cash flow requirements when a user sells or trades in a machinery complement. Table 6.29 presents the respective factors which indicate salvage value as a proportion of new cost (including inflation effects, if any). These remaining value factors are based on the assumed annual hour usage cited in calculating performance reliability and follow the convention presented by Bowers (p. 35).

Another programming feature of IFLMAPS penalizes the performance capacity of complement units as they age, i.e., they become less reliable. Such penalties are a function of the useful life of the respective complements components and an assumed hour usage of each complement unit owned (records of actual accumulated usage are not maintained in IFLMAPS). Figure 6.4 indicates the assumed decline in performance over equipments' useful life under normal maintenance. The expected useful life of the equipment comprising the machinery complements designed above are indicated in Table 6.30. Annual usage of each unit of a complement type owned is subjectively assumed to be 200, 300 and 150 hours for the land preparation, planting and harvesting complements, respectively.

Appraisal of the projected performance of the equipment items within each complement while recognizing that breakdown effects are multiplicative provides the reliability estimates shown in Table 6.31. These estimates multiplied by the performance capacity of a unit when new provide the realizable capacity over its expected life during IFLMAPS' simulation horizon. When more than one unit of a particular

TABLE 6,29

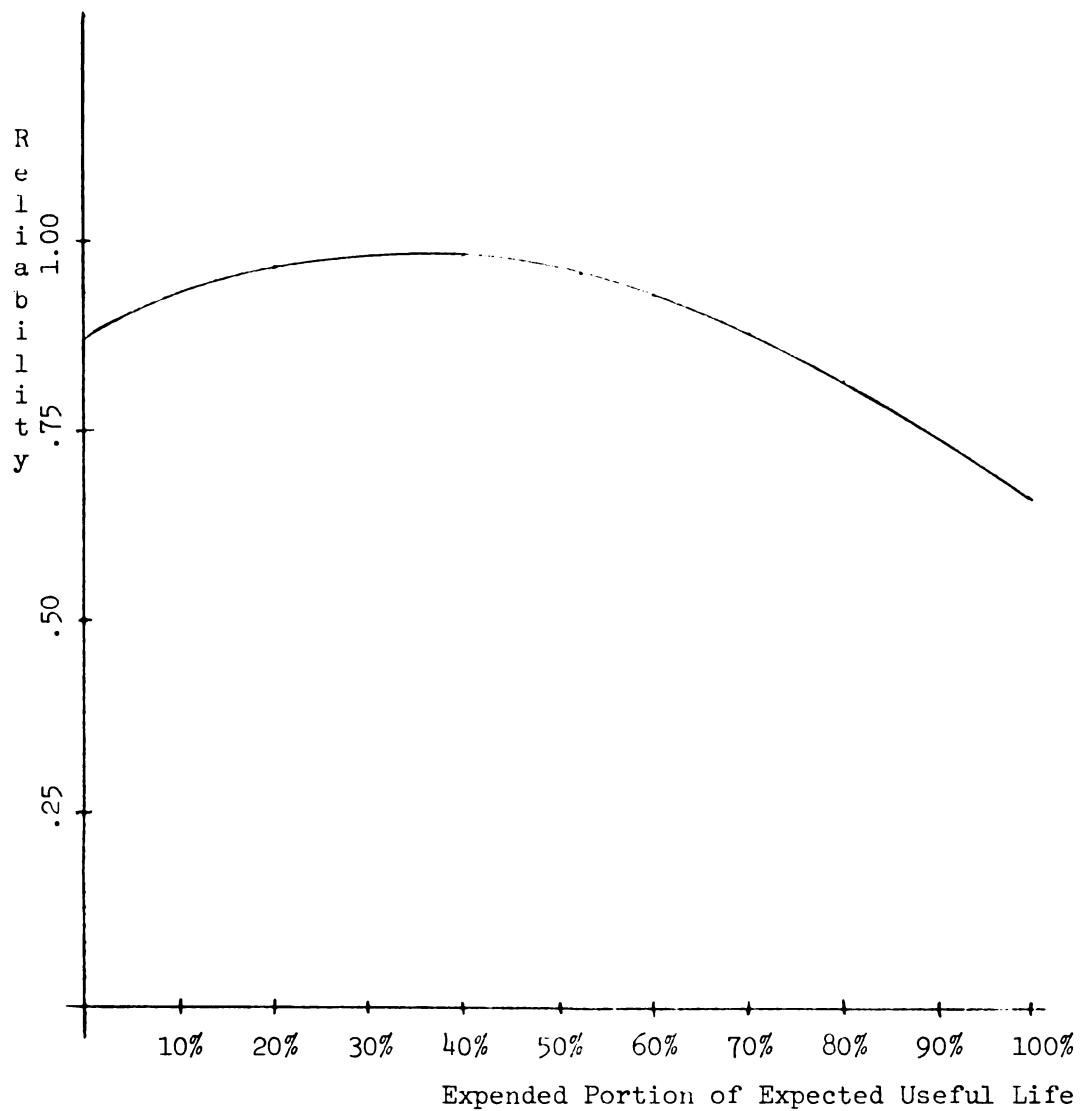
Salvage Value as a Function of Age and Current New Purchase
Price; Illustrative Inputs Complement
Data Set for IFLMAPS

Complement Unit Age	Complement Type		
	Land Preparation*	Planting**	Harvesting
0.0-1.99	.61	.57	.57
2.0-2.99	.56	.52	.51
3.0-3.99	.51	.47	.46
4.0-4.99	.46	.42	.41
5.0-5.99	.42	.38	.37
6.0-6.99	.39	.34	.33
7.0-7.99	.34	.31	.29
8.0-8.99	.31	.28	.26
9.0-9.99	.29	.25	.23
10.0+	.26	.23	.21

SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970), p. 35.

*Based on 70 percent of value representing tractor and remaining 30 percent representing other implements and miscellaneous capital items.

**Based on 45 percent of value representing tractor and remaining 55 percent representing other implements and miscellaneous capital items.



SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970), p. 33.

Fig. 6.4. Reliability of machinery as a function of expected useful life

TABLE 6.30

Expected Useful Life of Farm Machinery; Illustrative
Inputs Complement Data Set for IFLMAPS

Item	Expected Useful Life (Hours)
Tractor	12,000
Self-propelled combine	2,000
Planter	1,200
Subsoiler	2,000
Drill	1,000
Disc	2,000
Cultivator	2,000

SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970), p. 12.

TABLE 6.31

Reliability Adjustment Factors; Illustrative Inputs
Complement Data Set for IFLMAPS

Average Age of All Complement Units Owned	Machinery Type		
	Land Preparation	Planting	Harvesting
0.0-1.99	.81	.80	.95
2.0-2.99	.90	.89	.97
3.0-3.99	.92	.90	.98
4.0-4.99	.92	.91	.99
5.0-5.99	.92	.91	.99
6.0-6.99	.87	.88	.98
7.0-7.99	.84	.86	.98
8.0-8.99	.79	.80	.95
9.0-9.99	.74	.77	.93
10.0+	.62	.68	.89

SOURCE: Wendell Bowers, Modern Concepts of Farm Machinery Management, (Champaign, IL: Stipes Publishing Co., 1970, p. 33).

complement type is owned by a user, the average acre per hour capacity and average age of the complement units are used in arriving at the realizable capacity estimates.

The machinery complements developed above are utilized for performing the respective field operations on acreage relating to each of the three crops (wheat, corn and soybeans). IFLMAPS' programming allows modification of the performance measures cited above in a limited sense. Inasmuch as it is not possible to distinguish the crop previously planted on land currently being prepared, only one efficiency factor is included for the land preparation operation (PRPEFF). Three factors are included for both the planting operation and harvesting operation (PLTEFF(3) and HRVEFF(3), respectively). Normally, PRPEFF should have a value of 1.0, i.e., the capacity of land preparation complement units is 100% of the calculated levels, accounting for age of the owned units. However, deviation from this standard is suggested when an administrator desires to increase (lower PRPEFF) or decrease (raise PRPEFF) the time required for land preparation without recalculating an entire new complement. The assumption of heavier or lighter soils in a particular state/region may be such an occasion. When similar seedbed preparation requirements and similarly sized planter and drill implements in the planting complement are assumed, all PLTEFF factors may be set equal to 1.0. If one desires to drill wheat faster than planting corn and/or soybeans, PLTEFF(1) should be set at some level exceeding 1.0 and PLTEFF(2) and (3) adjusted accordingly, i.e., PLTEFF(1), (2) and (3) correspond to wheat, corn and soybeans, respectively. The harvesting efficiency factors (HRVEFF(3)) reflect two separate issues. Recognize that the performance measures for the harvesting units are based on

corn. First, the harvesting rate for wheat and soybeans will exceed that of corn and soybeans. And second, the average hours specified as being available for field operations in the selected State/Region complement data set during the harvesting season should also apply to corn. The necessity of allowing the dew to dry from wheat and soybeans in the mornings prior to beginning harvest effectively diminishes harvesting complement units' capacity when used on these two crops. Because of lower yields (both grain and dry matter) of wheat and soybeans, greater platform widths, faster ground speed and/or higher field efficiency (due to less unloading time) are permitted. With respect to the first issue, platform width, ground speed and field efficiency are adjusted so as to increase per hour capacity by 53 percent for wheat and soybeans as opposed to corn. Regarding the second issue, it is assumed that 75 and 85 percent of a corn harvest day is available for harvesting wheat and soybeans, respectively. The aggregation of this information results in harvesting efficiency factors for wheat, corn and soybeans of 1.15, 1.0 and 1.30, respectively.

Drying/storage facilities

The possibility of specifying six different sizes of units allows administrators an opportunity to incorporate some economics of size into IFLMAPS. Table 6.32 identifies the respective sizes and corresponding costs chosen for the simulation of Michigan farm environments.

TABLE 6.32

On-Farm Grain Drying and Storage Facilities
Available for Purchase; Illustrative Inputs
Complement Data Set for IFLMAPS

Size (Bushel Capacity)	Total Cost
2,000	\$ 7,700
5,000	16,500
10,000	26,620
20,000	46,420
30,000	59,400
50,000	102,300

SOURCE: These costs are based on initial capital investment estimates contained in Jerry Skees, et al., On-Farm Grain Handling Costs--Engineering and Economic Factors, Department of Agricultural Economics Staff Paper 79-83, Michigan State University, 1979. The costs are inflated 10 percent above those specified in the cited reference.

Inflation factors

As already noted, there are no inflation effects incorporated into this illustrative Inputs complement data set. Consequently all inflation factors are to be specified at levels of 1.0 with the exception of those affecting family living expenditures which should be set equal to 0.0.

Other technical parameters

Machinery operating costs

Annual usage of each unit of a complement type owned is subjectively assumed to be 200, 300 and 150 hours for the land preparation, planting and harvesting complements, respectively. The expected useful life of the equipment comprising the machinery complements designed above are indicated in Table 6.30.

Availability of rental acreage

Table 6.33 presents two sets of ten observations randomly selected from a uniform distribution of random numbers. The selection process was limited to two digit observations, thereby constraining the observation to the desired 0-99 range. These observations facilitate the endogenous calculation of rental land availability during each simulation year as discussed in Chapter 4.

TABLE 6.33

Rental Land Availability Random Observations from a
Uniform Distribution of 0-99; Illustrative
Inputs Complement Data Set for IFLMAPS

Observation	Tenure Arrangement	
	Cash-Rented Land	Share-Rented Land
1	52	24
2	35	58
3	09	97
4	92	54
5	04	20
6	20	60
7	60	43
8	06	13
9	52	99
10	91	10

SOURCE: These observations were randomly selected from a table found in John Neter and William Wasserman, Applied Linear Statistical Models, (Homewood, IL: Richard D. Irwin, Inc., 1974), 833.

Government Commodity Program¹³³

It has previously been indicated that the Government Commodity Program subsystem of IFLMAPS is only an approximation of the current real world program. The following data specifications are heuristic in origin, meant only to demonstrate the flexibility allowed for in designating such a complement data set.

Compliance

Cross-compliance across land tenure classes is assumed to be required only in alternating simulation years, beginning with the first year.

Diversion requirements

Table 6.34 indicates the respective assumptions regarding annual diversion requirements as a percentage of planted acreage on an individual crop basis.

Diversion payments

Table 6.35 indicates the corresponding respective assumptions pertaining to the per acre payment associated with diverted acreage during each simulation year.

Storage payments

Annual government storage payments for grain entered in the "reserves" program in IFLMAPS are assumed to be in the magnitude of \$.30 per bushel during each of the ten years in the simulation horizon.

¹³³Refer to Exhibit C.5 in Appendix C for an indication of how this data is entered on the appropriate input form.

TABLE 6.34

Diversion Requirements;* Illustrative Government Commodity
Program Complement Data Set for IFLMAPS

Simulation Year	Crop		
	Wheat	Corn	Soybeans
1	.00	.00	.00
2	.10	.20	.00
3	.30	.00	.00
4	.00	.10	.10
5	.10	.10	.10
6	.20	.15	.00
7	.00	.00	.00
8	.15	.15	.00
9	.20	.20	.00
10	.30	.30	.00

*Proportion of planted acreage that must be set aside
in an unplanted state.

TABLE 6.35

Diversion Payments;* Illustrative Government Commodity
Program Complement Data Set for IFILMAPS

Simulation Year	Crop		
	Wheat	Corn	Soybeans
1	\$.00	\$.00	\$.00
2	50.00	40.00	.00
3	75.00	.00	.00
4	.00	100.00	100.00
5	10.00	10.00	10.00
6	.00	.00	.00
7	.00	.00	.00
8	90.00	90.00	.00
9	75.00	75.00	.00
10	50.00	100.00	.00

*Payment levels are applicable to each acre diverted for government commodity program purposes during the respective simulation years.

Interest rates

Annual government interest rates are assumed to be 10% during each of the ten years in the simulation horizon.

Loan and reserve prices

Table 6.36 presents the respective loan prices chosen for each crop during each of the ten years contained in a simulation horizon. "Release" and "call" reserve price factors are represented as 1.45 and 1.75, respectively, for all three crops.

Yields¹³⁴

Dynamic yield conditions are represented in this illustrative Yields complement data set through use of MVBETA (the FORTRAN software package discussed previously in this Chapter regarding the derivation of quasi-random output price movements). The non-availability of readily accessible information necessitates several assumptions concerning the parameters of probability distributions representing the dynamic yield conditions, i.e., the populations from which the RY_1 factors in Exhibit 4.1 of Chapter 4 are selected.

First of all, it is assumed that each of the probability distributions are normal, i.e., they have a bell-shaped density function:

$$\frac{1}{\sqrt{2\pi} \sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad \text{for } -\infty < x < \infty \quad \text{with: mean} = \mu \text{ and standard deviation} = \sigma$$

In such a distribution, the interval ± 2 standard deviations of the mean includes 95.4% of the distribution (Bhattacharyya and Johnson, p. 194).

¹³⁴ Refer to Exhibit C.6 in Appendix C for an indication of how this data is entered on the appropriate input form.

TABLE 6.36

Loan Prices; Illustrative Government Commodity
Program Complement Data Set for IFLMAPS

Simulation Year	Crop		
	Wheat	Corn	Soybeans
1	\$3.00	\$2.30	\$5.00
2	3.00	2.30	5.00
3	3.25	2.30	5.00
4	3.25	2.30	5.00
5	3.30	2.30	5.00
6	3.30	2.30	5.00
7	3.35	2.30	5.00
8	3.40	2.30	5.00
9	3.40	2.30	5.00
10	3.40	2.30	5.00

ance

tion

Such

rela

cont

illu

dist

erm

assu

ther

2.3

is

ina

Thi

Tab

cas

ye

the

wit

ye

ran

ous

to

den

Recall that use of MVBETA requires specification of the mean, variance, and upper and lower bounds of the respective probability distributions as well as the assumed covariances between such distributions. Such specifications implicitly forces assumptions concerning the desired relationship of the random yield factors to the potential yield levels contained in the Initial Firm Structure complement data set. For this illustrative data set, it is assumed that the mean of the probability distributions in all cases is .90 of the potential yield level. Furthermore, the factor of 1.0 corresponding to the potential yield level is assumed to be located two positive standard deviations from the mean, thereby allowing for yields in excess of the potential yield level only 2.3% of the time.¹³⁵ It follows that the variance of such a distribution is .0025. The upper and lower bounds of the distributions are discriminately set at plus and minus three standard deviations, respectively. This constrains the random factors to a range of .75 to 1.05. Table 6.37 summarizes these assumptions.

Recall that a high degree of correlation is desirable between forecast and actual yields in order to represent farmers' perceptions of yields prior to harvest time. So as to introduce correlation between the factors representing forecast and actual yield levels for a crop within a simulation year as well as any desired correlation between yield levels for the different crops, MVBETA is used to determine the random factors from the six distributions noted in Table 6.37 simultaneously. Table 6.38 indicates the correlation matrix subjectively assumed to provide the desired degrees of correlation. Little correlation is

¹³⁵This is commensurate with the nature of a normal probability density function.

TABLE 6.37

Random Yield Probability Distribution Parameters;
 Illustrative Yields Complement Data Set
 for IFLMAPS

	Wheat	Corn	Soybeans
	<u>Forecast Yields</u>		
Mean	.90	.90	.90
Variance	.0025	.0025	.0025
Upper bound	1.05	1.05	1.05
Lower bound	.75	.75	.75
	<u>Actual Yields</u>		
Mean	.90	.90	.90
Variance	.0025	.0025	.0025
Upper bound	1.05	1.05	1.05
Lower bound	.75	.75	.75

Conn

W_P

C_P

C_P

W_A

C_A

C_A

resp

yield

TABLE 6.38

Correlation Matrix Relative to Random Yield Probability
Distribution Parameters; Illustrative Yields
Complement Data Set for IFLMAPS

	W_F	C_F	S_F	W_A	C_A	S_A
W_F	1.0	0.0	0.0	0.85	0.0	0.0
C_F	0.0	1.0	0.1	0.0	0.85	0.0
S_F	0.0	0.1	1.0	0.0	0.0	0.85
W_A	0.85	0.0	0.0	1.0	0.0	0.0
C_A	0.0	0.85	0.0	0.0	1.0	0.1
S_A	0.0	0.0	0.85	0.0	0.1	1.0

NOTE: W, C, and S refer to wheat, corn, soybeans, respectively. F and H refer to forecast and actual yield sets, respectively.

assumed among crops (only .1 between corn and soybeans) so as to result in more stochastic yield levels. A correlation of +.85 is assumed between forecast and actual yields for the purpose of providing consistency between pre-harvest observations and realized yields. Table 6.39 presents several observations produced by MVBETA under these assumptions. In this illustrative Yields complement data set, the respective factors are set at .90 during the first two simulation years in order to allow IFLMAPS' users to become comfortable with its simulation procedure prior to confronting them with sources of yield uncertainty. This is similar to the approach followed in the preparation of quasi-random price movements in the illustrative Output Price complement data set.

Field Time¹³⁶

The requisite data for this illustrative Field Time complement data set is prepared with the use of MVBETA. Inasmuch as there is no data currently available in a usable format, several unsubstantiated assumptions are made concerning the probability distributions of the RF_1 's in Exhibit 4.2 of Chapter 4. First of all, a normal probability density function is chosen. Refer to the illustrative Yields complement data set discussion in this Chapter for an indication of the mathematical nature of such a function. A mean of 1.0, a variance of .0064 and lower and upper bounds of .76 and 1.24, respectively, are designated as the parameters of the individual distributions corresponding to each of the 47 possible time periods. Correlation factors of .75 and .50 with the

¹³⁶ Refer to Exhibit C.7 in Appendix C for an indication of how this data is entered on the appropriate input form.

TABLE 6.39

Random Yield Factor Observations;* Illustrative Yields
Complement Data Set for IFLMAPS

Forecast Yield Factors			Actual Yield Factors		
Wheat	Corn	Soybeans	Wheat	Corn	Soybeans
.91	.93	.89	.94	.89	.89
.89	.93	.97	.88	.91	.92
.94	.95	.88	.97	.90	.83
.84	.93	.91	.86	.93	.91
.89	.91	.84	.89	.92	.86
.90	.83	.83	.90	.88	.86
.84	.93	.92	.88	.92	.91
.91	.92	.94	.93	.94	.94
.97	.80	.95	.96	.83	.96
.84	.85	.93	.86	.88	.99
.87	.89	.90	.84	.92	.91
.86	.84	.91	.89	.82	.90
.92	.90	.87	.95	.89	.89
.90	.84	.85	.84	.83	.85
.89	.98	.92	.90	.97	.91
.90	.92	.88	.89	.95	.89
.84	.83	.88	.87	.83	.91
.88	.95	.88	.89	.94	.88
.95	.95	1.00	.98	.95	.98
.89	.92	.85	.88	.96	.89
.89	.88	.93	.86	.89	.94
.91	.90	.98	.89	.91	.97
.90	.89	.87	.88	.88	.86
.90	.94	.95	.87	.95	.93
.78	.87	.96	.77	.92	.98
.90	.95	.96	.92	.92	.92
.96	.97	.92	.96	.93	.88
.95	.79	.90	.93	.78	.90
.93	.87	.97	.91	.88	.97
.89	.83	.89	.88	.80	.87

*These factors are representative of those derived through use of the MVBETA Fortran software package under the conditions specified in Tables 6.37 and 6.38.

time periods either side of and next to either side of the immediate time period, respectively, are also assumed. These relatively high degrees of correlation and confining parameters of the density functions appear to provide the desired consistency in variability across the time periods as evidenced by the data set presented in Table 6.40.¹³⁷ Random adjustment factors of 1.0 are specified during the first two simulation years in order to allow users to familiarize themselves with the static environment of IFLMAPS prior to subjecting them to a dynamic world.

¹³⁷The offsetting effect of prior periods' wet (dry) conditions are assumed to tend to temper the effect of dry (wet) conditions in the present time period. It is therefore not desirable to allow a wide range in the adjustment factors between adjacent time periods.

TABLE 6.40

Random Field Time Adjustment Factors; Illustrative
Field Time Complement Data Set for IFLMAPS

Time Period	Random Factor	Time Period	Random Factor
1	.99	25	.89
2	1.10	26	.85
3	1.17	27	.84
4	1.01	28	.86
5	1.01	29	.90
6	.85	30	.97
7	1.10	31	1.10
8	1.06	32	1.07
9	1.08	33	.96
10	.96	34	.93
11	.94	35	.92
12	.86	36	1.01
13	.93	37	.98
14	.92	38	.97
15	.90	39	.93
16	.93	40	.93
17	.94	41	.96
18	.98	42	.96
19	1.02	43	1.12
20	.94	44	1.11
21	.85	45	1.06
22	.84	46	.96
23	.85	47	.96
24	.95		

CHAPTER 7

TEACHING/EXTENSION APPLICATIONS

Introduction

While discussing the principles and methods associated with curriculum development, Kropp presents several ideas applicable to the teaching of an individual course (pp. 736-738):

The purpose here is to provide the learner with experiences which will enable him to understand himself better and to cope more meaningfully, in a nonvocational manner, with the reality with which he must interact....

...Focus should be on the behavior which learners should acquire. If one directs his attention to them and then asks what experiences can be devised so that exposure to them will cause the student to modify his behavior, he will immediately become aware that much of the content traditionally associated with a discipline would be equally useful in creating the desired experiences

Curriculum experiences should be chosen partially on their accessibility to students. The most accessible experience is, of course, that furnished by a single textbook or a lecturer, but neither is very useful in helping the student develop complex behaviors. These are more likely to be developed through planned exercises which require the student to integrate more elemental behaviors into more complex ones. To make such supportive learning environments accessible to the learner, the instructor must abstract them from life and present them as hypothetical situations into which learners are thrust. Exercises in a workbook are simple examples of this, and the old Link Trainer as a flight simulator is a more complex one. But now the curriculum developer is in a much more powerful position because he has electronic computers at his command. These are capable of simulating experiences in a way that is comprehensive, swift, and complex. Students are literally propelled into a make-believe world that has so many realistic qualities that the learner is swept up by the seeming realism of it.

Partly in response to these selected remarks of Kropp, IFLMAPS is designed and constructed to lend itself to teaching/extension

applications focusing on several farm management principles. Its structure is complementary to Harsh et al.'s description of the farm business environment and associated decision-making requirements:

Farming is a business that is subject to a continuous stream of changing circumstances. This dynamic environment includes price fluctuations, new technology, change in input availability, new marketing strategies, and need for improved management skills. In addition, farmer goals seldom remain constant through time, particularly as the farm advances through the business life cycle. Some of the changes confronting a farmer occur on a daily basis. Others occur on a yearly or less frequent basis. Regardless of their frequency of change, a farm manager must make decisions regarding how he should adjust his business to expected future circumstances. Given that changes are a significant part of farming, how does a manager determine when to make adjustments, what adjustments to make, or how great an adjustment is needed in his business? (p. 177)...

...Decision making is the crux of management. For every problem there is a "right" decision. Rightness, however, is seldom if ever measured in absolute terms. Decisions are conditionally right, depending on the manager's state of knowledge and goals and any resulting conditions he wishes to impose on the decision.

Farm decision making requires an evaluation of potential outcomes under various states of knowledge in conjunction with the goals of the manager and any conditions or assumptions he wishes to impose...Planning information by itself is inadequate for making a decision. It has to be appraised by the manager in the context of his goals and individual circumstances before making a decision. Since managerial goals are subject to change over the family/farm life cycle, individual farmers may not always make the same decision when confronted with the same problem (p. 359)....

...Because of unforeseen or uncontrollable factors, a farmer cannot be assured that good decisions always result in good outcomes. Indeed, unforeseen or controllable factors may sometimes turn bad decisions into good outcomes. Through studying the outcomes of past decisions, the farmer can assess the quality of his decision making. Over time, good outcomes cannot be achieved by farm managers without good decisions....

...a successful manager learns from his previous decisions and past experiences. If a decision was a good one in that some goals were achieved, the manager should attempt to determine why it was successful. If the decision was a bad one, what were the factors that caused it to be unfavorable? Past decisions should be considered a source of information, not a rigid plan for the future. Circumstances change and new decisions must include information to reflect these changes (p. 366).

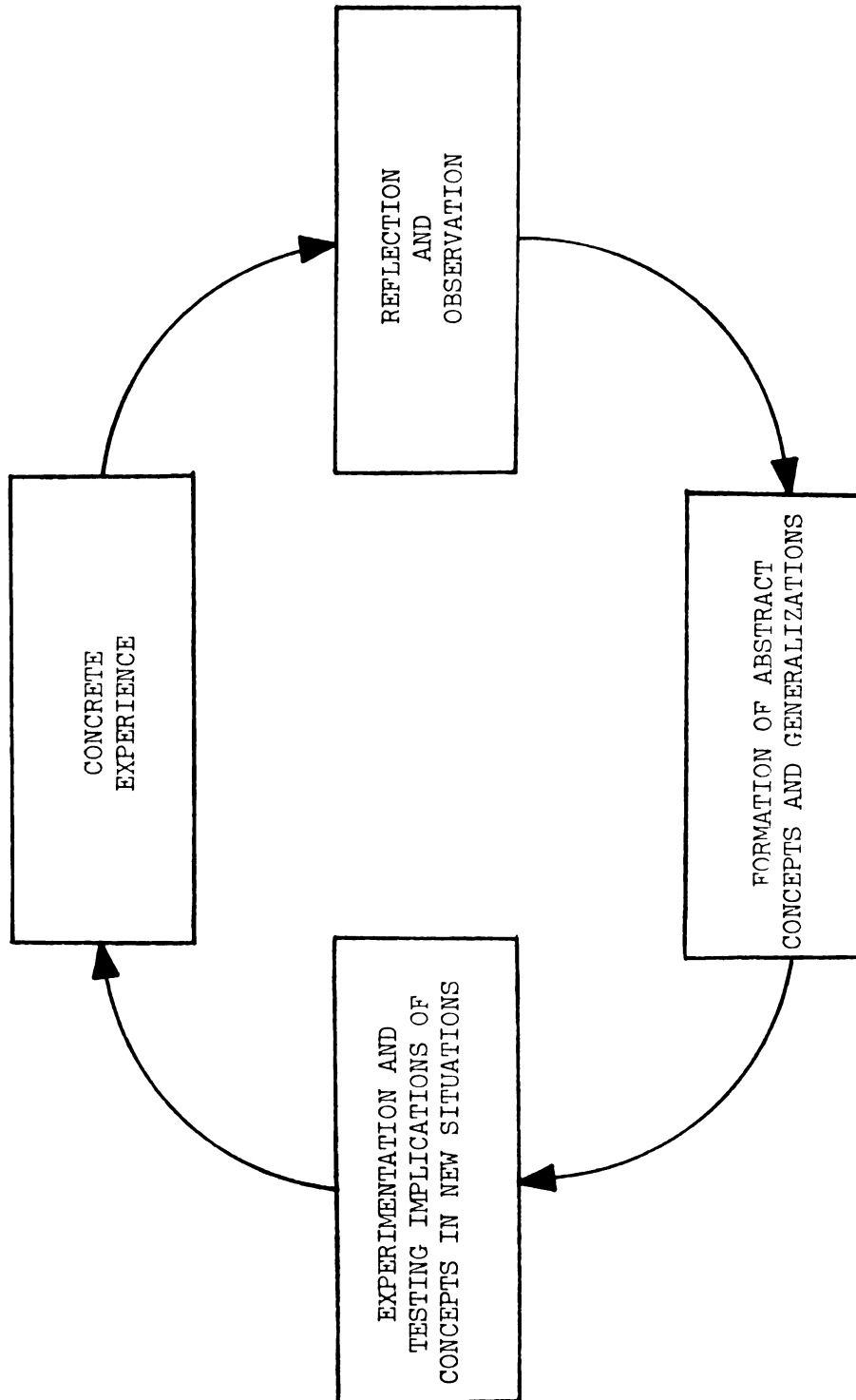
Menz and Longworth present several points pertinent to the application of using a complex computerized management simulation model as a teaching instrument (p. 551):

1. In referencing French, they note that "it is 'relevance' rather than exposure to the real world per se that is required."
2. In referencing Boehlje et al. and Huffman, they suggest that farm management instruction aimed at improving 'allocative ability' should emphasize concepts rather than the mechanical use of tools.
3. Motivation and involvement on the part of students is enhanced. This heightened interest may be transformed into a teaching approach "that emphasizes discovery and relevance."
4. "...basing [of a] course on a realistic management situation [helps] to create a classroom environment in which the student learns to recognize management problems and then actually 'reaches out for' analytical procedures to help meet the challenges posed by these problems."

Boehlje and Eidman present a firm case for using simulation and gaming models in both teaching and extension applications. The four objectives that they identify as being among the most important in most university and adult education programs are: (1) to transfer facts, (2) to increase analytical capabilities, (3) to improve integrative capability, and (4) to clarify values. Corresponding to Figure 7.1's depiction of the learning process, they suggest (p. 988):

Simulation and gaming procedures facilitate efficiently performing the learning functions in the testing and experimentation and concrete experience phases of the learning process. Gaming enables students to develop and test hypotheses concerning their conceptualization of the problem and its solution. The use of games accelerates the active experimentation and concrete experience phases of the learning process so that additional concepts can be introduced within a given time frame...Through the use of the gaming procedure, the benefits of active experimentation, hands-on decision making and "pseudo" concrete experiences can be included in the learning experience....

...Gaming provides an opportunity to apply the concept, obtain concrete experience, and complete the experiential learning model cycle by observing and reflecting.



SOURCE: Michael D. Boehlje and Vernon R. Eidman, "Simulation and Gaming Models: Application in Teaching and Extension Programs," American Journal of Agricultural Economics 60(1978):988.

Fig. 7.1. Experiential learning process

Boehlje and Eidman further reinforce the earlier cited views of Longworth and Menz in stating (p. 989):

The authors' experience indicates gaming contributes to learning by showing a use for facts, demonstrating a need for the analytical capabilities, providing an opportunity to practice integration, and forcing participants to consider their values in making decisions. The interest and challenge generated by the gaming process carries participants through the cycle of the experiential learning model in a repetitive manner.

Teaching Farm Management
Principles with IFLMAPS

Be it in the confines of the university classroom with students or in out-state Extension meetings with agricultural producers, IFLMAPS can be used in teaching several important farm management principles. The model represents many complex relationships inherent in a farm business. Its incorporation of several sources of uncertainty simulates an environment that is appropriate for the teaching of these principles. The integration of lectures, discussion sessions and use of selected references with IFLMAPS is foreseen as an excellent opportunity to challenge and encourage students and farmers alike to pursue their studies with heightened intensity.

IFLMAPS' scope prohibits full realization of its appropriateness for teaching applications unless one has used the model to simulate one or more complete years. Personal observation of the model's sequence of information flows and decision opportunities best serves to illustrate its value as a learning instrument.

Although IFLMAPS emphasizes numerous farm management concepts, there are several areas that are not addressed. Production functions and related stages of production, input and output substitution, form of business organization, personnel management, tax effect of a net

operating loss, spatial dispersion of operation and estate planning are among the issues ignored in IFLMAPS. Other topics not explicitly considered are the type of accounting system to be used, question of whether to own or custom hire machinery resources, quality of output product, whether or not to invest in real estate, and the value of crop insurance.

There are other farm management principals which are accounted for in IFLMAPS only in an implicit fashion. Discipline on the part of both the model's administrators and its users is necessary if these principles are to be adequately represented. Foremost among these principles are the influence of decision-makers' goals and the feedback impacts associated with responsibility bearing resulting from executed decisions. Users must be encouraged to interact with the model in a realistic manner. The fictitious automatic implementation of decisions and provision of information obscures the time delays associated with synonymous real world actions. The abbreviated decision period suppresses much of the subconscious analysis ordinarily conducted by producers while evaluating alternative marketing, production and financial strategies. Here again, users must be inspired to sufficiently deliberate on the repercussions of each feasible option.

Several of the farm management principles accounted for within IFLMAPS have been represented in previously constructed simulation models. IFLMAPS' focus on marketing decisions combined with its remote access, interactive and intermittent usage are the features which serve most to distinguish it from these models. Some strong features of IFLMAPS in teaching are its "whole farm" systems approach, its continuous and timely stress on the need to make decisions and its adaptability

to several geographic areas. The model highlights several concepts not easily observed in the real world. Providing for monthly decisions makes for increased realism by recognizing the need for awareness and evaluation of the several marketing alternatives available. The flexibility to represent farm decision-making environments in various geographical locations under sundry economic conditions is made possible by accessing various combinations of the several complement data sets.

The farm management concepts included in IFLMAPS are best discussed within the context of several broad areas:

1. Marketing
2. Production
3. Financial
4. Labor
5. Machinery
6. Income tax
7. Decision-making and information

Marketing

Each user must answer the basic questions of marketing methods, timing and related activities (refer to Figures 2.3 and 2.4 in Chapter 2). It is his or her responsibility to interpret the available information and analyze the alternatives prior to executing any marketing actions. The representation of the local cash market, local forward cash contracts, Chicago futures market contracts and government commodity loan and reserve programs within IFLMAPS results in a formidable marketing problem for the user. The modelling techniques used to reflect these distinct but interrelated markets directs attention toward

normal seasonal price relationships for the three crops. Subsequently, the effects of changing fundamental market conditions may be introduced into the current market accompanied by the reflection of uncertainty regarding future such price movements.

IFLMAPS allows its users to first be concerned with marketing decisions concerning a particular crop prior to deciding upon their planting intentions for that crop. The availability of forward cash contracts as well as the possibility of hedging in the futures market provides this early marketing opportunity. This feature of IFLMAPS enables users to consider market prices while deciding upon planting intentions of the respective crops in much the same manner as occurs in the real world. Throughout the planting season and up until harvest time, users are provided with additional marketing opportunities and related market outlook information. Forward cash contract obligations must be fulfilled. If a yield shortfall occurs, the model endogenously forces the user to buy the required grain at slightly above the local cash market price. However, in the case of futures market contracts, users are allowed to lift hedging (and speculative) contracts at their discretion. Harvested crops are disposed of as designated by users. On- and off-farm storage are among the alternatives allowed. Recognition of the cash and non-cash opportunity costs associated with such storage as well as evaluation of the uncertainty of ensuing price improvements are among the marketing problems to be addressed by IFLMAPS users.

Production

The provision for growing three crops under three distinct land tenure arrangements within IFLMAPS gives its users an excellent opportunity to discover and apply the "equimarginal principle" (Harsh et al.,

p. 43). The inclusion of several planting/harvesting period combinations and corresponding yield relationships presents users with the complex problem of deciding what level of machinery resources to possess. Users are also allowed to specify initial planting intentions with respect to each crop and subsequently change them, if desired, upon the completion of each respective planting period.

Opportunities for emphasizing variable and fixed costs as well as operating and ownership costs relationships are provided within IFLMAPS. The former principle is embodied in how hauling and/or drying costs are calculated for the respective crops. The latter concept is most apparent concerning the use of owned machinery resources.

Financial

The inclusion of a maximum allowed Debt/Equity ratio in the Initial Firm Structure complement data set is responsible for setting bounds on the financial position of IFLMAPS' users. Violation of this ratio results in sharply higher interest rates being levied against new short-term loans as well as the curtailment of the availability of additional intermediate loans. It follows that users must consider the cash flow consequences of their marketing, production and capital investment decisions while seeking to increase their annual Net Farm Income. The opportunity exists to emphasize the need for internal credit rationing in order to (1) avoid forced marketing of production and (2) enable execution of timely investment decisions.

The anticipation of principal and interest payments along with other sundry cash outflow items such as family living, variable inputs, land rent, grain storage and hauling costs, and futures' margin requirements, to name a few, should encourage users to investigate the

profitability of the available marketing alternatives with diligence. The provision of annual Net Farm Income statements, end of year Net Worth statements and both monthly and annual cash flow statements offers excellent opportunities for integrated financial analyses on the part of users. Users' exogenous calculation of various ratios can serve as the basis for both time series analysis of their own simulation operations and comparative analysis with others' simulated farms.

Labor

The manner in which IFLMAPS integrates labor and machinery availability to determine the performance of field operations during each time period necessitates users' attention towards the specification of labor availability. The encouragement of analysis in this area should result in students recognizing the respective marginal values of additional labor and machinery resources. IFLMAPS' representation of yield reduction effects occurring as a result of delayed field operation performance results in such analysis being of perplexing magnitude. The marginal values can not be determined in as straightforward a manner as is possible with linear programming. Rather, users will have to iteratively discover the value of additional resources by observing simulation results over several years.

Machinery

IFLMAPS includes machinery decision alternatives to account for (1) the effect of untimely field operations on yield and (2) the cash flow requirements associated with owning and operating such machinery. Both factors are assumed to impact producers' marketing decisions. The model's reflection of lessening reliability and increasing repair costs

as individual machinery units age along with the opportunity to buy, sell or trade individual machinery units confronts users with a capital investment problem. Both partial and capital budgeting can be utilized to evaluate such investments. The fluctuating impact of federal income tax and weather uncertainty realistically impedes such analyses. The possibility of distinguishing between original and replacement cost (Harsh et al., p. 52) also exists concerning machinery. Diminishing returns are implicitly incorporated into machinery ownership in the manner in which timeliness of field operations affects harvested yield.

Tax

IFLMAPS' representation of federal and state income taxation on a cash accounting basis confronts its users with a realistic tax management problem. Their ability to delay income and shift expenses along with the provision for income averaging represents several of the tax minimization strategies available in the real world. In addition, users desiring to make additional investments in machinery and/or grain drying and storage facilities are allowed to execute such decisions in both December and January. This flexibility enables users to ascertain which tax year they wish the additional depreciation and investment tax credit associated with such investments to first be considered in. Users of IFLMAPS can also be required to prepare the appropriate tax returns based on the information sets provided.

Decision-making and information

With respect to all of the aforementioned areas, IFLMAPS' users must assimilate sundry information sets in their efforts to execute "good" decisions. The integrated nature of IFLMAPS forces its users to

perform this phase of the managerial process in much the same manner as required in the real world. In addition to the varied information sets endogenously generated, users are to be encouraged to prepare forward planning budgets, whole farm analyses and assorted financial statement analyses. Records of performance similar to the output market price chart illustrated in Exhibit 7.1 are also probably useful exercises. In addition, graphing of the normal price relationships to be expected during the simulation of a particular geographical locations should be advocated as a further means of discovery "good" output pricing opportunities.

There is always the concern that "bad" decision-making skills will be taught when one abstracts from reality, be it through case problems, simulation games, etc. IFLMAPS is not capable of preventing "good" results from "bad" decisions. Therefore, just as in the real world, it is possible for the model's users to receive erroneous feedback for the types of decisions executed. It is the role of instructors using the model to focus attention on users' decision processes and the reasons responsible for their ultimate decisions. This type of discussion has the potential to expose faulty reasoning which is not always the case with teaching methods of lesser scope. Producers do not ordinarily examine their own real world decisions in the depth necessary to indicate whether a decision was "good" or "bad". Proper usage of IFLMAPS allows for careful review of users' managerial processes, thereby providing insight on their management skills.

Observations and Suggestions

In order for IFLMAPS to be successfully utilized in teaching and/or extension applications, a substantial amount of supportive material must

Exhibit 7.1. Chart for Recording IFLMAPS' Monthly Output Prices.

NAME: _____	OUTPUT PRICE COMPLEMENT: _____
SIMULATION YEAR: _____	STATE: _____
CROP: _____	REGION: _____
CONTRACT MATURITY MONTHS - HARVEST: _____; POST-HARVEST: _____	
MONTH: JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC	
1. <u>CASH PRICES:</u>	
2. NATIONAL AVERAGE	_____
3. CHICAGO	_____
4. LOCAL	_____
5. <u>FORWARD CASH CONTRACT PRICES:</u>	
6. HARVEST DELIVERY - CURRENT YEAR	_____
7. CURRENT BASIS	_____
8. NORMAL BASIS	_____
9. POST-HARVEST DELIVERY - CURRENT YEAR	_____
10. CURRENT BASIS	_____
11. NORMAL BASIS	_____
12. HARVEST DELIVERY - NEXT YEAR	_____
13. CURRENT BASIS	_____
14. NORMAL BASIS	_____
15. POST-HARVEST DELIVERY - NEXT YEAR	_____
16. CURRENT BASIS	_____
17. NORMAL BASIS	_____
18. <u>FUTURES MARKET CONTRACT PRICES:</u>	
19. HARVEST DELIVERY - CURRENT YEAR	_____
20. CURRENT BASIS	_____
21. NORMAL BASIS	_____
22. POST-HARVEST DELIVERY - CURRENT YEAR	_____
23. CURRENT BASIS	_____
24. NORMAL BASIS	_____
25. HARVEST DELIVERY - NEXT YEAR	_____
26. CURRENT BASIS	_____
27. NORMAL BASIS	_____
28. POST-HARVEST DELIVERY - NEXT YEAR	_____
29. CURRENT BASIS	_____
30. NORMAL BASIS	_____
31. <u>GOVERNMENT COMMODITY PROGRAM PRICES:</u>	
32. LOAN PRICE - REGIONALLY ADJUSTED	_____
33. RESERVE RELEASE PRICE	_____
34. RESERVE CALL PRICE	_____

be prepared. The various cited authors (Longworth and Menz; Boehlje et al; Boehlje and Eidman) all note the importance of such auxiliary information for introducing and further establishing the simulated decision-making conditions to be expected. The need to integrate the use of the model with other forms of relevant instruction is also expressed.

Classroom teaching

A possible scenario for an undergraduate teaching application of IFLMAPS might consist of:

1. Two to three weeks for introducing the course and the various principle concepts. During this period, the model would also be introduced in terms of its correspondence to such concepts.
2. One to two weeks for demonstrating respective decision opportunities associated with an entire simulation year within IFLMAPS. It is suggested that this demonstration be conducted by the instructor using several television monitors scattered throughout the classroom so as to allow all students to view the various decision opportunities allowed and related information sets presented.
3. Two weeks for teams composed of at least two but no more than five students to simulate one year under deterministic conditions. All teams should begin this second year with an Initial Firm Structure complement data set identical to the ending structure of the farm demonstrated in class as noted in (2) above. All simulation sessions should be performed outside of regular class time. Class will meet at its regular time for general discussion of the various concepts being emphasized within the simulation model. During the latter part of the second week, all teams should be required to present a short (10 to 15 minutes) oral presentation regarding their marketing and production decisions executed during this first simulation year and the associated results of such decisions.
4. Two to five weeks for the respective teams to simulate one or more years under conditions of yield, field time and output price uncertainty. Similar to (3) above, such simulation should occur exogenous to the regularly scheduled class time. That time should be used for more in-depth analysis of various applicable decision-making criteria and information sets. In all instances, student participation is to be encouraged.

5. One week for final oral presentations by students regarding their teams' simulation performance. Time should also be set aside for students to critique IFLMAPS' simulation environment in terms of its correspondence to the real world and its value as a teaching instrument. Such information can be integrated into future generations of the model.

The above proposed scenario is as challenging to the instructor as to the students. The instructor bears the burden of organizing and preparing the structure of the course commensurate with his or her desired learning objectives for students. Also, the complexity of the model and the associated time requirements necessary for introducing it to students tends to favor its use under a semester teaching arrangement rather than the quarter system. In case of the latter, an instructor would be hard pressed to develop the model to its full potential. However, utilization of the model in advanced farm management classes comprised of farm oriented students may still have merit at a university under the quarter system. The students' prior training in basic farm management principles along with their personal experiences should allow them to acclimate themselves to IFLMAPS' decision-making environment quick enough that they might benefit from its use. As evidenced by the several articles reviewed herein, the potential payoff for teaching efforts using farm management simulation models is favorable. Boehlje and Eidman's remarks are most appropriate here (p. 992):

The effectiveness of games as educational tools depends on the administration of the game, the consistency between the game and educational objectives, the interface with other teaching tools, and the learning style of the student. If properly used, they are an important tool in the educator's tool kit.

It is also relevant to refer to psychologists' (Jung, Meyers) and educators' (Lee and Roberts) claims that individuals' personality types influence their capability of learning through different educational

techniques. Whereas some people may be capable of learning by lectures alone or by a combination of lectures and selected readings, others require more innovative approaches. Experiencing the various concepts deemed important within a discipline or sub-area thereof through use of a simulation model--such as IFLMAPS--is a possible alternative.

Extension

The use of simulation models such as IFLMAPS in Extension meetings with agricultural producers poses a unique set of problems. No longer is one confronted with a captive audience attuned to an academic environment as is the case with university students. Producers' readily apparent quest for relevancy to their own farm businesses concerning additional information and advice forces Extension personnel to develop their programs in more of an applied context than is often provided in the classroom. Actual contact time with producers in Extension related activities is normally limited to no more than three or four six hour sessions per year; often less time than that is available. This subjective estimate of available contact time takes into consideration the lesser demands on producers' time during the winter months. As evidenced by the previous discussion regarding classroom applications of IFLMAPS, substantially more time than that is required to fully profit from using the model.

Recognition of these obstacles to IFLMAPS' application in Extension activities does not totally inhibit its use, however. It is advised that the use of IFLMAPS be incorporated into a setting such as that of the Michigan State University Marketing Workshops (Ferris, 1978) and the University of Kentucky's Kash Profits Extension Workshops (Jones, et al. (1979)). Supplement materials similar to those required in the

suggested teaching application could be utilized in this extension application also. Early workshop sessions could be used to introduce the model. The availability of several remote computer terminals at a relative inexpensive leasing charge could be used to encourage producers to interact with the model's decision-making environment in the comfort of their own homes. Encouraging such use of the model should allow for all members of the family to benefit from the simulated experiences. Subsequent workshop sessions can be used to discuss simulation results, allowing Extension specialists to link them to real world problems in the process.

Once a producer has become experienced with IFLMAPS, he or she may find it rewarding to use the model each year during the winter months. The opportunity to review alternative strategies under different economic scenarios could be very beneficial. IFLMAPS' focus on many of the more important interrelated factors in a farm business has much to offer in terms of directing producers' attention towards this area while they are making their real world decisions.

IFLMAPS' simulation environment offers an improved integration of many of the marketing concepts ordinarily discussed in Extension marketing meetings into producers complex decision-making environment over the commonly used case example approach. Observation of producers heightened interest in both fundamental and technical marketing strategies and their desire for additional and improved market information tends to indicate that they would be very receptive to making use of IFLMAPS in the manner briefly summarized above.

Qualifications

Critics of using simulation models such as IFLMAPS in teaching and/or extension programs are apt to argue that, as a result of having experienced the simulation environment of such a model, agricultural producers might be prone to execute relatively more risky types of decisions in the real world. As a consequence, they may be susceptible to suffering rather substantial detrimental economical consequences. At least three points are relevant to such criticism:

1. It is the responsibility of IFLMAPS' administrators to develop complement data sets which portray simulation scenarios approaching the real world. In all cases, the uncertainty of output prices, yields and institutional factors such as credit costs and government programs should be demonstrated. Users of IFLMAPS, upon having completed a simulation horizon under proper instruction, should recognize the inherent risk associated with decisions of the types represented therein.
2. Current educational efforts void of such complex integrated computerized models are hard pressed to represent the complete consequences of various producer marketing and/or production decisions. Most such efforts are presented in a partial analysis framework. Approaches of this type are necessarily incapable of capturing the various interrelationships inherent in farm businesses. Without the availability of a simulated decision-making environment similar to that provided by IFLMAPS, students and farmers alike are left to apply the concepts stressed in educational programs in the real world. It is hypothesized that the losses forthcoming from "bad"

decisions as a result of such educational efforts are greater than would be experienced if IFLMAPS is used as a supplemental instructional aid.

3. The requirement of discussing the results of simulated decisions during class meetings and extension workshop sessions provides an excellent opportunity for exposing faulty reasoning on the part of decision-makers. Through providing in-depth feedback, instructors should be able to focus attention on the several more important factors and resulting consequences of the various decision opportunities. Such feedback is not ordinarily possible with less refined teaching instruments such as case examples.

CHAPTER 8

RESEARCH APPLICATION

Introduction

This research study is concerned with farmers' firm level marketing strategies and the related value of market information. Current views on market outlook information include advocacy of delivering probabilistic market information (PMI) to farmers rather than the standard traditional market information (TMI). Ikerd, Nelson (1979 and 1980), King, and Black (1979-80) all recommend such delivery. Freebairn, Coth-ern, Schmererhorn and Dobson further suggest that individual decision makers most probably require different types and forms of market information, geared to their personal production/marketing situation.

Several research studies concerned with the evaluation of alternative types and forms of information offer observations pertinent to the assessment of PMI's value. Lee and Nicholson recognize the inadequacy of evaluating one set of information in isolation from other sets of information available in the decision-making environment. Perrin similarly indicates the necessity of measuring the marginal value of information in the presence of other information sets rather than assuming that the information of concern is the only available set. Doll voices the concern "Will the value of the forecast be sufficient to justify the research and development costs of making the forecast operational?" (p. 651) in regard to providing probabilistic information in a Bayesian context. Walker and Nelson hint at the lack of completed research

regarding the value of probabilistic information. Rosenberg and Gray describe a real world case study involving two groups of farmers receiving different sets of market information. Henderson, while promoting controlled laboratory experiments, cautions against real world studies because of the potential detriment to the well-being of study participants. Baquet et al. caution against making general recommendations meant to be applicable for individual decision makers. Debertin et al. (1975) and Debertin et al. (1976) use a gaming approach while measuring the value of information in an effort to capture the effects of the human element involved in the decision-making process.

The current promotion of the development and dissemination of PMI is somewhat disconcerting, given what the literature indicates is available to subjectively measure the value of such information. Serious questions exist concerning whether or not agricultural extension services, other public and/or private agencies should allocate their financial resources toward the development of this more "sophisticated" type of market information. A sampling of these concerns are: (1) what degree of accuracy is achievable--there is no track record available regarding forecasters' ability to provide such information, (2) can producers effectively use such additional information in their decision-making processes and (3) are the potential social benefits associated with such information of sufficient magnitude to warrant the investment of the resources necessary to provide good quality information. The social benefits referred to include greater and cheaper supplies of agricultural commodities realized from more efficient agricultural production systems as a result of improved management information. This

last point is the ultimate area of concern. However, it appears that the first two issues must be resolved prior to attempting to analyze the latter.

The current non-availability of PMI on a widespread public basis hinders efforts at responding to these areas of concern. Michigan State University's recent development of the MSU Agriculture Model enables them to deliver PMI while accounting for both international and domestic fundamental market conditions. It appears that no other public institution or private agency currently has the capability to prepare and deliver agricultural market outlook information of this quality. The uncertainties associated with weather and institutional (government) factors hinder efforts towards evaluating the track record of such PMI forecasts.¹³⁸ The Michigan State University group is currently attempting to address how to validate and verify probabilistic forecasts under such conditions.

Only a minimal attempt has been extended towards the empirical measure of the value of PMI to agricultural producers, however. Preliminary discussions in the annual winter Marketing Workshops sponsored by Michigan State University indicate that such information is well received by the more astute farmers. The efforts of Shane and Myer at the University of Nevada related to the provision of objectively prepared PMI have been similarly received. Use of IFLMAPS provides an

¹³⁸ Such factors are not ordinarily explicitly accounted for in base projections by the MSU Agriculture Model. The evaluation of alternative scenarios is possible and in fact occurs. However, Michigan State University is not presently prepared to forecast the likelihood of all possible such scenarios developing. Consequently, whenever such scenarios do develop, it is possible that the PMI produced by the MSU Agriculture Model may be somewhat erroneous.

opportunity to obtain a more empirical assessment of PMI's value relative to that of TMI. The above observations along with the acceptance of simulation modelling as a research instrument implies need for further research as conducted in the Debertin et al. studies to evaluate market information. A readily apparent shortcoming of the two Debertin et al. studies with respect to the marketing decision area is the presence of an annual decision period in the simulation game used. The dynamic temporal nature of firm level marketing suggests a more significant assessment of alternative market information forms' value may be obtainable with the use of a simulation game allowing for more frequent marketing and production decisions within a simulation year. Also, the procedure used in the Debertin et al. studies to assess the relative values of alternative information sets does not appear to recognize nor allow for the individuality of risk preferences and personality types. The remainder of this Chapter discusses a proposed methodology for implementing such a study followed by an indication of the strengths and weaknesses of such a research approach.

Assessing the Value of Market Information with IFLMAPS

The substance of this proposed research methodology involves using IFLMAPS in a survey of several farmers, grouped according to, among other factors, the form of market information received throughout the chosen simulation horizon. Evaluating selected measurements such as annual Net Farm Income and change in Owners' Equity will facilitate the

assessment of PMI's value relative to that of TMI. This methodology consists of three stages, each of which require analysis:

1. Selection of survey sample
2. Administration of survey
3. Evaluation of survey results

Selection of survey sample

Several factors merit consideration while selecting the sample of agricultural producers to be used in such a research study. From an analytical viewpoint, it is imperative that the sample design allow for proper association of observed differences in simulation performance with possible causes. The designated size of the sample should reflect both the costs associated with administering the study as well as the measurement techniques planned to be used while evaluating the results. Survey administrators should also be prepared to cope with obtaining cooperative participants, given the estimated required time commitment of 30-60 hours necessary over the duration of the study.

Obtaining cooperative survey participants

The identification of cooperative participants for research of this nature is by no means an insignificant part of the study. The approach followed by Binswanger in measuring risk preferences in rural India is not possible in the United States. There, relatively low monetary payments (\$10+ equivalence) to cooperators exceeded their monthly income, thus easily securing their attentiveness and cooperation. The opportunity costs of American farmers' time renders this approach impossible,

i.e., the "transaction costs" are much higher. The proper approach to securing farmer cooperation would seem to consist of three interrelated phases:

1. Plan for administration of the survey during calendar periods in which farmers' time is less constraining, i.e., winter months in the Midwest
2. Challenge producers to match their marketing/production skills against each other in a non-detrimental environment, allowing an opportunity for improving upon their skills in the process
3. Promote the potential benefits to be realized, by both society and individual farmers, from research of this nature

Caution is advised in implementation of these approaches. Extreme care must be taken to ensure that the decisions executed in the laboratory environment of IFLMAPS are representative of those producers would ordinarily execute in the real world if confronted with similar circumstances. Such caution is especially applicable in the case of the second phase. Cases of unrealistic behavior can easily result in such a "gaming" atmosphere application of simulation models. The end result is that the research conclusions may not be applicable to real world situations.

It is anticipated that following this approach with the aid of local county extension service personnel would result in sufficient cooperation for such a study. Michigan State University's sponsorship of winter Marketing Workshops during the past several years has resulted in an increased awareness of and interest in alternative firm level marketing strategies. It is hypothesized that prior participants of such workshops could be solicited to join in such a research study. Corresponding degrees of cooperation can also most likely be achieved in other states. A problem associated with such a biased sampling approach

is that the research results will be applicable to a narrow segment of the producer audience. This does not contradict the conclusions; rather, it indicates a continuing need to expand our Extension audiences.

Sample composition

Risk preferences and personality types of individuals may influence producer decisions. There may be a need to include several cross-classifications or cells within each major treatment group (form of market information received during simulation horizon) to identify these influences. Consideration of the conceivable impact of these factors on the manner in which survey participants respond to IFLMAPS' simulation environment reinforces this contention. Personal attributes such as age, type and size of current farm, educational level, marketing/production expertise level, and an indication of personality type are among those factors deserving attention.

Assuming age can be used as a proxy for individuals' position in the life cycle,¹³⁹ it is recommended that the sample be subdivided into four distinct age categories: 25-24, 35-44, 45-54 and 54+.

The nature of IFLMAPS suggests that survey participants should be limited to farmers whose real world primary enterprises are wheat, corn and soybeans. It is suggested that sample participants be further limited to those whose real world farm operations are at least 400 acres in size (included rented acreage) and an Owner's Equity in excess of \$50,000. In addition to accounting for similar requisite managerial

¹³⁹Barry and Brake suggest producers are prone to alter their risk preferences and related decision styles as farming experience accumulates and career plans are redirected with age.

skills, such an approach should alleviate any possible problems associated with participants existing in different ranges of the Friedman-Savage utility function (Johnson).

Observations of Ferris and Dike suggest that there is a need to include spouses in the study if possible. Their influence in both strategic and tactical decisions should not be disregarded when attempting to measure farmers' ability to use a specific form of information. Indeed, Binswanger (p. 396) indicates the need to allow time for family interaction between the required decision periods associated with behavioral research of this type.

Debertin et al. (1976), in contrasting the result of two gaming approach studies similar to the one proposed herein note that college students achieved higher average levels of profit performance than did farmers. They submit the notion that the students' recent academic environment involving testing experiences and other encounters with hypothetical problems may result in a competitive edge over farmers in using such a simulation model. Following from this observation and in anticipation of some farmers possibly being better "game" players than others, it is proposed that a pretest consisting of two parts be administered to all survey participants. The first part of the test would consist of several junior/senior college level marketing/production problems analogous to those encountered in IFLMAPS' simulation environment, i.e., a marketing/farm management exam. The second part of the test would involve use of IFLMAPS through a two year simulation horizon. These pretest results would then be used to distribute the survey sample among the various treatment cells.

With respect to measurement of personality type, survey participants will be administered the Myers Briggs Type Indicator exam (I. B. Myers). As discussed in Chapter 2, the (S-N) and (T-F) categories are of interest to this study. Their indication of "ways of finding out" and "ways of deciding," respectively, infer that there may be some correlation between individuals' personality types and the ability to use a specific form of information. The efforts of Roberts and Lee as well as those of Henderson and Nutt are examples of research indicating that such information should be considered while conducting behavioral studies similar to the one proposed herein.

Size of sample

The proper use of the above information regarding each participant should allow the research study administrators to design the survey sample to allow for correct identification of the factors associated with observed differences in simulation performance. Analysis of variance techniques and the interval approach to stochastic dominance testing (King and Robison) are anticipated to be the evaluative methods used to provide such an assessment, as subsequently addressed. For statistical testing purposes, the sample size per treatment should be no less than 20, with additional participants desired if at all possible in order to avoid degrees of freedom problems.

The two Debertin et al. (1975 and 1976) studies which used a gaming approach to assess the value of information consisted of sample sizes of 52 (student survey) and 40 (farmer survey), respectively. They cite an estimated cost of \$100 per participant as being responsible for the smaller sample size in the second study. However, due to the observation of substantial within-group variability in the performance

occurring in the earlier student study, the number of treatments was reduced from four to two for the second study, i.e., 20 replications per treatment were regarded as necessary to allow for significant inferences to be drawn from the study results. It is useful to note that no effort was made in either of these studies to account for the various attributes noted above. In fact, in the case of the farmer study, the summarization of results notes the substantial diversity of participants' age, education, total acres farmed, total acres corn, total acres soybeans and days worked off the farm per year. The intent of this proposed study to account for some of these factors as well as others should allow for less than 20 participants per cell within each major treatment (form of market information received) being acceptable for this study.

Accounting for computer time, travel, graduate assistantships and faculty time, the cost of such a study is subjectively estimated at a fixed cost of \$82,000 plus a variable cost of \$150 per participant.¹⁴⁰ The relatively low variable portion of the survey's cost indicates the sample size should not be constrained below the level felt necessary to provide an accurate assessment. The behavioral nature of this research

¹⁴⁰ Basis of such costs are estimated as follows:

1. Fixed costs	
9 months of Assistant Professor's time	\$21,000
3 months of Full Professor's time	11,000
1 year Graduate Assistantship--1/2 time	7,500
1 year Graduate Assistantship--3/4 time	12,500
Computer costs	20,000
Secretarial assistance, travel and supplies	10,000
TOTAL fixed costs	\$82,000
2. Variable costs	
Computer time and telephone charges	75
Travel	50
Miscellaneous (Workshop meals, prize money, etc)	25
TOTAL variable costs	\$150

study hinders efforts to firmly establish such a level. However, all factors considered, a total sample size of 120 appears adequate. This would allow for three primary groups according to form of market information received: (1) none, (2) TMI and (3) PMI. Within each of these groups, each of the age categories could be represented by 10 participants. Adequate representation of the other factors would also be possible with such a sample size.

Administration of survey

To reduce the necessary travel expenses along with facilitating the selection of as homogeneous a sample group as possible, it is recommended that this survey be conducted in no more than 2 or 3 counties within one state. The nature of the study is such that substantial effort and time will be required to acquaint potential participants with its purpose as well as allow for several centralized meetings with selected participants during the duration of the study.

A quasi-workshop approach appears to be the best manner in which to implement this study. The approach basically consists of six segments:

1. Solicitation and selection of participants
2. Design of survey
3. Initialization of simulation horizons
4. Individual simulation periods
5. Evaluation of participants' performance
6. Report of results

Solicitation and selection of participants

This segment of the study involves working closely with local agricultural extension personnel in the selected counties to instigate

interest in the research project. Mailings and several meetings in the sampling area are recommended for this phase. Upon completing the solicitation process, project administrators will have to determine the participants to be included in the study. Hopefully, this process will entail choosing among several applications rather than having to "draft" additional cooperators. This selection procedure should be conducted while taking into consideration the various personal attributes referenced above, i.e., age, type and size of farm, educational level, etc.

Design of survey

Upon selection of a sample of participants, project leaders must utilize the pretests and Myers Briggs Type Indicator (M.B.T.I.) exam to categorize the participants among treatment cells. It is suggested that these exams be administered in groups of 10 participants or smaller to allow for any interaction needed to clarify or further promote the project. Spouses are to be included in these sessions if at all possible. Three four hour sessions held on separate days are probably required for this phase of the study:

1. The M.B.T.I. and farm management exam will be given along with further discussion of the projects' nature, value, etc.
2. IFLMAPS will be introduced and explained as well as participants being allowed to individually simulate one year's marketing/production decisions through use of the simulation model (the decision-making environment will be non-dynamic).
3. Time will be allocated for further discussion of IFLMAPS' simulation environment in addition to requiring participants to execute the decisions associated with another simulation year using IFLMAPS (in this second year of required simulation, the decision-making environment will be dynamic).

Ten or more portable remote access hard-copy computer terminals will be used. Such units will either have to be rented for that part of the study requiring their use by participants (approximately 3 months) or

purchased outright--the former approach appears the least expensive unless the units can be further utilized elsewhere upon completion of the study. In this final selection stage of the study, the units will be available for use at the central meeting sites. During the subsequent requisite simulation sessions, participants will be allowed to check-out the units for 24 hour periods. Following completion of the third session for study participants, project leaders will be able to complete the final design of the survey. Treatment cell members will be designated to allow for as equal representation as possible of all attributes among forms of market information received.

Initialization of simulation horizon

All participants will begin a five year simulation horizon with identically structured farm operations as well as being subject to identical simulated environmental conditions over the horizon. Only the sequential results of their own decisions will introduce disparities among their decision-making situations. Having completed the survey design as discussed above, project leaders will again meet with the participants grouped according to the form of market information to be received during the simulation horizon. A three to four hour session will focus upon describing the initial position of the farm operation to be simulated along with several remarks of the nature of the market outlook information to be received. Participants will be encouraged to execute their simulated marketing/production decisions in isolation from other participants. Only their spouses should be consulted about forthcoming decision alternatives.

The simulation horizon will be announced as five years in duration. Although the fifth year's simulation will be allowed, only the results of the first four years will be used to avoid including the effects of any last minute desperation decisions on the part of participants. Annual Net Farm Income and annual change in Owner's Equity will be stressed as the important measurement variables. In an attempt to encourage realistic performances by participants, prizes of \$500, \$250 and \$100 will be offered to participants realizing the highest average levels of each of these measures over the simulation horizon as incentives. Care must be taken to ensure participants' interest is maintained throughout the entire simulation horizon, even when early "bad" decisions effectively eliminates them from being considered for such prizes.

Individual simulation periods

The participants will be instructed to check out, on a 24 hour basis, one of the portable terminals available at their county extension office and execute their decisions for IFLMAPS while at home. Another alternative would be to use the terminal available at the county office. Project leaders will be accessible by phone to answer any quick questions participants might have. Also, both project leaders and/or graduate students associated with the project will attend and observe one or more of each participant's simulation sessions. Participants encountering major difficulties will be able to obtain more observation time from these personnel upon request. Depending upon the number of terminals available for use in each county of the study area, participants will be encouraged to complete the required five year simulation horizon in two to three months. Participants will be advised to never simulate in

excess of one year per session. The preferred approach will be three simulation months per session to allow time for mental processing of the quarterly market outlook information and the various information sets made available during the course of a simulation year.

Evaluation of participants' performance

When all participants have completed four simulation years, analysis of the measurement variables located at the computer data file will commence. The details of this analysis are discussed below.

Report of results

Having completed the analysis phase of the study, a general meeting of all participants and spouses will be held for the purpose of discussing the results and recognizing winners of the several monetary awards.

Evaluation of results

The primary evaluation technique will be straightforward analysis of variance. The annual measurement variables of Net Farm Income and change in Owner's Equity will be evaluated both with respect to an average level across the simulation horizon for each participant and for all such annual observations associated with each participant.

Recognizing that such an evaluative approach may not correctly allow for consideration of agricultural producers' risk preferences, similar analysis will be conducted using a stochastic dominance approach. First and second degree stochastic dominance will be examined as will the more flexible interval approach advocated by King and Robison. For the latter case, observations of producers' risk preferences will have had to be elicited from survey participants using a methodology illustrated by King and improved upon by Cochran.

Strengths and Weaknesses of Proposed
Research Methodology

Recognition of information as one of several inputs into the decision-making process demands its evaluation be conducted with due consideration regarded the other inputs, i.e., decision makers' preferences, resource base (land, machinery), etc. The proposed research application of IFLMAPS discussed herein seeks to achieve such an assessment. The opportunity to evaluate decision-makers' ability to process and utilize information in an environment similar to the real world without their being susceptible to detrimental consequences of errant decisions is desirable.

The inclusion in IFLMAPS of marketing, production and financial decision opportunities enhances its value for a research application of this nature. An alternative approach focusing only on marketing decisions and the use of market information would neglect to account for the impact of cash flow and uncertainties associated with other kinds of decisions inherent in managing a farm operation. IFLMAPS' interactive structure and its allowance for the various sequential decisions normally encountered while managing a farm contributes to its suitability for research of the type proposed. The presence of monthly rather than annual decision periods in IFLMAPS also enhances its value for such an application. This feature along with the on-line storage of users' simulation information allows intermittent access to the model, and permits time for exogenous calculations and pondering of available information by users prior to their executing the next set of required decisions. The remote accessibility of the model via the telephone is an additional feature contributing to its appropriateness for research of the type proposed.

The results from the two Debertin et al. studies (1975 and 1976) along with supportive remarks of Henderson, and Johnson and Rausser suggest further research of the type discussed is worthwhile. There are several weaknesses to be recognized and managed, however, before the results of such research can be totally accepted. The most important area of concern revolves around the validity of the simulation model and the manner in which it is used by participants in the research study. The attempt, in IFLMAPS, to adequately account for all of the various interrelated factors possibly affecting farmers' use of market information results in a complex model. In and of itself, verifying and validating a model of such breadth is no small task. It is a time consuming process which requires review and inspection by several parties prior to being in any way acceptable for such an application. The nature of an acceptable model must be such that simulated conditions occurring as a result of users' decisions are analogous to what might be expected in the real world. To account for such cause-effect relationships endogenously in the model and then exogenously represent the associated information to users in an easily understood format requires substantial insight and effort on the part of the model builder. In IFLMAPS, this validation problem is not confined to the model alone. It also extends to the various complement data sets required. Of particular concern is the Output Price complement data set and the requirement of preparing corresponding market outlook information. Developing a marketplace environment for the simulation model similar to what might be expected

in the real world is not an endeavor to be underestimated. Such a simulation environment is essential, however, if the results of a study such as the one proposed herein are to be acceptable for their implied purpose.

Even if the various modelling problems denoted are adequately addressed, leaders of such a research project must confront the issue of how to get participants to process the available information and execute decisions in the manner they would ordinarily do in the real world. The offering of prize money and a small token payment per participant is a means of attempting to alleviate the possibility of producers acting otherwise. Such an approach ensures a positive gain being realized (ignoring the value of time expended in making decisions). This is an extrapolation from real world decision-making situations where detrimental losses are often suffered.

Given the extensive nature of this proposed study and the inordinate amount of time required of participants, it is still irrational to expect decisions in the simulated environment to be identical to those executed in the real world. Even if their intentions are genuine, assimilation and processing of the vast amount of information accompanying the simulation of a farm operation through several years in such a short real-time calendar period may be more than should be expected of participants.

The recognition of producers' subjective interpretation of the information sets they are provided with further hinders arriving at a "good" assessment of the relative value of TMI and PMI. Whereas producers are familiar with the former and may be expected to realistically utilize it, the latter type of market information is relatively new.

Producers' unfamiliarity with information of that type may result in them not being able to effectively make use of it. Such behavior does not deny PMI's possible superior value over TMI. Rather, it indicates more educational training may be necessary before that greater value can be realized by producers.

The second area of concern is the evaluation segment of the study. The variability in participants' risk preferences and real life goals most assuredly will influence their decisions in the simulation environment. It is unlikely that consideration of the annual Net Farm Income and change in Owners' Equity alone will completely account for those differences. The lack of a more valid interpersonal common denominator (Johnson and Zerby, pp. 7-8) hinders attempts to more fully evaluate such results. However, it is hoped that the use of the MBTI for stratifying the sample and use of stochastic dominance as an evaluative technique may help to overcome these difficulties.

The last area of concern involves recognition of the expense associated with collecting primary data through such a survey approach. As suggested in Chapter 3, the potential benefits of using IFLMAPS in educational applications are quite substantial. Substantive equal returns could conceivably be forthcoming from the results of the study proposed herein. However, in recognition of the monetary expense and time requirements associated with such a study, it is strongly suggested that it not be enacted until IFLMAPS has been reviewed, revised and otherwise critiqued and improved upon. The intent of the exhaustive review is to enhance acceptability by farmers and professional agricultural economists alike of IFLMAPS as a realistic simulation model of the environment it is designed to represent.

CHAPTER 9

SUMMARY REMARKS

Conclusions

In seeking to improve upon current teaching and extension activities in the farm management area, an interactive computerized simulation model called IFLMAPS is designed and constructed. The model integrates the marketing, production and financial components of a farm business in a manner representative of the real world sequential decision-making process. Information endogenous to a producer's management system as well as that provided from exogenous sources is accounted for in a timely fashion. In addition to suggesting teaching and extension applications of the model, a methodology involving use of the model in behavioral research is developed. The primary purpose of the suggested research is to assess the relative values to agricultural producers of traditional and probabilistic market information to agricultural producers.

A significant contribution of this research study is the review of literature concerning four primary subject matter areas:

1. Risk management and producers' decision-making processes
2. Market information and its usefulness in determining and implementing marketing strategies
3. Educational techniques
4. The systems approach and simulation models

This review establishes the complexity of the managerial process. The impact of individuals' values and goals, risk preferences and psychological personality types are all explored.

The increasing variability of commodity market prices since the mid-1972 Soviet grain deal is offered as probable cause for heightened interest in improved marketing outlook information and analyses of alternative marketing strategies. Both fundamental and technical strategies are included in the opportunity sets of interest. Several applied studies are reviewed to demonstrate the varied analytical approaches that are being taken in an effort to aid producers in their marketing decisions.

Also stressed is the emergence of computerized information delivery systems in agriculture. Such developments have the potential for providing producers more information of higher quality than has previously been possible to deliver. The inspection of related research indicates a felt need to improve upon producers' ability to compile and assimilate information relevant to their managerial problems. Generally lacking from both on-going and proposed endeavors in this area, however, is an empirical evaluation of producers' effectiveness in (1) performing these functions and (2) integrating this additional information into their managerial processes. More specifically, little has been done to evaluate the resulting impact on absolute levels and associated variances of Net Farm Income, growth in Owners' Equity and other relevant measurement variables while taking into consideration individuals' personal attributes.

Strong support for the systems approach and the use of simulation models in agricultural research is demonstrated. This support along

with the documented success and advocacy for further application of simulation and gaming models in teaching, extension and research applications are among the premises underlying IFLMAPS' development in this research study. Among the features of IFLMAPS which differentiate it from other previously constructed farm management simulation models is its allowance for alternative marketing strategies in a monthly decision-period framework. The model's capability of delivering exogenously developed quarterly market outlook information corresponding to the simulated marketing environment complements this more intensive modelling representation of farmers' real world marketing decision-making environment.

Specific modelling traits of IFLMAPS which enhance its value for teaching, extension and research applications are:

1. Remote access availability
2. Interactive rather than batch
3. Possibility of varying parameter data sets for different simulation runs
4. Provision for intermittent usage
5. Simultaneous multiple users possible

IFLMAPS simulates a firm level decision-making environment characteristic of farms on which wheat, corn and soybeans are grown. The possibility of several parameter sets allows for substantial flexibility in representing simulation conditions in various geographical locations. Suggestions are offered regarding how the model might be utilized in teaching, extension and research applications. In the latter case, the modelling of IFLMAPS' marketing component facilitates the investigation of the relative value of traditional and probabilistic market information to agricultural producers. Although not implemented in this

current research study, a methodology for conducting and evaluating such research is proposed.

IFLMAPS' "interactive" feature represents an added dimension to the art of farm management simulation modeling. It allows for the input of agricultural producers' own responses to situations normally requiring heuristic assumptions on the part of the simulation modeller. In enabling sequential decision-making within a monthly decision period, IFLMAPS confronts users with realistic management problems. In addition to enhancing teaching and extension activities in the farm management area, the model provides an excellent opportunity for behavioral research aimed at investigating agricultural producers' managerial processes.

Recommendations for Future Research

Similar to most modelling processes, the evolvement of a simulation model of IFLMAPS' scope is an iterative process. The current structure of IFLMAPS represents the first fully functioning edition of the model in the requisite extended development process. In attempting to capture a realistic representation of agricultural producers' decision-making environment within such a simulation context, it is necessary to integrate many interrelated factors. Consequentially, it is no easy task to effectively elicit review of such a model from one's peers until it is in an operational form. It is to be expected that this first edition of IFLMAPS is subject to much criticism and constructive suggestions for alterations. Preliminary validation of the model involving interactions with Harsh and Schwab through several simulation sessions have identified areas for possible improvement and streamlining.

Some suggested refinements concern the modelling of user decision opportunities and chances for the recovery of various information statements. A menu approach appears more practical than the present forced sequencing of events. There is further need for expanding the types of information sets available as decision aids (extended monthly cash flow projections and annual summary of executed marketing strategies). Improvements can also be made in simplifying the various information sets meant to describe IFLMAPS' simulation environment to its users. Clarification of some issues as well as the elimination of some extraneous information can be accomplished in several areas.

Following completion of the above modifications, development of a corresponding Users' Manual is suggested. The nature of this manual should allow users to access and utilize IFLMAPS with minimal assistance. The manual will be written for teaching and extension audiences. These manuals should expand upon this dissertation's enumeration of the farm management concepts accounted for in IFLMAPS. Special attention should be directed towards designating appropriate references in each case. Research applications of IFLMAPS may be able to utilize these same materials. However, it will most probably be necessary to compile additional manuals focusing on the particular subject-matter area being investigated.

Further validation of IFLMAPS with farmers, students and extension service personnel is also warranted. The concerns indicated above are those noticeably absent in IFLMAPS' current form.

Other more general recommendations for further research in the area of agricultural producers' decision-making ability and the associated value of information are forthcoming from this research study. Provided

the above suggested alterations to IFLMAPS are executed along with the preparation of a supportive Users' Manual, the methodology advanced for investigating the relative values of traditional and probabilistic market information is plausible. The review of literature demonstrates the importance of individuals' input into the managerial process. Most approaches at assessing the value of information ignores these factors. Attempts at researching such issues in real world operations are thwarted by the possibility of detrimental economic consequences to study participants. The recent rapid advancements in computer technology make it possible to develop a rather sophisticated laboratory environment appropriate for researching these issues.

Although limited support for this type of research has been evident, few efforts have been completed. The challenge exists to enact studies in the area. Although the agricultural economics discipline has been innovative in its development of theorems and analytical techniques, it has lagged behind in considering the ability of its clientele to effectively apply these advanced concepts. Successful endeavors in the area will necessarily cut across discipline and sub-discipline lines, involving both researchers and extension specialists. Farm management specialists must take it upon themselves to be the catalyst in organizing and promoting this type of activity. Consideration of the resources being committed towards the development of more sophisticated agricultural management aids indicates feedback from research of the type proposed herein and other similar types of efforts has substantial potential value. In addition to enhancing the possibility of increasing the agricultural system's efficiency, the research results should point towards voids in our knowledge base. A valuable contribution of the

systems approach to research is its ability to disclose relevant factors requiring further investigation.

There is also potential value in contrasting the effectiveness of using IFLMAPS as a teaching instrument relative to more traditional approaches of teaching farm management and marketing concepts. Others' efforts in using the Myers Briggs Type Indicator suggests that some success is to be had in predetermining the instructional method best suitable for individual learners.

In recognition of the emergence of computerized information delivery systems, it is strongly recommended that additional research efforts concentrate on developing computer software designed to process raw data into an information form easily understood by agricultural producers. The resulting information set should integrate exogenously supplied information with producer specified alternative marketing management strategies so as to enumerate the outcomes and corresponding probabilities of occurrence of each considered strategy. This approach allows producers to integrate their own risk preferences into the decision process. Supportive efforts must be conducted simultaneously so as to document the accuracy of such forecasted information sets. This documentation should facilitate the improvement of both the software package and the process responsible for developing the exogenously supplied information. In addition, the development of a track record reflecting accuracy and helpfulness will enable producers to subjectively interpret current and future information sets.

The latter suggestion is offered in recognition of the fact that the development of new, more intensive additional forms of information will not wait for the empirical results forthcoming from the prior suggested research applications of IFLMAPS. Consequentially, research aimed at improving producers' ability to integrate information into their decision-making processes should be conducted concurrently with the development of the information. Much remains to be accomplished before the sophisticated decision-making aids being analyzed in disciplinary and subject-matter research are in a form useful in problem-solving.

APPENDIX A

IFLMAPS' SUBROUTINES

APPENDIX A

IFLMAPS' SUBROUTINES

The following statements provide a terse review of the several subroutines constituting the simulation model IFLMAPS. Figure A.1 indicates the organization of these subroutines according to their function in representing IFLMAPS' simulation environment. These narrative summaries combined with Chapter 4 and Appendix B explain the model for those persons interested in using it in its present form.¹⁴¹

ACGDTL -- prints an information set relating the current state of nature for all acreage controlled by a user in each land tenure class

ADJUST -- modifies resource variables to reflect amount of resource used during the performance of a given field operation sequence

ALCPRP -- allocates land preparation acreage capacity within a time period across acreage controlled with respect to each of the three land tenure classes according to user specified order of priority

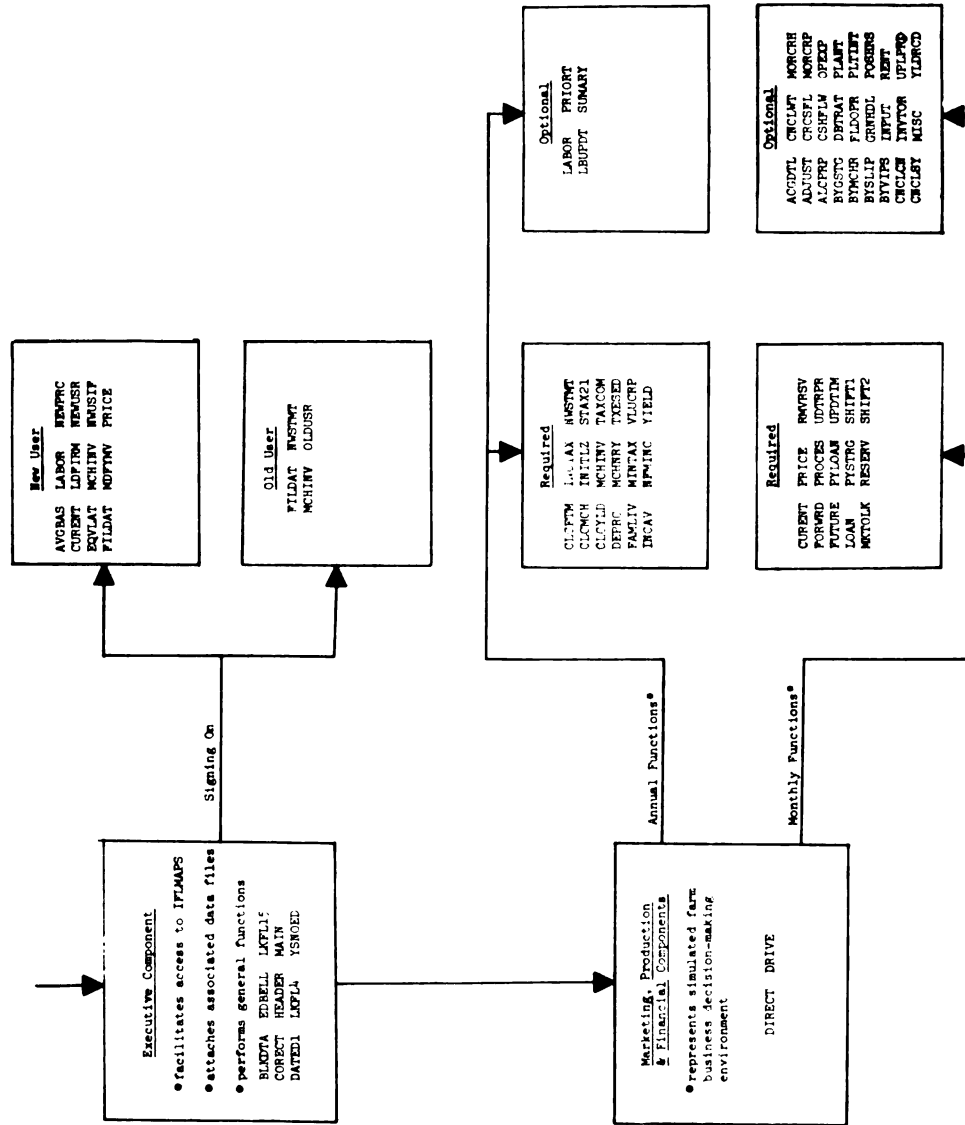
AVGBAS -- prints an information set describing output price relationships under general equilibrium economic conditions for the particular geographical area being simulated

BLKDTA -- contains all of the required Common Block statements and identifies several general endogenous data requirements

BYGSTG -- presents users with an opportunity to purchase additional on-farm grain drying and storage capacity. If purchase is desired, financing is arranged if possible; if successful the various cash flow and other required accounting variables are processed

BYMCHR -- provides an opportunity to review a brief information set describing a user's current owned machinery as well as permitting an opportunity to buy, sell or trade machinery units

¹⁴¹ Further documentation is available in the copyrighted source code of the software; telephone 517-353-2979 for more information.



*The distinction between required and optional functions in IFLMAPS is the former occur automatically while the latter occur only if scheduled by an administrator or if requested by a user.

Fig. A.1. General organization of IFLMAPS' subroutines

BYSLIP -- a general subroutine endogenously designating those simulation months in which users are allowed to: (1) invest/disinvest in variable inputs, (2) buy, sell and /or trade machinery units and (3) buy on-farm grain drying and storage facilities

BYVIPS -- provides an opportunity for users to invest and/or disinvest in variable inputs for each of the three crops; is primarily a tax management opportunity

CLCFTM -- calculates the amount of time suitable for field operations during each of the time periods within a year specified for the simulation of a particular geographical location

CLCMCH -- calculates the current market value and associated acre/hour capacity of each owned machinery unit as a function of age and simulated general economic conditions

CLCYLD -- calculates forecast and harvested yields for each crop for each of the allowed planting/harvesting time period combinations

CNCLCN -- converts remaining corn planting intention to soybean planting intention at end of last allowed corn planting period

CNCLSY -- converts remaining soybean planting intentions to idle acreage at the conclusion of the last possible soybean planting period

CNCLWT -- eliminates remaining wheat planting intentions at the conclusion of the last allowed wheat planting period

CORECT -- facilitates verification of user responses

CRCSFL -- presents a preliminary cash flow projection for the current simulation month prior to the execution of scheduled field operations and other activities

CSHFLW -- balances cash flow for the current simulation month and allows for retrieval of information sets corresponding to the current simulation month and completed simulation years

CURRENT -- retrieves the necessary applicable simulation parameters from DTABANK during each simulation month

DBTRAT -- calculates current debt/equity ratio for usage in determining whether or not intermediate credit is available and what is the applicable short-term loan interest rate

DEPRC -- performs the necessary depreciation calculations on owned machinery and grain drying and storage facilities for tax purposes; used in both preliminary and final tax analyses during a simulation year--updates age of assets when performing final analyses

DIRECT -- orchestrates the within month simulation process; determines and calls the appropriate subroutines

DRIVE -- controls the general within year simulation process after a user has signed on and accessed his simulation record

EDBELL -- rings a bell to prompt user to supply requested input

EDSTAT -- presents a statistical summary of a user's performance over the entire simulation horizon; includes the calculation of mean, standard deviation and coefficient of variation standards for key performance measures; based on software developed by Hoskin

ENTBUD -- prepares and presents enterprise budgets for the different crops

EQVLAT -- initializes to zero all of the variables considered in a user's simulation record prior to the relevant variables being transferred from the applicable Initial Firm Structure complement data set

FAMLIV -- calculates monthly family living cash flow requirements

FILDAT -- retrieves and records appropriate information for a user's simulation record as well as transferring the selected Initial Firm Structure complement data set from DTABANK to GAMEDTA

FLDOPR -- directs sequencing of field operations and their simulation within time periods as scheduled in the applicable State/Region complement data set

FORWRD -- closes out forward cash contracts maturing within each simulation month

FUTURE -- closes out futures market contracts maturing within each simulation month; updates margin accounts on contracts remaining active

GOVT -- allows opportunity for user to review specifics of current government program and decide whether or not to participate; if participation is elected and the program requires acreage diversion for wheat, the acreage is removed from production. Acreage diversion associated with corn and soybeans is accounted for as planting occurs

GRNHDL -- routes harvested grain to appropriate marketing alternatives; accounts for cash flow and net farm income impacts if appropriate--otherwise, identifies storage location

HARVES -- allocates harvesting acreage capacity across land tenure classes in order of user specified priority; acreage planted to a crop is harvested according to planting period, i.e., all corn planted in the first allowed planting period is harvested on all three land tenure classes prior to corn planted in the second period being harvested

HEADER -- prints brief introduction header upon accessing of the model

INCAV -- tax subroutine designed to calculate federal tax liability using the income averaging approach; based on software developed by Harsh and Kelsey

INCTAX -- directs computation of preliminary and final federal and state income tax analysis

INITLZ -- sets all cash flow and net farm income variables to zero at the beginning of the simulation year

INPUT -- prints an information set describing current input prices

INVTOR -- prints an information set describing current stored grain inventory, marketing obligations and intentions and an indication of planted acreage

LABOR -- allows annual review and respecification of labor availability during each of the time periods

LBUPDT -- updates that portion of a user's simulation record concerned with labor resource availability and usage

LDFIRM -- facilitates the loading of a new Initial Firm Structure complement data set onto DTABANK

LKFL4 -- locks and unlocks GAMEDTA file as it is accessed so as to facilitate multiple users

LKFL15 -- locks and unlocks DTABANK file as it is accessed so as to facilitate multiple users

LOAN -- closes out matured government commodity program loans after grain has been entered for 9 months

MAIN -- this is the main program of IFLMAPS; it is responsible for attaching the data files, determining the type of user (old or new) and calling the appropriate subroutines to facilitate such users

MCHINV -- presents an information set describing a user's owned machinery

MCHNRY -- presents and describes the available buy, sell and/or trade opportunities existing with respect to machinery; processes user requested choices

MDFYMV -- modifies user specified machinery market values in the Initial Firm Structure complement data set to reflect the simulation environment being represented in the current simulation horizon

MINTAX -- tax subroutine designed to calculate minimum tax liability; based on software developed by Harsh and Kelsey

MISC -- processes cash flow and net farm income accounting associated with payment of property taxes, insurance and miscellaneous repairs

MKTOLK -- retrieves and presents quarterly market outlook information

MORCRH -- determines if there is remaining acreage of a crop to be harvested during the simulation of field operations

MORCRP -- determines if there is remaining acreage of a crop to be planted during the simulation of field operations

NEWPRC -- calculates initial cash prices for the purpose of valuing stored grain so as to prepare a beginning net worth statement

NEWUSR -- determines if there is available file space for a new user; directs signing on process if so

NFMINC -- prepares and offers opportunity for users to retrieve a Net Farm Income Statement

NWSTMT -- prepares and offers users an opportunity to retrieve a Net Worth Statement

NWUSIF -- processes sign on information required of a new user

OLDUSR -- processes signing on of an old user--verifies access codes and retrieves simulation record

OPEXP -- calculates fuel and repair costs associated with operating machinery

PLANT -- directs simulation of planting across land tenure classes in order of user specified priority

PLTINT -- allows users to specify their planting intentions with respect to each crop

POSHRS -- determines the number of hours of field time available from each type of machinery

PRICE -- calculates and presents monthly prices for each marketing alternative permitted

PRIORT -- allows user to specify desired priority ranking of land tenure classes for field operations

PROCES -- directs end of month accounting functions

PYLOAN -- handles end of month repayment of financial loans and associated interest charges

PYSTRG -- handles payment of monthly on- and off-farm grain storage costs

RENT -- provides users with various options regarding rental land and accounts for payment of cash rent

RESERV -- checks if any grain entered in the government reserve program is scheduled to be taken over by the government

RMVRSV -- in the case that the current national average price is above the call price for a crop, converts all reserve grain of that crop to uncommitted storage

SELCRP -- provides users with various allowed marketing options for each crop during each month; execute any user specified strategies

SHIFT1 -- deletes void spaces in 3-dimensional arrays of dimensions (3, 2, 30)

SHIFT2 -- deletes void spaces in 3-dimensional arrays of dimensions (3, 30, 5)

STAX21 -- calculates state income tax for Michigan; based on software developed by Harsh and Kelsey

SUMARY -- develops and presents an information set summarizing a user's performance over his or her entire simulation horizon in terms of key values from the Net Worth and Net Farm Income statements

TAXCOM -- calculates ordinary federal income tax liabilities; based on software developed by Harsh and Kelsey

TXESD -- converts IFLMAPS information to format required to utilize software developed by Harsh and Kelsey to calculate federal and state income tax and self-employment tax liabilities

UDTRPR -- maintains a record of random price movements experienced during the completed portion of a user's simulation horizon

UPDTIM -- maintains a record of the amount of simulation time a user has completed

UPLPRD -- converts diverted and/or idle acreage back to a prepared state so as to make it available for use during the next crop year

VLUCRP -- values growing crops at current cash prices for purpose of preparing a Net Worth Statement

YIELD -- calculates forecast and actual yield for each crop during each simulation year

YLDRCR -- maintains a record of a user's crop yield history with respect to each land tenure class

YSNOED -- processes Yes/No response required of users in IFLMAPS

APPENDIX B

IFLMAPS' EXECUTIVE COMPONENT

APPENDIX B

IFLMAPS' EXECUTIVE COMPONENT

The following discussion describes the various functions performed by IFLMAPS' executive component. Readers are encouraged to have read Chapter 4 prior to studying this section.

Attach Data Files

IFLMAPS requires accessibility to two distinct on-line data storage files: GAMEDTA and DTABANK. Figure B.1 illustrates how the software programs comprising IFLMAPS are interlinked with these data files. It also indicates how LOADATA, the software program enabling administrators to add complement data sets to DTABANK, utilizes part of the software used in IFLMAPS. GAMEDTA contains user specific information for the respective grain farm operations being simulated and presents associated applicable simulation parameter complement data sets. DTABANK stores the various sets of administrator supplied simulation parameters which are employed throughout a user's simulation horizon to characterize his or her decision-making environment. In the absence of these two files, IFLMAPS is inoperable. The first function performed in IFLMAPS is the attaching of these data files. If in some rare event, one or both of the files is (are) unavailable,¹⁴² the model automatically terminates.

¹⁴²This should never occur. The only foreseen occasions for such nonavailability are (1) an MTS (Michigan Terminal System) operating system malfunction (highly improbable) and (2) IFLMAPS' administrators' accidental destruction of the designated files (hopefully never happening). File space permitting, both files will be periodically backed up so as to allow for easy restoration of any lost information should such destruction occur.

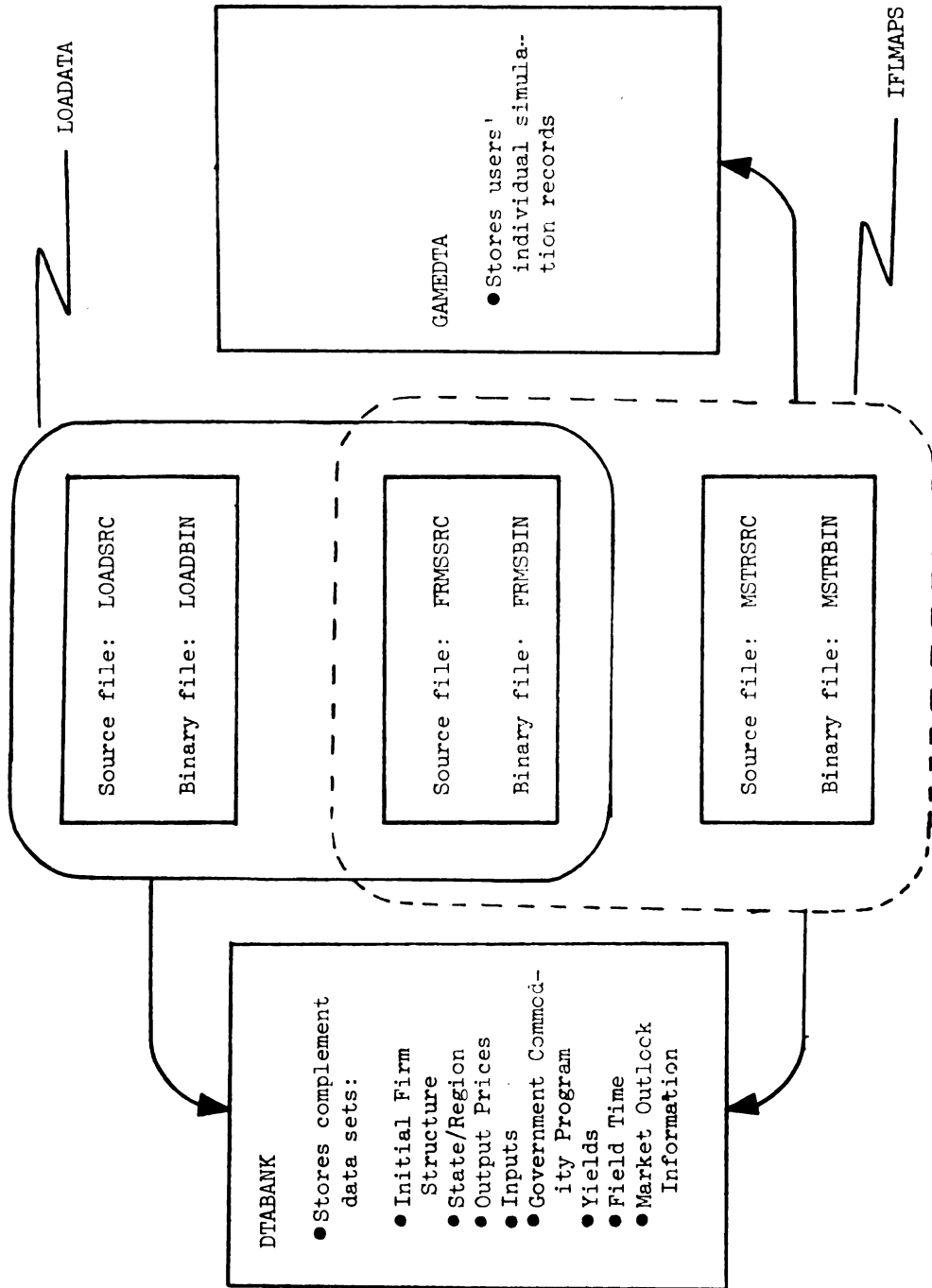


Fig. B.1. Organization of on-line storage files and IFLMAPS' software

IFLMAPS utilizes MTS software to lock and unlock these files as they are used so as to facilitate multiple simultaneous users. The essence of this feature is that when a file is being read from or written upon with reference to a particular user, it is not accessible by other users. IFLMAPS awaits such required access before proceeding with a user's simulation horizon. The design and construction of IFLMAPS seeks to economize on the need for such access, thereby enhancing simultaneous usage of the model.

Identify Type of User

The executive component discerns between new users and old users of IFLMAPS. The former are required to identify their desired simulation environment prior to being allowed to begin simulation while the latter must only correctly identify their previously stored simulation record. More details follow below.

New user

Each user of IFLMAPS requires approximately 120,000 bytes of storage space on file GAMEDTA.¹⁴³ Only after such availability has been substantiated is a new user allowed full access to IFLMAPS. In the case file space is not available,¹⁴⁴ the aspiring user is advised to contact

¹⁴³ This is roughly 24 pages of disk space at the University of Michigan facilities.

¹⁴⁴ At the present time, file space is available for six concurrent users of IFLMAPS. This availability is endogenously specified in FORTRAN subroutine NEWUSR; should more or less file space become available, the value MAXUSR should be altered in this subroutine (line 3425) and the subroutine should be recompiled and integrated with the original compiled version of the other subroutines using the FORTRAN H compiler-- a relative inexpensive operation.

administrators of IFLMAPS concerning if and when access might be obtained.¹⁴⁵

Provided adequate file space is available on GAMEDTA, the new user will be requested to identify himself or herself along with the desired simulation environment. Exhibit B.1 represents an example of the appropriate input form to be used in providing such information. Lines 1-4 concern the identification of the individual user. This information is used to: (1)supervise the file space requirements of IFLMAPS, allowing for administrators to contact individuals associated with obsolete simulation records prior to such information being deleted from GAMEDTA and (2)identify individuals affiliated with particular simulation records.

Lines 5-7 of the input form relate to sundry simulation options available in IFLMAPS. Line 5 defines six simulation parameter complement data sets desired to be in effect over the simulation horizon. While the specifics of the individual complement data sets are described in Chapter 5 it is relevant to mention at this point that these data sets are normally located on file DTABANK, having been stored there by IFLMAPS' administrators. However, with respect to the first type of complement data set requested on Line 5 (Initial Firm Structure), an opportunity exists for new users to provide information regarding a set of grain farm operation circumstances different from those already located on DTABANK (perhaps describing his or her own farm operation to a limited degree). The option to specify such information is activated by

¹⁴⁵IFLMAPS is administered by the Agricultural Economics Department at Michigan State University. Telephone inquiries should be directed to 517-353-2979.

F. Rister
May, 1981
NUID; 1:1

```

Line 1:  Name (40 characters
         maximum)
Line 2:  Mailing (40 characters
         and
         maximum
Line 3:  Address      per line)
Line 4:  Phone number, including Area Codea
Line 5:  Complement Data Set Selectiona,b
        1) Initial Firm Structure (enter 0
           if you wish to enter a new Initial
           Firm Structure Complement)
        2) Output Price Complement
        3) Yield Complement
        4) Field Day Complement
        5) Input Complement
        6) Government Commodity Program Complement
Line 6:  Simulation Optionsa
        1) Number of years to be simulatedd
        2) Form of market information to be providede
        3) State codef
        4) Region code
Line 7:  Output Optionsa,g
        1) Net Worth Statement
        2) Net Farm Income Statement
        3) Cash Flow Summary
        4) Enterprise Budget Projections
        5) Cash Flow Projections
Management options allowed during course of gameh
        6) Alter maximum labor allowed each year
        7) Alter priority of land tenure classes for field operations
        8) Allow speculation on futures market as opposed to only hedging

```

Enter 1 if management option designated is okay; enter 2 otherwise

entering 0 as the respective complement data set desired. In such case, IFLMAPS reads and stores on DTABANK the relevant information.¹⁴⁶ More details concerning the specification of an Initial Firm Structure complement data set are contained in Chapter 5. IFLMAPS internally verifies the existence on DTABANK of each complement data set requested. In the case that a complement data set does not exist, new users will be advised to select another set.¹⁴⁷

The 6 required values in line 6 include the length of time to be simulated, the form of market information to be received and the particular geographical area to be simulated. From one to ten year simulation horizons are possible. Each Output Price complement data set (Value 2 of Line 5) includes identification of the relevant administrator supplied market outlook information. In general, users should select either the traditional form of market information or none at all.¹⁴⁸ Administrators

¹⁴⁶When additional Initial Firm Structure complement data sets are specified for IFLMAPS, either by new users or administrators, such information is first recorded on file DTABANK and then transferred to file GAMEDTA for users requesting the respective complement data set. Maintaining the original version of the complement data set on DTABANK while modifying the user's version on GAMEDTA throughout his or her simulation horizon allows for repeated usage of the Initial Firm Structure complement data set by the same and/or other users. Storage of new Initial Firm Structure complement data sets requires approximately 100,000 bytes of disk space (20 pages at the University of Michigan computer facilities). There is no internal means of IFLMAPS predetermining whether or not such disk space is available. It attempts to store the information as if the space is available. If adequate space is not available, the program will abort, denoting the lack of file space. IFLMAPS' administrators should be contacted if this problem is encountered (call 517-353-2979).

¹⁴⁷In general, information regarding available complement data sets should be solicited from administrators prior to signing on as a new user.

¹⁴⁸Relative to the second objective of this research study, file space has been allocated for two sets of market outlook information per Output Price complement data set, i.e., traditional and probabilistic market information. Recognizing (1) that IFLMAPS will not always be

are allowed to designate various geographical environments (State/Region complement data sets) in an effort to further orient IFLMAPS to the agricultural marketing and production conditions with which a user is more familiar. An explanation of the possible geographical codes is presented in Chapter 5.

Line 7 pertains to several optional features of IFLMAPS. A new user is allowed to indicate whether or not these options will be activated during his or her current simulation horizon. With respect to the output options, a user is provided an opportunity to retrieve the designated statements desired. Such retrieval is not mandatory nor in anyway essential to the endogenous calculations of IFLMAPS. The management options denoted are features incorporated into IFLMAPS nonessential to its intended purpose but available nonetheless. Previous experience in using IFLMAPS is recommended if these options are to be activated.

Upon completion of user specification and model verification of the requested simulation parameters, a user specific simulation record is established on GAMEDTA. Such a record allows for tracking and maintaining an individual user's simulation history while preserving undisturbed for others' usage the various simulation parameters being used to represent his simulation environment.

The process of signing on a new user to IFLMAPS also includes designation of maximum allowed labor availability during each of the

used in applications requiring both forms of information and (2) on-line storage of such market occupies a relatively large amount of file space if the information provided is very extensive, an option is allowed for provision of no information. When this option is selected, administrators are advised to augment the various information sets available to IFLMAPS' users with either verbal or written market outlook statements covering monthly, quarterly or annual simulation periods, at the administrators' discretion.

field operation time periods specified by administrators in the State/Region complement data set. Such information cannot be specified a priori without consideration of the machinery units assumed to be owned by the simulated farm operation (specification of which is contained in the Initial Firm Structure). The user is provided (1) a description of his or her owned machinery and (2) a description of the various field operations possible during the numerous field time periods¹⁴⁹ and is required to specify the maximum amount of labor (in hours) to be assumed available from (1) family and full-time annually hired labor and (2) part-time hourly hired labor during each of the respective field time periods. More details on the specification and the various related factors are contained in the production component of Chapter 4. A thorough understanding of the field operations simulation processes as described in Chapter 4 is recommended prior to such specification.

New users of IFLMAPS are also provided, an indication of the normal seasonal price relationship to be expected for the output market alternatives. Such relationships are specific to the particular geographical area being simulated and are representative of general equilibrium economic conditions, i.e., the relationships are based on an average of historical seasonal price movements. As such, they are considered to be void of price movements attributed to changing fundamental market conditions (supply and/or demand). Users should rely on market outlook information provided during the simulation horizon for an indication of price

¹⁴⁹Field time periods are not to be confused with simulation periods. The latter are one month in duration while the former are of a length specified by IFLMAPS' administrators in the respective State/Region complement data sets. Field time periods are assumed to be subsets of simulation periods.

movements occurring due to such fluctuating fundamental conditions. Such price movements are assumed to be independent of the normal seasonal price movements noted.¹⁵⁰ A new user is also provided an indication of the output market prices in effect during the first simulation month. Such information is provided for study by the user prior to he or she beginning the requested simulation horizon, if so desired.

A user's simulation record is protected by issuance of a pair of unique access codes: (1) user code and (2) security code. Unless these codes can be properly specified in unison, a user's simulation record is inaccessible in the future (see following discussion with respect to "old user").

Once this signing on process has been completed, the new user is allowed to decide whether or not to initiate simulation at that time. Should he or she not wish to do so, the current session with IFLMAPS may be terminated. At the user's convenience, IFLMAPS may be accessed at a later date with simulation commencing in the first month of the first year—the signing on process need not be repeated.

Old user

Upon identifying an individual as an old user of IFLMAPS (someone who terminated a previous simulation session prior to completing his or her designated planning horizon), the executive component requires joint specification of his or her user and security codes. As discussed above, such codes are verified against matching codes on file GAMEDTA prior to allowing access to a user's simulation record. Should an error

¹⁵⁰A full discussion of the underlying assumptions inherent in the calculation of the output market prices in effect during each simulation month is contained in Chapter 4.

be detected, the user will be allowed up to two more attempts to sign on correctly. IFLMAPS automatically terminates if proper sign-on has not occurred within three attempts.¹⁵¹ Normally, however, a user will be able to promptly supply the prerequisite codes correctly. In that case, the executive component of IFLMAPS locates the user's simulation record on GAMEDTA and loads it into memory. Simulation is now ready to begin.

Information Retrieval at Beginning
of a Simulation Session

At the beginning of a user's simulation horizon and at the start of each simulation session thereafter, he or she is allowed an opportunity to retrieve a limited description of the grain farm operation being simulated. The specific information provided is a current Net Worth Statement and an inventory of owned farm machinery. These descriptions are provided to acquaint users with their simulated farm operation's current financial position and field operation capability. Their retrieval is allowed at this time since such information is ordinarily presented only upon completion of a simulation year. Should simulation begin in the midst of a simulation year, such information would otherwise be nonaccessible. As is the case with many of IFLMAPS' information retrieval opportunities. This retrieval is optional. Simulation proceeds in the same manner regardless of whether or not the user takes advantage of the opportunity.

¹⁵¹ Should a user forget or lose his or her access codes, inquiries should be directed to the Department of Agricultural Economics, Michigan State University (telephone 517-353-2979).

Monitor Simulation Time

IFLMAPS is capable of simulating from a one to ten year planning horizon. Within each year, simulation occurs on a monthly basis. Two sets of variables are used to monitor the amount of simulation time completed (IYRG and IMOG) and indicate the current time period being simulated (NYR and NMO). At the beginning of a user's simulation horizon, IYRG and IMOG are both set equal to zero, indicating no simulation time has been completed. NYR and NMO are initialized equal to one, indicating simulation of the first year and month, respectively, is occurring. As simulation of each year/month is completed, the respective "monitor" variables are incremented. These values are registered in a user's simulation record for the purpose of facilitating intermittent usage of IFLMAPS, i.e., should a user find it necessary to discontinue his simulation horizon prior to completion, it is possible to continue simulation in a subsequent session on the same or at a later date without having to repeat that portion of the simulation horizon already completed. In such a case, simulation would begin after the last completed simulation year/month. A user's simulation record is updated upon completion of all activities scheduled for a particular simulation year/month. If simulation should be disrupted prior to such updating, it would be necessary to repeat those events occurring since the last update.

Beginning of a simulation year

Whenever a user accesses his simulation record, the executive component, through use of IYRG and IMOG (see above), determines at what point simulation should begin. If simulation is beginning or continuing (during the current simulation session) in January of a simulation year and provided a user has previously completed a simulation year, the user

is provided an opportunity to retrieve several sets of information summarizing his performance during the previous simulation year, i.e., retrieval of ending Net Worth Statement, annual Cash Flow Statement and annual Net Farm Income Statement is allowed. Regardless of whether or not these statements are retrieved, IFLMAPS internally records a summary of the Net Worth Statement and Net Farm Income Statement on a user's simulation record. This information is used upon completion of the simulation horizon to summarize the user's overall performance.

At the beginning of each simulation year, users are also allowed an opportunity to alter labor availability and priority of land tenure classes for field operations, provided such management options were authorized when the user initially signed on as a new user. These opportunities allow a user to react to his observations during the previous simulation year in anticipation of improving the profitability and/or lessening the risk associated with his simulated farm operation.

The executive component also directs calculations of assumed time available for field operations throughout the upcoming simulation year and the respective yield levels for the three crops (wheat, corn and soybeans) on the three land tenure classes (owned, cash-rented and share-rented) during the respective planting/harvesting periods (details of these calculations are presented in Chapter 4). The time and yield information is stored on a user's simulation record for future reference. This storing procedure avoids the need for recalculation during each simulation month should a user choose to overexercise the intermittent usage option. Annual calculation and file storage of such information is considered to be more efficient than repeated calculations upon the beginning at each user simulation session.

Within month

The executive component of IFLMAPS "drives" the simulation processes occurring within each month. This responsibility includes initialization of the various parameters reflecting the current simulation environment. The initialization is accomplished by retrieving the required information from the applicable complement data sets located on file DTABANK. This process leaves such information unscathed on DTABANK, available for access by other simultaneous and/or later users of IFLMAPS.

Once the simulation environment for the current month has been initialized, the executive component directs the simulation of several events, some requisite and others optional. The events required during each simulation month are limited to calculation of output market prices, various accounting functions (removal of grain from reserve program if current national price above call price, removal of grain from reserve and/or loan program upon completion of allowed storage period, disbursement of required principal and interest payments on outstanding loans, updating of margin accounts on existing futures market contracts, etc.) as well as balancing of the cash flow for the period. Non-performance of these required events would hinder the simulation of several related events. Therefore, such events are endogenously scheduled in IFLMAPS.

Conversely, the optional events possible in IFLMAPS may either be totally omitted or scheduled at the discretion of the respective State/Region complement data sets' administrator. The general nature of such events is that (a) a set of information is presented the user, (b) some intermediate calculations are endogenously performed, (c) the

user is allowed an opportunity to make a decision and (d) the decision is endogenously enacted. Examples of such events include deciding whether or not to rent additional land, whether or not to participate in the government program, amount of acreage planned for each crop, market strategies for growing and/or stored crops, purchase of additional grain drying and storage facilities, etc.

Upon completion of the simulation activities for a particular year/month, the executive component updates a user's simulation record on GAMEDTA. As discussed previously, this allows subsequent simulations to continue from this point rather than requiring the repeated simulation of that part of the horizon already completed should usage be interrupted. The simulation record includes information regarding net farm income, cash flow, existing marketing obligations and all other facets of the farm operation being simulated. The entire simulation environment of the simulated farm operation is preserved in on-line file storage for future access by the user.

After updating of the simulation record at the end of a simulation month, the executive component offers the user an opportunity to decide whether or not to continue simulation at this time. If so desired, simulation of the next month begins immediately. However, if there is a need or desire to disrupt simulation, the user is allowed an opportunity to retrieve next period's relevant output prices and market information (if any available) prior to termination of the session. Retrieval of such information is allowed to facilitate in-between session budgeting, market strategy evaluation, and other managerial activities by the user.

Summary of Performance

Upon completion of the user's requested simulation horizon (stated at time of signing on as a new user) the executive component disallows further simulation. Instead, simulation is halted and the user is provided an opportunity to retrieve a summary of his or her performance over the entire simulation horizon.¹⁵² The summary of performance includes presentation of selected values from the annual Net Worth Statements and Net Farm Income Statements as well as, if the simulation horizon covered three or more years, a brief statistical analysis of the results. A more in-depth discussion of this summary of performance is contained in Chapter 4.

¹⁵² Should a user attempt to sign on again and begin simulation as an old user with the completed simulation record, completion of the requested simulation horizon will be noted and the user will be advised, if he or she desires to continue usage of IFLMAPS, to either sign-on again as a new user or contact the administrators (telephone 517-353-2979) to see if the requested simulation horizon can be extended (may be possible if less than 10 years was initially requested as the desirable simulation horizon).

APPENDIX C

IFLMAPS' COMPLEMENT DATA SETS

APPENDIX C

IFLMAPS' COMPLEMENT DATA SETS

Exhibit C.1. IFLMAPS' Initial Firm Structure Complement Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: INITIAL FIRM STRUCTURE complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exist--verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrator's Manual if there are questions concerning the designated data.

Line 1: (4(I7,1x), 2(F10.2,1x))

Required values are: 1) initial cash on hand, (i.e. checking account balance, 2) current market value of all cropland owned, 3) current market value of farmstead buildings and improvements, 4) current market value of residence (include only if it is desirable to allow consideration of this asset in the calculation of the firm's debt/equity ratio used in determining the availability of outside credit), 5) previous year's federal income tax liability (total of all partners), and 6) previous year's state income tax liability (total of all partners).

500	100000	25000	90000	10000.00	2500.00
1	2	3	4	5	6

Line 2: (F8.0,1x,12,1x,F5.3,1x,F10.2)

Required values are: 1) outstanding mortgage balance associated with owned land and/or farmstead buildings and improvements, 2) numerical code of month during which annual mortgage payment is due (01 = January, ..., 12 = December), 3) annual mortgage interest rate (for example, enter .125 if the applicable interest rate is 12.5%) and 4) annual amortized mortgage payment (sum of both principal and interest).

95000	11	.015	12000.00
1	2	3	4

Line 3: (3(I4,1x), 3(F9.2,1x))

Required values are: 1-3) number of acres of crop variable inputs currently owned and held in inventory for wheat, corn and soybeans, respectively and 4-6) the aggregate cost or market value of such inputs for each respective crop.

25	50	0	2000.00	5000.00	0.00
1	2	3	4	5	6

Lines 4-7:

These input lines are concerned with the characteristics of outstanding current liabilities due within the next year.

Line 4: (6(F10.2,1x))

Required values are principal amounts of current loans and/or other various liabilities due during January, ..., June, respectively, of the first simulation year (do not include income tax liabilities as this information was specified on Line 1).

20000.00	0.0	0.0	0.0	0.0	0.0
1	2	3	4	5	6

Line 5: (6(F10.2,1x))

Required values are similar to those for Line 4, except for the months of July, ..., December.

15000.00	0.0	0.0	0.0	25000.00	0.0
1	2	3	4	5	6

Line 6: (12(F5.0,1x))

Required values are outstanding accrued interest to date on the respective monthly liabilities specified in Lines 4(1-6) and 5(7-12).

0	0	0	0	0	0	0	0	0	0	0	0
1	2	3	4	5	6	7	8	9	10	11	12

Line 7: (12(F5.3,1x))

Required values are the annual interest rates applicable to the respective monthly liabilities specified in Lines 4(1-6) and 5(7-12).

0.100	0.0	0.0	0.0	0.0	0.0	0.120	0.0	0.0	0.0	0.150	0.0
1	2	3	4	5	6	7	8	9	10	11	12

Exhibit C.1 (continued).

Lines 8-13:

These input lines are concerned with the characteristics of currently outstanding intermediate loans maturing during the first 7 simulation years in either June or December. EDSGAME assumes such loans are repaid via equal annual principal payments accompanied by the payment of interest on the total principal balance outstanding during the previous twelve months. All currently held intermediate loans maturing at some point in excess of 7 years should be classified as 7 year loans--that is the upper limit in EDSGAME except for the long-term mortgage specified in Line 2.

Line 8: (7(F10.2,1x))

Required values are total principal balances of intermediate loans due to mature in June of the first seven respective simulation years, i.e. value 1) is the total of such loans maturing during June in the first year, value 2) is the total of such loans maturing during June of the second year--two equal payments are required to repay this loan--one during the first year and another during the second year--enter the total of the two principal payments as the year 2 value, etc.

-----0.0-----0.0-----0.0-----0.0-----0.0-----0.0-----0.0
1 2 3 4 5 6 7

Line 9: (7(F10.2,1x))

Required values are similar to those for Line 8 except for such loans maturing in December of each year.

-----0.0-----0.0-----17000.00-----0.0-----35000.00-----46000.00-----0.0
1 2 3 4 5 6 7

Line 10: (7(F5.0,1x))

Required values are outstanding accrued interest amounts to date on the respective intermediate loans specified in Line 8.

-----0.-----0.-----0.-----0.-----0.-----0.-----0.
1 2 3 4 5 6 7

Line 11: (7(F5.0,1x))

Required values are outstanding accrued interest amounts to date on the respective intermediate loans specified in Line 9.

-----0.-----0.-----0.-----0.-----0.-----0.-----0.
1 2 3 4 5 6 7

Line 12: (7(F5.3,1x))

Required values are the annual interest rates applicable to the respective intermediate loans specified in Line 8.

0.07 0.0 0.0 0.0 0.0 0.0 0.0
1 2 3 4 5 6 7

Line 13: (7(F.3,1x))

Required values are the annual interest rates applicable to the respective intermediate loans specified in Line 9.

0.0 0.0 0.07 0.0 0.15 0.13 0.0
1 2 3 4 5 6 7

Lines 14-24:

These input lines describe the characteristics of up to ten units for each of the three machinery complement types considered in EDSGAME--land preparation, planting and harvesting. This section is provided to allow an approximate specification of a farm operation's current machinery assets commensurate with the programming structure of EDSGAME. Additional information regarding specification of the required descriptive information is contained in the Administrators' Manual.

Line 14: (3(I2,1x))

Required values are the number of units of each type machinery complement currently owned with respect to land preparation, planting and harvesting complements--a maximum of 10 per complement type is allowed.

2, 2, 1
1 2 3

Lines 15-24: (F10.2,1x,F10.2,1x,F3.0,1x,F7.3,1x,F7.3,1x,F3.0)

Required values are, for owned land preparation complement units, 1) current book value, 2) current market value, 3) age of unit (years), 4) acre per hour capacity rating of unit when new, 5) horsepower rating of unit's power source and 6) size rating (denotes corresponding size unit available for purchase in EDSGAME--information contained in Input complement data set). Note: Data entries are required only for the number of complement units owned--ignore the remaining lines in this section and skip to Line 25.

Line 15:

-----0.0-----40000.00-----8-----2.5-----95.0-----4.
1 2 3 4 5 6

Line 16:

-----30000.00-----50000.00-----2-----3.0-----125.0-----6.
1 2 3 4 5 6

Exhibit C.1 (continued).

Line 17:

1	2	3	4	5	6
---	---	---	---	---	---

Line 18:

1	2	3	4	5	6
---	---	---	---	---	---

Line 19:

1	2	3	4	5	6
---	---	---	---	---	---

Line 20:

1	2	3	4	5	6
---	---	---	---	---	---

Line 21:

1	2	3	4	5	6
---	---	---	---	---	---

Line 22:

1	2	3	4	5	6
---	---	---	---	---	---

Line 23:

1	2	3	4	5	6
---	---	---	---	---	---

Line 24:

1	2	3	4	5	6
---	---	---	---	---	---

Lines 25-34: (F10.2,1x,F10.2,1x,F3.0,1x,F7.3,1x,F7.3,1x,F3.0)

Required values are, for owned planting complement units, 1) current book value, 2) current market value, 3) age of unit (years), 4) acre per hour capacity rating of unit when new, 5) horsepower rating of unit's power source and 6) size rating (denotes corresponding size unit available for purchase in EDSGAME--information contained in input complement data set). Note: Data entries are required only for the number of complement units owned--ignore the remaining lines in this section and skip to Line 35.

Line 25:

5000.00	50000.00	7	2.5	89.0	3
1	2	3	4	5	6

Line 26:

25000.00	60000.00	4	3.1	115.0	5
1	2	3	4	5	6

Line 27:

1	2	3	4	5	6
---	---	---	---	---	---

Line 28:

1	2	3	4	5	6
---	---	---	---	---	---

Line 29:

1	2	3	4	5	6
---	---	---	---	---	---

Line 30:

1	2	3	4	5	6
---	---	---	---	---	---

Line 31:

1	2	3	4	5	6
---	---	---	---	---	---

Line 32:

1	2	3	4	5	6
---	---	---	---	---	---

Exhibit C.1 (continued).

Line 33:

1	2	3	4	5	6

Line 34:

1	2	3	4	5	6

Lines 35-44: (F10.2,1x,F10.2,1x,F1.0,1x,F7.1,1x,F7.1,1x,F1.0)

Required values are, for owned harvesting complement units, 1) current book value, 2) current market value, 3) age of unit (years), 4) acre per hour capacity rating of unit when new, 5) horsepower rating of unit's power source and 6) size rating (denotes corresponding size unit available for purchase in EDSGAMES--information contained in Input complement data set). Note: Data entries are required only for the number of complement units owned--ignore the remaining lines in this section and skip to Line 45.

Line 35:

1	2	3	4	5	6
55000.00	80000.00	1	44	1450	2

Line 36:

1	2	3	4	5	6

Line 37:

1	2	3	4	5	6

Line 38:

1	2	3	4	5	6

Line 39:

1	2	3	4	5	6

Line 40:

1	2	3	4	5	6

Line 41:

1	2	3	4	5	6

Line 42:

1	2	3	4	5	6

Line 43:

1	2	3	4	5	6

Line 44:

1	2	3	4	5	6

Line 45: (2(I7,1x),I2)

Required values are 1) currently owned capacity (in bushels) of on-farm drying and storage facilities, 2) book value of such facilities and 3) average age of same (years).

1	2	3
35000	10500	7

Line 46: (6(I6,1x))

Required values are 1-3) bushels of wheat, corn and soybeans, respectively, currently stored in on-farm storage facilities and 4-6) bushels of wheat, corn and soybeans, respectively, currently stored in off-farm storage facilities. The sum of values 1-3 may not exceed value 1 of line 45.

1	2	3	4	5	6
5000	10000	5000	1000	5000	3000

Exhibit C.1 (continued).

Line 47: (12(I5,1x))

Required values are current levels of all partners' (including spouses' income) aggregated monthly off-farm income (January, ..., December, respectively) being realized by the farm operation being simulated.

2000, 3000, 3000, 1500, 1500, 0, 0, 0, 1500, 1500, 1500, 3000
1 2 3 4 5 6 7 8 9 10 11 12

Line 48: (2(I2,1x),I1,3(1x,I6))

Required values are 1) number of families (partners) sharing income from simulated farm operation, 2) number of tax exemptions per family, 3) tax filing type assumed for all involved families (1 = single, 2 = married and separate and 3 = married and joint), 4) current annual per family living expense expenditure level, 5) minimum allowed level of annual per family living expenses and 6) maximum allowed level of annual per family living expenses.

2, 3, 14000, 12000, 48000
1 2 3 4 5 6

Line 49: (F6,2,1x,3(I2,1x),F5,2)

Required values are: 1) current per acre cash rent on land so rented (enter a realistic value even if no land is currently rented in this fashion--you may decide to rent some such land during the simulation period), 2) numerical code of month during which property taxes are due, 3-4) numerical codes of months during which semi-annual insurance payments are due and 5) the maximum allowable ratio of liabilities/equity with respect to the availability of outside credit.

75.00, 11, 03, 09, 1.00
1 2 3 4 5

Line 50: (8(F4,2,1x))

Required values are landlord's proportionate share of income and expenses associated with land rented on a share tenure basis; specifically, the values relate to 1) land preparation cash operating costs, 2) planting cash operating costs, 3) harvesting cash operating costs, 4) crop variable inputs, 5) government diversion payments, 6) wheat yield, 7) corn yield and 8) soybean yield. Values 1, 2 and 3 relate to machinery fuel, lubrication and repair costs; fixed machinery costs and all labor costs are assumed to be the sole responsibility of the tenant. Please specify realistic values even if no land is currently rented on a share tenure basis--you may decide to rent some such land during the simulation period.

0.0, 0.0, 0.50, 0.40, 0.50, 0.40, 0.50, 0.40
1 2 3 4 5 6 7 8

Lines 51-55:

These input lines relate to characteristics of acreage currently controlled by the farm operation to be simulated. Use the workspace provided below to insure that the values specified in Lines 51-53 do not exceed the total acreage of each land tenure class currently controlled.

Acreage Inventory Workspace

	Owned Land	Cash- Rented Land	Share- Rented Land
Planted to Wheat (Line 51)	<u>25</u>	<u>200</u>	<u>100</u>
Fall-plowed (Line 52)	<u>50</u>	<u>200</u>	<u>0</u>
Unprepared, i.e. not fall-plowed (Line 53)	<u>25</u>	<u>0</u>	<u>200</u>
TOTAL ACREAGE*	<u>100</u>	<u>400</u>	<u>300</u>

*A maximum of 999 acres per land tenure class is allowed.

Line 51: (3(I4,1x))

Required values are acres of land currently planted to wheat on owned land, cash-rented land and share-rented land, respectively.

25, 200, 100
1 2 3

Line 52: (3(I4,1x))

Required values are acres of land fall-plowed and ready to be planted to either corn or soybeans with respect to owned land, cash-rented land and share-rented land, in that order.

50, 200, 0
1 2 3

Line 53: (3(I4,1x))

Required values are acres of land not plowed during the fall and needing to be prepared in the spring prior to the planting operation with respect to owned land, cash-rented land and share-rented land, in that order.

25, 0, 200
1 2 3

Exhibit C.1 (continued).

Line 54: (3(11,1x))

Required values are ranked priority of land tenure classes with respect to the performance of field operations during each time period; values 1, 2 and 3 correspond to owned, cash-rented, and share-rented land--rank them 1-3 per your preferred scheduling priority.

1, 3, 2
1 2 3

Line 55: (3(3(13,1x)))

Required values are the potential yield levels, in bushels, under ideal weather and planting/harvesting conditions for: 1-3) wheat on owned, cash- and share-rented land, 4-6) corn on owned, cash- and share-rented land and 7-9) soybeans on owned, cash- and share-rented land.

50, 43, 45, 120, 90, 110, 47, 40, 42
1 2 3 4 5 6 7 8 9

Line 56: (110,1x,4(F10,2,1x))

Required values are, for each individual partner, 1) current investment credit carry-over and 2-5) taxable income of the four most recent years, oldest first.

1000, 2000.00, 1500.00, 0.0, 5000.00
1 2 3 4 5

Exhibit C.2. IFLMAPS' State/Region Complement Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1991

INPUT FORM: STATE/REGION complement data set

Data input is free formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exists--verify your input on each line before hitting the RETURN key. Type all digits in and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrator's Manual if there are questions concerning the designated data.

Line 1: (I2,1x,I2)

Required values are state and regional identification codes, respectively, for complement data set being input.

21, 01
1 2

Line 2: (I1,1x,I2)

Required values are 1) state income tax code (1, 2 or 3) and 2) state income tax as a percentage of federal income tax (applicable only if state income tax code is 2--enter 00 otherwise).

1, 00
1 2

Line 3: (I2)

Required value is number of time periods included during each simulation year for field operations in this State/Region complement data set (maximum is 47).

12
1

Lines 4-97:

This section of input is a series of two line descriptors of the time periods designated for field operations during each simulation year. Lines 4 and 5 pertain to the first time period, lines 6 and 7 apply to the second time period, etc. The respective formats and explanation presented for lines 4 and 5 are relevant for the remaining pairs of input lines in this section. Input is required only for the number of periods indicated in Line 3--program automatically skips to input line 99 thereafter.

Line 4: (I2,1x,I2,1x,I4,12(1x,11))

Required values are 1) number of time period (1, 2, 3...through number of periods identified in Line 3), 2) code designating type of field operation(s) to be simulated during period (01, 02, ..., 12), 3) expected number of hours available during period for field work, 4) identification of current planting period for wheat, corn and soybeans, respectively, 5) identification of current harvesting period for wheat, corn and soybeans, respectively, 6) designation of total number of planting periods allowed for wheat, corn and soybeans, respectively, and 7) designation of total number of harvesting periods allowed for wheat, corn and soybeans, respectively.

01, 01, 15, 00, 0, 00, 0, 344, 55, 5
---, ---, ---, ---, ---, ---, ---, ---
1. 2 3 4 5 6 7

Line 5: (3A4,1x,12A4) Fixed Format

Required values are 1) range of calendar dates encompassed by time period designated in above line, i.e., 03/10-04/03 and 2) an alphanumeric description of the field operations to be performed during the time period (maximum of 49 characters).

04/01-04/24, LAND PREP ONLY

1

2

Exhibit C.2 (continued).

Line 6: (I2,1x,I2,1x,I4,12(1x,I1))

02	03	40	010	000	344	555
1	2	3	4	5	6	7

Line 7: (3A4,1x,12A4) Fixed Format

04/25-05/10	LAND PREP & PLANT CORN(1)
1	2

Line 8: (I2,1x,I2,1x,I4,12(1x,I1))

03	03	29	020	000	344	555
1	2	3	4	5	6	7

Line 9: (3A4,1x,12A4) Fixed Format

05/11-05/19	LAND PREP & PLANT CORN(1)
1	2

Line 10: (I2,1x,I2,1x,I4,12(1x,I1))

04	05	63	031	000	344	555
1	2	3	4	5	6	7

Line 11: (3A4,1x,12A4) Fixed Format

05/19-05/26	LAND PREP & PLANT CORN(1) AND SOYBEANS(1)
1	2

Line 12: (I2,1x,I2,1x,I4,12(1x,I1))

05	05	53	042	000	344	555
1	2	3	4	5	6	7

Line 13: (3A4,1x,12A4) Fixed Format

05/27-06/03	LAND PREP & PLANT CORN(4) SOYBEANS(2)
1	2

Line 14: (I2,1x,I2,1x,I4,12(1x,I1))

06	04	63	003	000	344	555
1	2	3	4	5	6	7

Line 15: (3A4,1x,12A4) Fixed Format

06/04-06/11	LAND PREP & PLANT SOYBEANS(5)
1	2

Line 16: (I2,1x,I2,1x,I4,12(1x,I1))

07	04	53	004	000	344	555
1	2	3	4	5	6	7

Line 17: (3A4,1x,12A4) Fixed Format

06/12-06/19	LAND PREP & PLANT SOYBEANS(4)
1	2

Line 18: (I2,1x,I2,1x,I4,12(1x,I1))

08	06	42	000	100	344	555
1	2	3	4	5	6	7

Exhibit C.2 (continued).

Line 19: (3A4,1x,12A4) Fixed Format

07/15-07/22, LAND PREP & Harvest Wheat(1)

1

2

Line 20: (I2,1x,I2,1x,I4,12(1x,I1))

09,06,64,0,0,0,2,0,0,3,4,4,5,5,5

1

2

3

4

5

6

7

Line 21: (3A4,1x,12A4) Fixed Format

07/23-07/31, LAND PREP & HARVEST Wheat(2)

1

2

Line 22: (I2,1x,I2,1x,I4,12(1x,I1))

10,06,105,0,0,0,3,0,0,3,4,4,5,5,5

1

2

3

4

5

6

7

Line 23: (3A4,1x,12A4) Fixed Format

09/01-09/15, LAND PREP & HARVEST WHEAT(3)

1

2

Line 24: (I2,1x,I2,1x,I4,12(1x,I1))

11 06 83 0,0,0 4,0,0 3,4,4 5,5,5

1

2

3

4

5

6

7

Line 25: (3A4,1x,12A4) Fixed Format

09/16-09/30, LAND PREP & HARVEST WHEAT(4)

1

2

Line 26: (I2,1x,I2,1x,I4,12(1x,I1))

12,06,165,0,0,0,5,0,0,3,4,4,5,5,5

1

2

3

4

5

6

7

Line 27: (3A4,1x,12A4) Fixed Format

09/01-09/26, LAND PREP & HARVEST WHEAT(5)

1

2

Line 28: (I2,1x,I2,1x,I4,12(1x,I1))

13,08,31,0,0,0,0,0,1,3,4,4,5,5,5

1

2

3

4

5

6

7

Line 29: (3A4,1x,12A4) Fixed Format

09/27-10/03, LAND PREP & HARVEST SOYBEANS(1)

1

2

Line 30: (I2,1x,I2,1x,I4,12(1x,I1))

14,12,41,1,0,0,0,1,2,3,4,4,5,5,5

1

2

3

4

5

6

7

Line 31: (3A4,1x,12A4) Fixed Format

10/04-10/10, LAND PREP, HARV SOYS(2) AND CORN(1), PLT WHEAT(1)

1

2

Exhibit C.2 (continued).

Line 32: (I2,1x,I2,1x,I4,I2(1x,I1))

15	12	41	200	023	344	555
1	2	3	4	5	6	7

Line 33: (3A4,1x,12A4) Fixed Format

10/11-10/17	LAND PREP, HARV SOYS(3) AND CORN(2), PLT WHEAT(2)
1	2

Line 34: (I2,1x,I2,1x,I4,I2(1x,I1))

16	12	103	300	034	344	555
1	2	3	4	5	6	7

Line 35: (3A4,1x,12A4) Fixed Format

10/18-11/07	LAND PREP, HARV SOYS(4) AND CORN(3), PLT WHEAT(3)
1	2

Line 36: (I2,1x,I2,1x,I4,I2(1x,I1))

17	09	65	000	045	344	555
1	2	3	4	5	6	7

Line 37: (3A4,1x,12A4) Fixed Format

11/08-11/20	LAND PREP & HARVEST SOYS(5) AND CORN(4)
1	2

Line 38: (I2,1x,I2,1x,I4,I2(1x,I1))

18	07	13	000	050	344	555
1	2	3	4	5	6	7

Line 39: (3A4,1x,12A4) Fixed Format

11/29-12/12	LAND PREP & HARVEST CORN(5)
1	2

Line 40: (I2,1x,I2,1x,I4,I2(1x,I1))

19	01	8	000	000	344	555
1	2	3	4	5	6	7

Line 41: (3A4,1x,12A4) Fixed Format

12/13-12/31	LAND PREP ONLY
1	2

Line 42: (I2,1x,I2,1x,I4,I2(1x,I1))

20						
1	2	3	4	5	6	7

Line 43: (3A4,1x,12A4) Fixed Format

1						2

Line 44: (I2,1x,I2,1x,I4,I2(1x,I1))

21						
1	2	3	4	5	6	7

Exhibit C.2 (continued).

Line 45: (3A4,1x,12A4) Fixed Format

1 2

Line 46: (I2,1x,I2,1x,I4,12(1x,I1))

22

1 2 3 4 5 6 7

Line 47: (3A4,1x,12A4) Fixed Format

1 2

Line 48: (I2,1x,I2,1x,I4,12(1x,I1))

23

1 2 3 4 5 6 7

Line 49: (3A4,1x,12A4) Fixed Format

1 2

Line 50: (I2,1x,I2,1x,I4,12(1x,I1))

24

1 2 3 4 5 6 7

Line 51: (3A4,1x,12A4) Fixed Format

1 2

Line 52: (I2,1x,I2,1x,I4,12(1x,I1))

25

1 2 3 4 5 6 7

Line 53: (3A4,1x,12A4) Fixed Format

1 2

Line 54: (I2,1x,I2,1x,I4,12(1x,I1))

26

1 2 3 4 5 6 7

Line 55: (3A4,1x,12A4) Fixed Format

1 2

Line 56: (I2,1x,I2,1x,I4,12(1x,I1))

27

1 2 3 4 5 6 7

Line 57: (3A4,1x,12A4) Fixed Format

1 2

Exhibit C.2 (continued).

Line 58: (I2,lx,I2,lx,I4,l2(lx,I1))

28

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 59: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 60: (I2,lx,I2,lx,I4,l2(lx,I1))

29

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 61: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 62: (I2,lx,I2,lx,I4,l2(lx,I1))

30

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 63: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 64: (I2,lx,I2,lx,I4,l2(lx,I1))

31

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 65: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 66: (I2,lx,I2,lx,I4,l2(lx,I1))

32

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 67: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 68: (I2,lx,I2,lx,I4,l2(lx,I1))

33

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```

Line 69: (3A4,lx,l2A4) Fixed Format

```
-----
      1                                     2
-----
```

Line 70: (I2,lx,I2,lx,I4,l2(lx,I1))

34

```
--,--,---, -,--, -,--, -,--, -,--
-----
 1  2  3      4      5      6      7
```


Exhibit C.2 (continued).

Line 71: (3A4,1x,12A4) Fixed Format-----
1 2

Line 72: (I2,1x,I2,1x,I4,12(1x,11))

35

1 2 3 4 5 6 7Line 73: (3A4,1x,12A4) Fixed Format-----
1 2

Line 74: (I2,1x,I2,1x,I4,12(1x,11))

36

1 2 3 4 5 6 7Line 75: (3A4,1x,12A4) Fixed Format-----
1 2

Line 76: (I2,1x,I2,1x,I4,12(1x,11))

37

1 2 3 4 5 6 7Line 77: (3A4,1x,12A4) Fixed Format-----
1 2

Line 78: (I2,1x,I2,1x,I4,12(1x,11))

38

1 2 3 4 5 6 7Line 79: (3A4,1x,12A4) Fixed Format-----
1 2

Line 80: (I2,1x,I2,1x,I4,12(1x,11))

39

1 2 3 4 5 6 7Line 81: (3A4,1x,12A4) Fixed Format-----
1 2

Line 82: (I2,1x,I2,1x,I4,12(1x,11))

40

1 2 3 4 5 6 7Line 83: (3A4,1x,12A4) Fixed Format-----
1 2

Exhibit C.2 (continued).

Line 84: (I2,lx,I2,lx,I4,l2(lx,I1))

41

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 85: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 86: (I2,lx,I2,lx,I4,l2(lx,I1))

42

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 87: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 88: (I2,lx,I2,lx,I4,l2(lx,I1))

43

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 89: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 90: (I2,lx,I2,lx,I4,l2(lx,I1))

44

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 91: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 92: (I2,lx,I2,lx,I4,l2(lx,I1))

45

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 93: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 94: (I2,lx,I2,lx,I4,l2(lx,I1))

46

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Line 95: (3A4,lx,l2A4) Fixed Format

1	2
---	---

Line 96: (I2,lx,I2,lx,I4,l2(lx,I1))

47

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Exhibit C.2 (continued).

Line 97: (3A4,1x,12A4) Fixed Format

Lines 98-121:

This section of input is a series of two lines of several 4-digit codes which identify the events scheduled for each of the twelve simulation months. The respective formats and explanations presented for Lines 98 and 99 are relevant for the remaining pairs of input lines.

Line 98: (I2,14(1x,I4))

January. Required values are (1) number of events scheduled during the month and (2) the 4 digit codes of the first 14 events--enter 0's if no events.

[illegible]

Line 99: (15(14,1x))

Required values are the 4 digit codes of the remaining 15 events scheduled for the month noted in the line above, if any (enter 0's otherwise).

0 _____

Line 100:

February.

03, 0200, 0300, 1000, _____, _____, _____, _____, _____, _____, _____, _____
1 2

Line 101:

φ _____

Line 102:

March.

05, 0200, 0300, 0502, 0503, 1000
1 2

Line 103:

Line 103:

0

Line 104:

April.

09, 0200, 0300, 0400, 0700, 0800, 0902, 0903, 1000, 1101, ---, ---, ---, ---,
1 2

Line 105:

Line 105: 0

Line 106:

May.

06, 0200, 0300, 1000, 1102, 1103, 1104, _____, _____, _____, _____, _____, _____
1 2

Line 107:

Line 107:

0

Line 108:

June.

07 0200, 0300, 0801, 1000, 1105, 1106, 1107, _____, _____, _____, _____, _____
1 2

Line 109:

LINE 109: 0

Exhibit C.2 (continued).

Line 110:

July.

06, 0200, 0300, 0400, 1000, 1108, 1109, -----
 1 2

Line 111:

0

Line 112:

August.

05, 0200, 0300, 1000, 1110, 1111, -----
 1 2

Line 113:

0

Line 114:

September.

09, 0200, 0300, 0501, 0602, 0603, 1000, 1112, 1203, -----
 1 2

Line 115:

0

Line 116:

October.

08, 0200, 0300, 0400, 0901, 1000, 1113, 1114, 1115, -----
 1 2

Line 117:

0

Line 118:

November.

05, 0200, 0300, 1000, 1116, 1117, -----
 1 2

Line 119:

0

Line 120:

December.

06, 0200, 0300, 0400, 1000, 1118, 1119, -----
 1 2

Line 121:

0

Lines 122-147:

This section of input involves the specification of the planting/harvesting yield and moisture (corn) relationships for wheat (Lines 122-128), corn (Lines 129-141) and Soybeans (Lines 142-147).

Line 122: (I1, Ix, I1, I0(Ix, I4))

Required values are (1) number of planting periods allowed for wheat (maximum of 5), (2) number of harvesting periods allowed for wheat (maximum of 5), and (3) beginning and ending date codes for 5 planting periods (code is 0307, 0315 for a planting period extending from March 7 through March 15)--enter 0's if no period exists. The dates noted in 3 should correspond to those noted in lines 4-97 for the respective field operations.

35, 1004, 1010, 1011, 1017, 1018, 1107, 0000, 0000, 0000, 0000
 1 2 3a 3b 3c 3d 3e

Line 123: (I4, 9(Ix, I4))

Required values are the same as those noted in line 122-3 except for 5 wheat harvesting periods.

0715, 0711, 0723, 0731, 0801, 0815, 0816, 0830, 0901, 0916
 a b c d e

Exhibit C.2 (continued).

Line 124: (5(F4.2,1x))

Required values are relative wheat yield factors with respect to the ideal yield potential identified in an Initial Firm Structure complement; this line contains the factors for the first planting period and up to 5 harvest periods (values should be 0.00 to 1.00).

1.00, -.96, -.86, -.56, -.28
1 2 3 4 5

Line 125: (5(F4.2,1x))

Required values are the same as those described in Line 124 except for the second wheat planting period.

-.96, -.92, -.83, -.54, -.27
1 2 3 4 5

Line 126: (5(F4.2,1x))

Required values are the same as those described in Line 124 except for the third wheat planting period.

-.87, -.84, -.75, -.49, -.24
1 2 3 4 5

Line 127: (5(F4.2,1x))

Required values are the same as those described in Line 124 except for the fourth wheat planting period.

0.0, 0.0, 0.0, 0.0, 0.0
1 2 3 4 5

Line 128: (5(F4.2,1x))

Required values are the same as those described in Line 124 except for the fifth wheat planting period.

0.0, 0.0, 0.0, 0.0, 0.0
1 2 3 4 5

Line 129: (11,1x,11,10(1x,14))

Required values are the same as those in Line 122 except for corn.

4.5, 0425, 0510, 0511, 0518, 0519, 0526, 0527, 0603, 0000, 0000
1 2 3a 3b 3c 3d 3e

Line 130: (14,9(1x,14))

Required values are the same as those in Line 123 except for corn.

1004, 1010, 1011, 1017, 1018, 1107, 1108, 1128, 1129, 1212
a b c d e

Line 131: (5(F4.2,1x))

Required values are the same as those in Line 124 except for corn.

1.00, -.99, -.98, -.98, -.44
1 2 3 4 5

Line 132: (5(F4.2,1x))

Required values are the same as those in Line 125 except for corn.

-.92, -.91, -.90, -.80, -.40
1 2 3 4 5

Line 133: (5(F4.2,1x))

Required values are the same as those in Line 126 except for corn.

-.84, -.83, -.82, -.71, -.35
1 2 3 4 5

Line 134: (5(F4.2,1x))

Required values are the same as those in Line 127 except for corn.

-.76, -.75, -.74, -.62, -.31
1 2 3 4 5

Line 135: (5(F4.2,1x))

Required values are the same as those in Line 128 except for corn.

0.0, 0.0, 0.0, 0.0, 0.0
1 2 3 4 5

Exhibit C.2 (continued).

Lines 136-140:

This section involves designation of the expected moisture content, in decimal form, of corn planted and harvested during the various allowed periods--corn is priced at a 15.5% moisture content (values should normally be within a range of 0.13 to 0.35).

Line 136: (5(F5.3,1x))

Required values are moisture contents of corn planted during the first planting period and harvested during the respective 5 harvested periods.

28 26 23 21 21
1 2 3 4 5

Line 137: (5(F5.3,1x))

Required values are the same as those in Line 136 except for the second planting period.

30 28 25 25 25
1 2 3 4 5

Line 138: (5(F5.3,1x))

Required values are the same as those in Line 136 except for the third planting period.

32 30 27 25 25
1 2 3 4 5

Line 139: (5(F5.3,1x))

Required values are the same as those in Line 136 except for the fourth planting period.

35 35 30 27 27
1 2 3 4 5

Line 140: (5(F5.3,1x))

Required values are the same as those in Line 136 except for the fifth planting period.

00 00 00 00 00
1 2 3 4 5

Line 141: (11,1x,11,10(1x,14))

Required values are the same as those in Line 122 except for soybeans.

45 0519 0526 0527 0603 0604 0611 0612 0619 0000 0000
1 2 3a 3b 3c 3d 3e

Line 142: (14,9(1x,14))

Required values are the same as those in Line 123 except for soybeans.

0927 1003 1004 1010 1011 1017 1018 1107 1108 1128
a b c d e

Line 143: (5(F4.2,1x))

Required values are the same as those in Line 124 except for soybeans.

100 95 87 68 34
1 2 3 4 5

Line 144: (5(F4.2,1x))

Required values are the same as those in Line 125 except for soybeans.

96 91 84 64 32
1 2 3 4 5

Line 145: (5(F4.2,1x))

Required values are the same as those in Line 126 except for soybeans.

93 87 79 61 30
1 2 3 4 5

Line 146: (5(F4.2,1x))

Required values are the same as those in Line 127 except for soybeans.

82 76 69 50 25
1 2 3 4 5

Line 147: (5(F4.2,1x))

Required values are the same as those in Line 128 except for soybeans.

00 00 00 00 00
1 2 3 4 5

Exhibit C.2 (continued).

Line 148: (6(I2,1x))

Required values are the numerical codes for the contract maturity months for harvest and post-harvest delivery contracts for wheat, corn and soybeans, respectively (January = 01, February = 02, etc.).

09, 12, 11,	05, 07, 05
1 2 3	4 5 6
-----	-----
harvest	post-harvest
delivery	delivery

Lines 149-151:

This section involves the specification of the normal or historical average monthly cash bases between the Chicago cash market and the primary State/Region locality (Basis = Chicago cash price less local price).

Line 149: (12(F5.2,1x))

Required values are wheat local cash bases for January, February, etc.

46	54	56	53	59	55	46	42	44	42	33	43
1	2	3	4	5	6	7	8	9	10	11	12
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Line 150: (12(F5.2,1x))

Required values are corn local cash bases for January, February, etc.

36	37	36	39	37	33	32	33	31	41	41	36
1	2	3	4	5	6	7	8	9	10	11	12
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Line 151: (12(F5.2,1x))

Required values are soybean local cash bases for January, February, etc.

37	34	36	35	30	33	35	38	38	39	40	34
1	2	3	4	5	6	7	8	9	10	11	12
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Line 152: (3(F5.2,1x))

Required values are regional adjustment factors which localize the primary State/Region cash bases noted in Lines 149-151 to the specific region in the state this complement is being prepared to represent; wheat, corn and soybeans, respectively.

10	10	10
1	2	3
-----	-----	-----

Exhibit C.2 (continued).

Lines 153-158:

This section involves the designation of the normal or historical average bases between the Chicago Board of Trade futures market contract prices and the local cash prices for the respective commodities in the primary state/region locality (Basis = Chicago B.O.T. price less local cash price). The values are required according to the age of the contract-- value 1 is for the first month during which the contract becomes available (All contracts are assumed to have a 15 month lifetime), ... and 15 is for the month during which the contract matures; if it is desired to not make a contract available during one of the early months enter a basis of 99.99.

Line 153: (15(F5.2,2x))

Required values are the normal bases for wheat harvest delivery futures market contract.

99.99	90	1.01	95	75	71	70	66	67	68	70	66	57	48	46
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 154: (15(F5.2,1x))

Required values are the normal bases for wheat post-harvest delivery futures market contract.

65	1.00	89	85	1.02	1.02	95	89	74	61	58	55	58	56	59
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 155: (15(F5.2,1x))

Required values are the normal bases for corn harvest delivery futures market contract.

59	58	47	52	51	49	44	36	39	38	36	39	53	48	35
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 156: (15(F5.2,1x))

Required values are the normal bases for corn post-harvest delivery futures market contract.

99.99	58	49	57	61	70	63	50	52	50	46	42	37	37	37
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 157: (15(F5.2,1x))

Required values are the normal bases for soybean harvest delivery futures market contract.

99.99	67	40	23	28	25	09	45	40	02	12	31	44	60	55
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 158: (15(F5.2,1x))

Required values are the normal bases for soybean post-harvest delivery futures market contract.

14	23	28	13	35	55	70	73	59	51	52	55	52	48	40
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Line 159: (3(F5.2,1x))

Required values are regional adjustment factors which localize primary state/region bases noted in Lines 153-158 to the specific region in the state this complement is being prepared to represent; wheat, corn and soybeans, respectively.

10	10	10
1	2	3

Line 160: (3(F5.2,1x))

Required values are state/region adjustments to the national government commodity program loan price for wheat, corn and soybeans, respectively; adjustment equals local loan price less national loan price.

05	01	0.0
1	2	3

Exhibit C.3. IFLMAPS' Output Price Complement Data Set Input Form.

INTERNAL FIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: OUTPUT PRICE complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exist--verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrator's Manual if there are questions concerning the designated data.

Line 1: (I2)

Required value is the identification code of the corresponding Market Outlook Information set.

01

1

Line 2: (3(F5.2,1x))

Required values are initial annual national average prices received by farmers for wheat, corn and soybeans, respectively.

3 00 2 50 9 00

1 2 3

Lines 3-12: (12(F5.2,1x))

Required values are the monthly pseudo-random price adjustments for each crop during each of the ten years in the simulation horizon. On each line, value 1 is for January, value 2 is for February, etc.

Lines 3-12: Wheat pseudo-random price adjustments; Line 3 is for simulation year 1, Line 4 is for simulation year 2, etc.

Line 3:

00 00 00 00 00 00 00 00 00 00 00 00

1 2 3 4 5 6 7 8 9 10 11 12

Line 4:

00 00 00 00 00 00 00 00 00 00 00 00

1 2 3 4 5 6 7 8 9 10 11 12

Line 5:

07 08 05 03 05 05 -04 -08 -04 02 03 03

1 2 3 4 5 6 7 8 9 10 11 12

Line 6:

-09 04 00 12 01 08 14 16 14 -05 -07 04

1 2 3 4 5 6 7 8 9 10 11 12

Line 7:

-11 -09 -04 02 03 03 11 11 09 13 14 20

1 2 3 4 5 6 7 8 9 10 11 12

Line 8:

16 14 18 04 -13 -03 01 -04 -01 01 06 01

1 2 3 4 5 6 7 8 9 10 11 12

Line 9:

03 -03 00 17 16 19 -08 -03 -07 -13 -12 -12

1 2 3 4 5 6 7 8 9 10 11 12

Line 10:

09 06 04 -03 -07 -03 07 09 10 -16 -06 -16

1 2 3 4 5 6 7 8 9 10 11 12

Line 11:

-04 -10 -09 -15 -04 -09 -09 -14 -17 07 06 02

1 2 3 4 5 6 7 8 9 10 11 12

Line 12:

09 04 02 02 -01 00 -04 04 00 -14 -17 -14

1 2 3 4 5 6 7 8 9 10 11 12

Exhibit C.3 (continued).

Lines 13-22: Corn pseudo-random price adjustments; Line 13 is for simulation year 1, Line 14 is for simulation year 2, etc.

Line 13:

00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
1 2 3 4 5 6 7 8 9 10 11 12

Line 14:

00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
1 2 3 4 5 6 7 8 9 10 11 12

Line 15:

04, 04, 07, 02, 02, 03, -12, -09, -09, 13, 05, 08
1 2 3 4 5 6 7 8 9 10 11 12

Line 16:

-05, -01, -05, 04, 01, 07, 10, 05, 07, 03, 01, 01
1 2 3 4 5 6 7 8 9 10 11 12

Line 17:

-02, 00, 00, 05, 03, 02, -08, -09, -06, 10, 13, 11
1 2 3 4 5 6 7 8 9 10 11 12

Line 18:

-05, 02, -05, 01, -02, -03, 00, -03, -06, 00, 07, 02
1 2 3 4 5 6 7 8 9 10 11 12

Line 19:

01, 05, 03, -03, -04, -01, -02, -04, -01, 03, -01, 04
1 2 3 4 5 6 7 8 9 10 11 12

Line 20:

-09, -08, -07, -07, -06, -08, 01, -01, 01, -04, -04, -07
1 2 3 4 5 6 7 8 9 10 11 12

Line 21:

03, 04, 06, -13, -13, -11, 02, -01, 01, -07, -04, -08
1 2 3 4 5 6 7 8 9 10 11 12

Line 22:

05, 10, 09, 10, 05, 02, -01, -04, -04, -05, -01, 01
1 2 3 4 5 6 7 8 9 10 11 12

Lines 23-32: Soybean pseudo-random price adjustments; Line 23 is for simulation year 1, Line 24 is for simulation year 2, etc.

Line 23:

00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
1 2 3 4 5 6 7 8 9 10 11 12

Line 24:

00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
1 2 3 4 5 6 7 8 9 10 11 12

Line 25:

05, 03, 08, 10, -01, 19, -10, 08, 05, -02, 06, 12
1 2 3 4 5 6 7 8 9 10 11 12

Line 26:

-13, -08, -13, 00, -07, -10, 12, 10, 13, -14, -10, 01
1 2 3 4 5 6 7 8 9 10 11 12

Line 27:

-02, -07, -03, -15, -24, -15, 23, 27, 21, -15, -01, -11
1 2 3 4 5 6 7 8 9 10 11 12

Line 28:

03, 02, 04, 12, 00, 10, -31, -24, -28, 03, 09, 03
1 2 3 4 5 6 7 8 9 10 11 12

Exhibit C.3 (continued).

Line 29:

02	01	-07	01	01	04	-04	06	10	-21	-21	-11
1	2	3	4	5	6	7	8	9	10	11	12

Line 30:

05	08	01	-16	-14	-18	-04	-06	-01	-26	-28	-16
1	2	3	4	5	6	7	8	9	10	11	12

Line 31:

-03	-20	-07	-16	-06	-08	24	30	22	-07	-05	-11
1	2	3	4	5	6	7	8	9	10	11	12

Line 32:

-15	-03	-19	15	03	10	-06	-02	-12	10	09	13
1	2	3	4	5	6	7	8	9	10	11	12

Lines 33-50: (20(12,1x))

Required values are codes indicating perceptions of fundamental market conditions during each simulation quarter of the ten year simulation horizon for the three subsequent quarters; respective codes are 1, 0 and -1 for bullish, possumish and bearish market conditions.

Lines 33-38: Wheat forecast codes; Line 33 (39,45) is forecasts for the next quarter during the first five simulation years and Line 34 (40,46) is the same for the next five simulation years; Line 35 (41,47) is perceptions for two quarters hence during the first five simulation years and Line 36 (42,48) is the same for the next five simulation years; Line 37 (43,49) is perceptions for three quarters hence during the first five simulation years and Line 38 (44,50) is the same for the next five simulation years. Numbers in () apply respectively to the line numbers concerned with the specification of perceptions concerning corn and soybean futuristic market conditions.

Line 33:

0	0	0	0	0	0	0	0	1	-1	1	0	-1	1	1	1	1	0	-1	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 34:

0	0	1	0	-1	0	1	1	0	0	-1	-1	1	0	-1	1	1	0	0	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 35:

0	0	0	0	0	0	0	0	-1	1	0	1	-1	-1	0	0	0	0	-1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 36:

0	1	0	1	0	-1	1	-1	-1	1	0	0	0	-1	0	0	0	-1	1	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 37:

0	0	0	0	0	0	0	0	0	1	0	0	0	-1	-1	1	0	0	-1	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 38:

-1	0	0	-1	1	0	0	0	0	0	1	1	1	0	-1	-1	1	-1	0	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Lines 39-44: Corn perception codes; see wheat perception codes explanation above.

Line 39:

0	0	0	0	0	0	0	0	-1	0	-1	-1	-1	-1	-1	-1	-1	0	-1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 40:

0	0	1	-1	1	-1	-1	0	-1	-1	1	-1	-1	0	-1	1	1	-1	-1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 41:

0	0	0	0	0	0	0	0	1	0	0	-1	0	-1	1	0	-1	0	-1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 42:

-1	-1	0	1	0	-1	0	-1	0	-1	0	-1	-1	-1	-1	-1	0	0	-1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Exhibit C.3 (continued).

Line 43:

-0	-0	-0	-0	-0	-0	-0	-0	-1	-1	-1	-1	-0	-1	-1	0	0	0	1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 44:

-1	-0	-1	-0	-1	-1	0	-1	0	0	-1	-1	1	1	0	0	-1	0	0	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Lines 45-50: Soybean perception codes; see wheat perception codes explanation on previous page.

Line 45:

0	0	0	0	0	0	0	0	1	0	-1	-1	1	0	0	1	1	1	0	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 46:

-1	-1	-1	0	1	0	0	1	0	-1	1	0	1	0	-1	1	0	1	-1	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 47:

0	0	0	0	0	0	0	0	-1	-1	1	-1	-1	1	-1	0	0	0	1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 48:

0	0	0	-1	-1	-1	-1	0	-1	0	0	-1	0	0	0	0	-1	0	0	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 49:

0	0	0	0	0	0	0	0	1	0	-1	0	0	0	0	1	-1	-1	1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Line 50:

-1	-1	-1	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Lines 51-72: (I1,1x,I1,1x,I2,1x,I2,1x,F5.2)

Required values are bias factors with respect to futures market and forward cash contracts; value 1 designates crop (1:wheat, 2:corn and 3:soybeans), value 2 designates contract type (1:futures market contracts and 2:forward cash contracts); values 3 and 4 denote the simulation year and month, respectively in which the bias is to be interjected and value 5 represents the bias factor itself--a positive value favors contractual alternatives and a negative value is non-conductive to their use. A value of 0 for value 1 on a line indicates no further bias factors are to be interjected.

Line 51:

2	1	04	04	10
1	2	3	4	5

Line 52:

2	1	04	05	10
1	2	3	4	5

Line 53:

2	1	04	06	10
1	2	3	4	5

Line 54:

3	2	04	07	15
1	2	3	4	5

Line 55:

3	2	04	08	15
1	2	3	4	5

Line 56:

3	2	04	09	15
1	2	3	4	5

Line 57:

0	-	-	-	-
1	2	3	4	5

Exhibit C.3 (continued)

Line 58:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 59:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 60:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 61:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 62:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 63:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 64:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 65:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 66:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 67:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 68:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 69:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 70:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 71:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Line 72:

```

--,-,--,-,--,-,--,-
1 2 3 4 5

```

Note: Continue the format of (I1,1x,I1,1x,I2,1x,I2,1x,F5.2) on additional lines until all desired bias factors have been specified--terminate input by specifying a value of 0 for item 1 on the input line.

Exhibit C.4. IFLMAPS' Inputs Complement Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: INPUT complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exists—verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrators' Manual if there are questions concerning the designated data.

Line 1: 10(15,1x)

Line 1: 10(14,1X)
Required values are annual costs of one full-time man year of labor (approximately 2500 hours) for each simulation year.

$\frac{-15000}{1}, \frac{-15000}{2}, \frac{-15000}{3}, \frac{-15000}{4}, \frac{-15000}{5}, \frac{-15000}{6}, \frac{-15000}{7}, \frac{-15000}{8}, \frac{-15000}{9}, \frac{-16000}{10}$

Line 2: 10(F5.2,1x)

Required values are hourly costs of part-time labor for each simulation year.

-\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00, -\$5.00

Line 3: 10(I3,1x)

Required values are random factors (0-99) relating to additional acres of cash rent land available for rent during each simulation year.

52, 35, 09, 92, 04, 20, 60, 66, 62, 91
1 2 3 4 5 6 7 8 9 10

Line 4: 10(I3.1x)

Line 4: 10(1),11;
Required values are random factors (0-99) relating to additional acres of share rent land available for rent during each simulation year.

24, 58, 97, 54, 20, 60, 43, 13, 99, 16
1 2 3 4 5 6 7 8 9 10

Line 5: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the base cash rent during each simulation year.

$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.00}{3}, \frac{1.00}{4}, \frac{1.00}{5}, \frac{1.00}{6}, \frac{1.00}{7}, \frac{1.00}{8}, \frac{1.00}{9}, \frac{1.00}{10}$

Line 6: 3(F7.2,1x)

Required values are the brokerage fees per 1000 bushel futures market contract of wheat, corn and soybeans, respectively.

$$\begin{array}{r} \underline{\underline{25.00}}, \underline{\underline{25.00}}, \underline{\underline{30.00}} \\ 1 \qquad \qquad 2 \qquad \qquad 3 \end{array}$$

Line 7: 3 (F8.2, 1x)

Required values are the margin requirements per 1000 bushels futures market contract of wheat, corn and soybeans, respectively.

$$\begin{array}{r} \text{---}500.00, \text{---}400.00, \text{---}900.00 \\ \quad \quad \quad 1 \quad \quad \quad 2 \quad \quad \quad 3 \end{array}$$

Line 8: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the normal futures market and forward cash contracts' bases during each simulation year.

$$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.00}{3}, \frac{1.00}{4}, \frac{1.00}{5}, \frac{1.00}{6}, \frac{1.00}{7}, \frac{1.00}{8}, \frac{1.00}{9}, \frac{1.00}{10}$$

Exhibit C.4 (continued)

Line 9: 3(F7.2,1x)

Required values are initial (simulation time zero (0)) costs of the composite variable crop inputs on a per acre basis for wheat, corn and soybeans, respectively.

42.58	70.60	50.43
1	2	3

Line 10: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the initial composite variable crop input costs to arrive at "planting time" costs during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Line 11: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the initial composite variable crop input costs to arrive at December ("tax management time") costs during each simulation year.

.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
1	2	3	4	5	6	7	8	9	10

Line 12: 10(F4.2,1x)

Required values are per bushel hauling costs of all crops from field to on-farm drying and storage facilities during each simulation year.

.07	.07	.07	.07	.07	.07	.07	.07	.07	.07
1	2	3	4	5	6	7	8	9	10

Line 13: 10(F4.2,1x)

Required values are per bushel hauling costs of all crops from field to off-farm drying and storage facilities or sales points during each simulation year.

.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
1	2	3	4	5	6	7	8	9	10

Line 14: 10(F4.2,1x)

Required values are per bushel hauling costs of all crops from on-farm drying and storage facilities to off-farm sales points during each simulation year.

.08	.08	.08	.08	.08	.08	.08	.08	.08	.08
1	2	3	4	5	6	7	8	9	10

Line 15: 10(F5.3,1x)

Required values are per bushel monthly on-farm storage costs during each simulation year.

.005	.005	.005	.005	.005	.005	.005	.005	.005	.005
1	2	3	4	5	6	7	8	9	10

Line 16: 10(F5.3,1x)

Required values are per bushel monthly off-farm storage costs during each simulation year.

.025	.025	.025	.025	.025	.025	.025	.025	.025	.025
1	2	3	4	5	6	7	8	9	10

Line 17: 10(F6.4,1x)

Required values are per bushel per point of moisture removed on-farm drying costs during each simulation year.

.015	.015	.015	.015	.015	.015	.015	.015	.015	.015
1	2	3	4	5	6	7	8	9	10

Line 18: 10(F6.4,1x)

Required values are per bushel per point of moisture removed off-farm drying costs during each simulation year.

.020	.020	.020	.020	.020	.020	.020	.020	.020	.020
1	2	3	4	5	6	7	8	9	10

Exhibit C.4 (continued).

Line 19: 6(I6,1x)

Required values are the sizes, in bushel units, of on-farm grain drying and storage facilities assumed available for purchase, i.e., 1000, 5000, 10000, etc.

2000	5000	10000	20000	30000	50000
1	2	3	4	5	6

Line 20: 6(I7,1x)

Required values are the initial (simulation time zero (0)) purchase costs corresponding to respective sizes of on-farm grain handling facilities specified on Line 19.

7700	16500	26620	46420	59400	102300
1	2	3	4	5	6

Line 21: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the initial on-farm grain handling facilities' costs during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Lines 22-38:

Required values relate to specification of machinery units available for purchase during the simulation horizon. Up to ten units of each type complement (land preparation, planting and harvesting) may be described; enter 0.0 value where applicable if less than ten units of a particular complement type are desired.

Line 22: 10(F4.0,1x)

Required values are the horsepower ratings for up to ten different sizes of land preparation complement units available for purchase.

50	75	90	100	110	120	150	175	200	250
1	2	3	4	5	6	7	8	9	10

Line 23: 10(F5.2,1x)

Required values are the respective acre per hour performance capacity ratings (when new) of the different sizes of land preparation complement units available for purchase.

1.30	1.92	2.27	2.53	2.79	3.05	3.83	4.44	5.07	6.36
1	2	3	4	5	6	7	8	9	10

Line 24: 10(F7.0,1x)

Required values are the respective initial (simulation time zero (0)) costs of the different sizes of land preparation complement units available for purchase.

23230	29391	37067	41006	44945	50399	65751	79689	88173	104232
1	2	3	4	5	6	7	8	9	10

Line 25: 10(F4.2,1x)

Required values are land preparation complement units' salvage values as a percentage of new cost for ages 1-10+; enter in decimal form, (100% = 1.00, 10% = 0.10, etc.).

.61	.56	.51	.46	.42	.39	.34	.31	.29	.26
1	2	3	4	5	6	7	8	9	10

Line 26: 10(F4.2,1x)

Required values are land preparation complement units' reliability factors for ages 1-10+ (used to modify acre/hour capacity as machinery units age).

.91	.90	.92	.92	.92	.87	.84	.79	.74	.62
1	2	3	4	5	6	7	8	9	10

Line 27: 10(F4.0,1x)

Required values are the horsepower ratings for up to ten different sizes of planting complement units available for purchase.

50	75	90	100	110	120	150	175	200	250
1	2	3	4	5	6	7	8	9	10

Line 28: 10(F5.2,1x)

Required values are the respective acre per hour performance capacity ratings of the different sizes of planting complement units available for purchase.

1.51	1.96	2.50	2.64	3.20	3.34	4.55	4.95	6.35	8.14
1	2	3	4	5	6	7	8	9	10

Exhibit C.4 (continued).

Line 29: 10(F7.0,1x)

Required values are the respective initial (simulation time zero (0)) costs of the different sizes of planting complement units available for purchase.

34875	41582	55656	59414	70921	76154	104404	117877	146122	191578
1	2	3	4	5	6	7	8	9	10

Line 30: 10(F4.2,1x)

Required values are planting complement units' salvage values as a percentage of new cost for ages 1-10+; enter in decimal form, (100% = 1.00, 10% = 0.10, etc.).

.57	.52	.47	.42	.38	.34	.31	.28	.25	.23
1	2	3	4	5	6	7	8	9	10

Line 31: 10(F4.2,1x)

Required values are planting complement units' reliability factors for ages 1-10+ (used to modify acre/hour capacity as machinery units age).

.80	.89	.90	.91	.91	.88	.86	.80	.77	.68
1	2	3	4	5	6	7	8	9	10

Line 32: 10(F4.0,1x)

Required values are the horsepower ratings for up to ten different sizes of harvesting complement units available for purchase.

100	145	165	200	0	0	0	0	0	0
1	2	3	4	5	6	7	8	9	10

Line 33: 10(F5.2,1x)

Required values are the respective acre per hour performance capacity ratings of the different sizes of harvesting complement units available for purchase.

2.97	4.45	5.94	8.91	0.0	0.0	0.0	0.0	0.0	0.0
1	2	3	4	5	6	7	8	9	10

Line 34: 10(F7.0,1x)

Required values are the respective initial (simulation time zero (0)) costs of the different sizes of harvesting complement units available for purchase.

64741	88779	105848	134431	0	0	0	0	0	0
1	2	3	4	5	6	7	8	9	10

Line 35: 10(F4.2,1x)

Required values are harvesting complement units' salvage values as a percentage of new cost for ages 1-10+; enter in decimal form, (100% = 1.00, 10% = 0.10, etc.).

.57	.51	.46	.41	.37	.33	.29	.26	.23	.21
1	2	3	4	5	6	7	8	9	10

Line 36: 10(F4.2,1x)

Required values are harvesting complement units' reliability factors for ages 1-10+ (used to modify acre/hour capacity as machinery units age).

.95	.97	.98	.99	.99	.98	.98	.95	.93	.89
1	2	3	4	5	6	7	8	9	10

Line 37: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the initial farm machinery complementary units' costs during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Line 38: 7(F5.2,1x)

Required values are the machinery complement efficiency factors for (1) land preparation, (2-4) planting (wheat, corn and soybeans) and (5-7) harvesting (wheat, corn and soybeans) complements, respectively.

1.00	1.00	1.00	1.00	1.15	1.00	1.30
1	2	3	4	5	6	7

Exhibit C.4 (continued).

Lines 39-48: 10x12(F5.3,1x)

Required values are the monthly short-term annual interest rates during each simulation year; Line 39 is for simulation year 1, line 40 is for simulation year 2, etc.; first value on a line is for January, second value is for February, etc.

Line 39:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 40:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 41:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 42:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 43:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 44:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 45:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 46:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 47:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Line 48:

$\frac{.14}{1}, \frac{.14}{2}, \frac{.14}{3}, \frac{.14}{4}, \frac{.14}{5}, \frac{.14}{6}, \frac{.14}{7}, \frac{.14}{8}, \frac{.14}{9}, \frac{.14}{10}, \frac{.14}{11}, \frac{.14}{12}$

Exhibit C.4 (continued).

Lines 49-58: 10x12(F5.2,1x)

Required values are the monthly intermediate annual interest rates during each simulation year; Line 49 is for simulation year 1, Line 50 is for simulation year 2, etc.; first value on a line is for January, second value is for February, etc.

Line 49:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 50:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 51:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 52:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 53:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 54:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 55:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 56:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 57:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Line 58:

12	12	12	12	12	12	12	12	12	12	12	12
1	2	3	4	5	6	7	8	9	10	11	12

Exhibit C.4 (continued).

Line 59: 3(F7.2,1x)

Required values are the costs per \$1000 of assessed value for property tax, insurance and miscellaneous repairs, respectively.

10.00	15.00	50.00
1	2	3

Line 60: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the value of owned land, residence and improvements during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Line 61: 10(F5.2,1x)

Required values are annual, non-cumulative inflation factors which modify the level of family living expenses during each simulation year.

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	2	3	4	5	6	7	8	9	10

Line 62: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the level of monthly off-farm income during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Line 63: 10(F5.2,1x)

Required values are cumulative or compounded inflation factors which modify the base level of crop prices during each simulation year.

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	2	3	4	5	6	7	8	9	10

Line 64: (F5.2)

Required value is initial per gallon cost of diesel; cost during each simulation year is calculated using "planting time" inflation rates applicable to crop variable inputs.

1.00
1

Line 65: 6(F7,1x)

Required values are 1-3) assumed hours of annual use for each owned unit of land preparation, planting and harvesting machinery complements, respectively, and 4-6) lifetime expectancy, in hours of use, of land preparation, planting and harvesting complement units, respectively.

100	300	150	5000	1000	2000
1	2	3	4	5	6

Exhibit C.5. IFLMAP's Government Commodity Program Complement
Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: GOVERNMENT COMMODITY PROGRAM complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exist--verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrators' Manual if there are questions concerning the designated data.

Line 1: (10(I1,1x))

Required values are land class cross-compliance codes during each simulation year; 1= yes and 2 = no.

1 2 1 2 1 2 1 2 1 2
1 2 3 4 5 6 7 8 9 10

Line 2: (10(F5.3,1x))

Required values are annual per bushel government storage payments for grain held in reserver program during each simulation year.

1 2 3 4 5 6 7 8 9 10
10 30 30 30 30 30 30 30 30 30

Line 3: (10(F5.3,1x))

Required values are annual interest rates charged on government loans during each simulation year.

1 2 3 4 5 6 7 8 9 10
10 10 10 10 10 10 10 10 10 10

Line 4: (10(F4.2,1x))

Required values are the diversion percentage requirements with respect to wheat acreage planted during each simulation year (values should be between 0.00 and .50).

1 2 3 4 5 6 7 8 9 10
00 10 30 00 10 20 00 15 20 30

Line 5: (10(F6.2,1x))

Required values are the per acre diversion payments for wheat diverted acreage during each simulation year.

1 2 3 4 5 6 7 8 9 10
00 50 00 75 00 10 00 00 00 90 00 75 00 50 00

Line 6: (10(F5.2,1x))

Required values are the national government loan prices per bushel of wheat during each simulation year.

1 2 3 4 5 6 7 8 9 10
3 00 3 00 3 25 3 25 3 30 3 30 3 35 3 40 3 40 3 40

Exhibit C.5 (continued).

Line 7: (10(F4.2,1x))

Required values are the diversion percentage requirements with respect to corn acreage planted during each simulation year (values should be between 0.00 and .50).

00	20	00	10	10	15	00	15	20	30
1	2	3	4	5	6	7	8	9	10

Line 8: (10(F6.2,1x))

Required values are the per acre diversion payments for corn diverted acreage during each simulation year.

00	40.00	00	100.00	10.00	00	00	90.00	75.00	100.00
1	2	3	4	5	6	7	8	9	10

Line 9: (10(F5.2,1x))

Required values are the national government loan prices per bushel of corn during each simulation year.

1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
1	2	3	4	5	6	7	8	9	10

Line 10: (10(F4.2,1x))

Required values are the diversion percentage requirements with respect to soybean acreage planted during each simulation year (values should be between 0.00 and .50).

00	00	00	10	10	00	00	00	00	00
1	2	3	4	5	6	7	8	9	10

Line 11: (10(F6.2,1x))

Required values are the per acre diversion payments for soybean diverted acreage during each simulation year.

0.0	0.0	0.0	100.00	10.00	0.0	0.0	0.0	0.0	0.0
1	2	3	4	5	6	7	8	9	10

Line 12: (10(F5.2,1x))

Required values are the national government loan prices per bushel of soybean during each simulation year.

5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1	2	3	4	5	6	7	8	9	10

Line 13: (6,(F4.2,1x))

Required values are the respective release and call factors as they relate to the loan price of each crop; values 1 and 2 are for wheat, values 3 and 4 are for corn and values 5 and 6 are for soybeans. The same factors apply to all simulation years.

1.45	1.75	1.45	1.75	1.45	1.75
1	2	3	4	5	6

Exhibit C.6. IFLMAP's Yield Complement Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: YIELD complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exist--verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrators' Manual if there are questions concerning the designated data.

Line 1: (10(F4.2,1x))

Required values are forecast wheat yield random factors for years 1-10.

-.90,-.90,-.91,-.89,-.94,-.84,-.89,-.90,-.84,-.91
1 2 3 4 5 6 7 8 9 10

Line 2: (10(F4.2,1x))

Required values are actual wheat yield random factors for years 1-10.

-.90,-.90,-.94,-.88,-.97,-.86,-.89,-.90,-.88,-.93
1 2 3 4 5 6 7 8 9 10

Line 3: (10(F4.2,1x))

Required values are forecast corn yield random factors for years 1-10.

-.90,-.90,-.93,-.93,-.95,-.93,-.91,-.83,-.93,-.92
1 2 3 4 5 6 7 8 9 10

Line 4: (10(F4.2,1x))

Required values are actual corn yield random factors for years 1-10.

-.90,-.90,-.89,-.91,-.90,-.93,-.92,-.88,-.92,-.94
1 2 3 4 5 6 7 8 9 10

Line 5: (10(F4.2,1x))

Required values are forecast soybean yield random factors for years 1-10.

-.90,-.90,-.89,-.97,-.88,-.91,-.84,-.83,-.92,-.94
1 2 3 4 5 6 7 8 9 10

Line 6: (10(F4.2,1x))

Required values are actual soybean yield random factors for years 1-10.

-.90,-.90,-.89,-.92,-.83,-.91,-.86,-.86,-.91,-.94
1 2 3 4 5 6 7 8 9 10

Exhibit C.7. IFLMAP's Field Time Complement
Data Set Input Form.

INTERACTIVE FARM LEVEL
MARKETING/PRODUCTION SIMULATION MODEL
AGRICULTURAL ECONOMICS DEPARTMENT
MICHIGAN STATE UNIVERSITY

E. RISTER
May, 1981

INPUT FORM: FIELD TIME complement data set

Data input is free-formatted; however, it is recommended that the formats indicated be used so as to minimize the possibility of input errors. No opportunity for correcting errors exist--verify your input on each line before hitting the RETURN key. Type all decimals and separate multiple data entries on a single line either by commas or blanks. Refer to the Administrators' Manual if there are questions concerning the designated data.

Lines 1-47: (10(F4.2,1x))

Required values are random field time adjustment factors for time periods 1 through 47 during each of the ten simulation years. Line 1 values are for time period 1, Line 2 values are the time period 2, etc.

Line 1: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{.99}{3}, \frac{.97}{4}, \frac{.89}{5}, \frac{.01}{6}, \frac{.91}{7}, \frac{.86}{8}, \frac{.96}{9}, \frac{.10}{10}$

Line 2: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.10}{3}, \frac{.99}{4}, \frac{.94}{5}, \frac{.91}{6}, \frac{.86}{7}, \frac{.89}{8}, \frac{.89}{9}, \frac{1.05}{10}$

Line 3: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.17}{3}, \frac{1.07}{4}, \frac{1.04}{5}, \frac{.93}{6}, \frac{.88}{7}, \frac{.91}{8}, \frac{.92}{9}, \frac{.98}{10}$

Line 4: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.13}{3}, \frac{1.07}{4}, \frac{1.03}{5}, \frac{.89}{6}, \frac{.89}{7}, \frac{.91}{8}, \frac{.94}{9}, \frac{.89}{10}$

Line 5: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.01}{3}, \frac{1.09}{4}, \frac{.99}{5}, \frac{.99}{6}, \frac{.96}{7}, \frac{.85}{8}, \frac{1.07}{9}, \frac{.87}{10}$

Line 6: $\frac{1.00}{1}, \frac{1.00}{2}, \frac{.85}{3}, \frac{1.01}{4}, \frac{.88}{5}, \frac{.98}{6}, \frac{.97}{7}, \frac{.83}{8}, \frac{1.02}{9}, \frac{.89}{10}$

Exhibit C.7 (continued).

Line 7:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.10}{3}, \frac{.99}{4}, \frac{1.03}{5}, \frac{1.09}{6}, \frac{.92}{7}, \frac{.95}{8}, \frac{1.08}{9}, \frac{.91}{10}$
Line 8:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.06}{3}, \frac{.95}{4}, \frac{1.07}{5}, \frac{.95}{6}, \frac{.95}{7}, \frac{.96}{8}, \frac{1.06}{9}, \frac{.87}{10}$
Line 9:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.08}{3}, \frac{1.03}{4}, \frac{1.02}{5}, \frac{1.01}{6}, \frac{1.02}{7}, \frac{1.00}{8}, \frac{1.09}{9}, \frac{.86}{10}$
Line 10:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.96}{3}, \frac{.99}{4}, \frac{1.00}{5}, \frac{1.00}{6}, \frac{1.08}{7}, \frac{1.00}{8}, \frac{1.03}{9}, \frac{.87}{10}$
Line 11:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.94}{3}, \frac{1.06}{4}, \frac{.90}{5}, \frac{1.18}{6}, \frac{1.11}{7}, \frac{1.00}{8}, \frac{1.04}{9}, \frac{.92}{10}$
Line 12:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.86}{3}, \frac{.97}{4}, \frac{.92}{5}, \frac{1.17}{6}, \frac{1.09}{7}, \frac{.96}{8}, \frac{.97}{9}, \frac{.98}{10}$
Line 13:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.93}{3}, \frac{1.06}{4}, \frac{1.11}{5}, \frac{.94}{6}, \frac{.88}{7}, \frac{.97}{8}, \frac{1.09}{9}, \frac{1.10}{10}$
Line 14:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.92}{3}, \frac{1.02}{4}, \frac{1.12}{5}, \frac{.89}{6}, \frac{.98}{7}, \frac{.99}{8}, \frac{1.03}{9}, \frac{1.11}{10}$
Line 15:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.90}{3}, \frac{1.02}{4}, \frac{1.06}{5}, \frac{.85}{6}, \frac{.91}{7}, \frac{.92}{8}, \frac{.95}{9}, \frac{1.12}{10}$
Line 16:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.93}{3}, \frac{.93}{4}, \frac{1.01}{5}, \frac{.86}{6}, \frac{1.06}{7}, \frac{.94}{8}, \frac{.93}{9}, \frac{1.12}{10}$
Line 17:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.94}{3}, \frac{.92}{4}, \frac{.94}{5}, \frac{.88}{6}, \frac{.87}{7}, \frac{.90}{8}, \frac{.95}{9}, \frac{1.14}{10}$
Line 18:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.98}{3}, \frac{.88}{4}, \frac{.98}{5}, \frac{.95}{6}, \frac{.94}{7}, \frac{.98}{8}, \frac{1.03}{9}, \frac{1.13}{10}$
Line 19:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.02}{3}, \frac{1.01}{4}, \frac{.95}{5}, \frac{1.02}{6}, \frac{1.04}{7}, \frac{1.10}{8}, \frac{.99}{9}, \frac{.89}{10}$
Line 20:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.94}{3}, \frac{1.01}{4}, \frac{.98}{5}, \frac{1.02}{6}, \frac{.98}{7}, \frac{1.03}{8}, \frac{.97}{9}, \frac{.92}{10}$

Exhibit C.7 (continued).

Line 21:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.85}{3}, \frac{.99}{4}, \frac{1.00}{5}, \frac{.97}{6}, \frac{.96}{7}, \frac{1.00}{8}, \frac{.95}{9}, \frac{1.00}{10}$
Line 22:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.84}{3}, \frac{.95}{4}, \frac{1.03}{5}, \frac{.99}{6}, \frac{.93}{7}, \frac{.96}{8}, \frac{.98}{9}, \frac{1.08}{10}$
Line 23:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.85}{3}, \frac{1.00}{4}, \frac{1.01}{5}, \frac{.98}{6}, \frac{.97}{7}, \frac{1.01}{8}, \frac{1.03}{9}, \frac{1.13}{10}$
Line 24:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.95}{3}, \frac{1.01}{4}, \frac{1.00}{5}, \frac{1.03}{6}, \frac{.99}{7}, \frac{1.04}{8}, \frac{1.08}{9}, \frac{1.11}{10}$
Line 25:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.89}{3}, \frac{1.12}{4}, \frac{1.07}{5}, \frac{1.03}{6}, \frac{1.05}{7}, \frac{1.15}{8}, \frac{1.06}{9}, \frac{1.18}{10}$
Line 26:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.85}{3}, \frac{1.08}{4}, \frac{.99}{5}, \frac{1.10}{6}, \frac{1.09}{7}, \frac{1.10}{8}, \frac{1.02}{9}, \frac{1.13}{10}$
Line 27:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.84}{3}, \frac{1.00}{4}, \frac{1.04}{5}, \frac{1.08}{6}, \frac{1.11}{7}, \frac{1.07}{8}, \frac{.95}{9}, \frac{1.13}{10}$
Line 28:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.86}{3}, \frac{1.03}{4}, \frac{1.01}{5}, \frac{1.05}{6}, \frac{1.13}{7}, \frac{.91}{8}, \frac{.92}{9}, \frac{1.02}{10}$
Line 29:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.90}{3}, \frac{1.12}{4}, \frac{1.12}{5}, \frac{.91}{6}, \frac{1.12}{7}, \frac{.89}{8}, \frac{.92}{9}, \frac{1.08}{10}$
Line 30:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.97}{3}, \frac{1.14}{4}, \frac{1.09}{5}, \frac{.89}{6}, \frac{1.11}{7}, \frac{.86}{8}, \frac{.94}{9}, \frac{1.02}{10}$
Line 31:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.10}{3}, \frac{1.06}{4}, \frac{1.04}{5}, \frac{1.00}{6}, \frac{.89}{7}, \frac{.93}{8}, \frac{.92}{9}, \frac{.91}{10}$
Line 32:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{1.07}{3}, \frac{1.10}{4}, \frac{1.05}{5}, \frac{.98}{6}, \frac{.83}{7}, \frac{.95}{8}, \frac{.98}{9}, \frac{.91}{10}$
Line 33:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.96}{3}, \frac{1.06}{4}, \frac{1.01}{5}, \frac{1.09}{6}, \frac{.80}{7}, \frac{1.00}{8}, \frac{.96}{9}, \frac{.83}{10}$
Line 34:	$\frac{1.00}{1}, \frac{1.00}{2}, \frac{.93}{3}, \frac{1.08}{4}, \frac{1.03}{5}, \frac{1.04}{6}, \frac{.83}{7}, \frac{1.09}{8}, \frac{1.06}{9}, \frac{.88}{10}$

Exhibit C.7 (continued).

Line 35: $\frac{100}{1}, \frac{100}{2}, \frac{92}{3}, \frac{104}{4}, \frac{103}{5}, \frac{107}{6}, \frac{91}{7}, \frac{115}{8}, \frac{104}{9}, \frac{85}{10}$

Line 36: $\frac{100}{1}, \frac{100}{2}, \frac{101}{3}, \frac{108}{4}, \frac{107}{5}, \frac{94}{6}, \frac{103}{7}, \frac{116}{8}, \frac{110}{9}, \frac{101}{10}$

Line 37: $\frac{100}{1}, \frac{106}{2}, \frac{98}{3}, \frac{109}{4}, \frac{103}{5}, \frac{90}{6}, \frac{93}{7}, \frac{101}{8}, \frac{112}{9}, \frac{109}{10}$

Line 38: $\frac{100}{1}, \frac{100}{2}, \frac{97}{3}, \frac{106}{4}, \frac{103}{5}, \frac{90}{6}, \frac{99}{7}, \frac{100}{8}, \frac{105}{9}, \frac{109}{10}$

Line 39: $\frac{100}{1}, \frac{100}{2}, \frac{93}{3}, \frac{98}{4}, \frac{101}{5}, \frac{87}{6}, \frac{104}{7}, \frac{104}{8}, \frac{101}{9}, \frac{105}{10}$

Line 40: $\frac{100}{1}, \frac{100}{2}, \frac{93}{3}, \frac{96}{4}, \frac{103}{5}, \frac{92}{6}, \frac{107}{7}, \frac{96}{8}, \frac{91}{9}, \frac{96}{10}$

Line 41: $\frac{100}{1}, \frac{100}{2}, \frac{92}{3}, \frac{95}{4}, \frac{105}{5}, \frac{93}{6}, \frac{101}{7}, \frac{94}{8}, \frac{92}{9}, \frac{88}{10}$

Line 42: $\frac{100}{1}, \frac{100}{2}, \frac{96}{3}, \frac{103}{4}, \frac{108}{5}, \frac{102}{6}, \frac{96}{7}, \frac{86}{8}, \frac{93}{9}, \frac{88}{10}$

Line 43: $\frac{100}{1}, \frac{100}{2}, \frac{112}{3}, \frac{110}{4}, \frac{107}{5}, \frac{90}{6}, \frac{107}{7}, \frac{87}{8}, \frac{105}{9}, \frac{101}{10}$

Line 44: $\frac{100}{1}, \frac{100}{2}, \frac{111}{3}, \frac{105}{4}, \frac{102}{5}, \frac{98}{6}, \frac{103}{7}, \frac{86}{8}, \frac{96}{9}, \frac{116}{10}$

Line 45: $\frac{100}{1}, \frac{100}{2}, \frac{106}{3}, \frac{104}{4}, \frac{93}{5}, \frac{97}{6}, \frac{108}{7}, \frac{100}{8}, \frac{107}{9}, \frac{117}{10}$

Line 46: $\frac{100}{1}, \frac{100}{2}, \frac{96}{3}, \frac{99}{4}, \frac{89}{5}, \frac{105}{6}, \frac{103}{7}, \frac{104}{8}, \frac{102}{9}, \frac{117}{10}$

Line 47: $\frac{100}{1}, \frac{100}{2}, \frac{90}{3}, \frac{102}{4}, \frac{87}{5}, \frac{97}{6}, \frac{109}{7}, \frac{113}{8}, \frac{115}{9}, \frac{99}{10}$

APPENDIX D

DEVELOPMENT OF MACHINERY INFORMATION FOR
ILLUSTRATIVE INPUTS COMPLEMENT DATA SET

APPENDIX D

DEVELOPMENT OF MACHINERY INFORMATION FOR ILLUSTRATIVE INPUTS COMPLEMENT DATA SET

Exhibit D.1. Sizing and Performance Capacity Rating Calculation
Worksheet: Land Preparation Machinery Units; Illustrative
Inputs Complement Data Set for IFLMAPS.

1. Tractor Size = _____ Horsepower

2. Implement Sizes:
 - a. Draft of subsoiler (W = number of shanks spaced at 3 ft. intervals):

$$= 130 \text{ lbs} \times W \times 20" \text{ depth} = 2600 \text{ lbs} \times W$$
 - b. Size subsoiler in terms of whole shank units; adjust speed if necessary:
 - 1) $W = (\text{_____ HP} \times 375) / (2600 \text{ lbs} \times 5.0 \text{ mph}) = \text{_____}$
 - 2) $\text{MPH} = (\text{_____ HP} \times 3750 / (2600 \text{ lbs} \times \text{_____ shanks})) = \text{_____}$
 - 3) Therefore $W = \text{_____ shanks} \times 3 \text{ ft} = \text{_____}$
 - c. Draft of heavy tandem disc (W = width in inches):

$$= (7.6 + .15(\text{_____ mph}^2)) \times W \times 6"$$

$$= (45.6 + .90(\text{_____ mph}^2)) \times W$$
 - d. Size disc in terms of width in whole foot increments; adjust speed if necessary:
 - 1) $W = \text{_____} = [(\text{_____ HP} \times 375) / [(45.6 + .90(5.0^2)) \times 5.0]] / 12$
 - 2) $\text{MPH} = \text{_____} = (\text{_____ HP} \times 375) / [(45.6 + .90(\text{_____ mph}^2)) \times \text{_____ ft} \times 12]$

3. Performance Capacity:
 - a. Subsoiling task ac/hr capacity:

$$= [\text{_____} (2b2) \times \text{_____} (2b3) \times .7 \text{ eff}] / 8.25 = \text{_____}$$
 - b. Discing task ac/hr capacity:

$$= [\text{_____} (2d2) \times \text{_____} (2d1) \times .7 \text{ eff}] / 8.25 = \text{_____}$$
 - c. Proportion of an hour spent subsoiling:

$$= [.5 \text{ acre subsoiled} \times \text{_____} (3b)] / [(1 \text{ acre discing} \times \text{_____} (3a)) + (.5 \text{ acre subsoiled} \times \text{_____} (3b))] = \text{_____}$$
 - d. Composite performance rating (ac/hr):

$$= 2(\text{_____} (3a) \times \text{_____} (3c)) = \text{_____}$$

Exhibit D.2. Sizing and Performance Capacity Rating Calculations
 Worksheet: Planting Machinery Units; Illustrative Inputs
 Complement Data Set for IFLMAPS.

1. Tractor Size = _____ Horsepower
2. Implement Sizes:
 - a. Draft of seedbed preparation implements (since all tasks are accomplished in one pass, the drafts are summed to be additive):
 1. Field cultivator:

$$= (117 + 17\text{mph} \times (5"/3.25")^2 \times W(\text{feet}))$$
 2. Sprayer: = 0
 3. Spring tooth harrow: = $125 \times W(\text{feet})$
 - b. Size field cultivator, sprayer and harrow (W=width in feet); adjust speed if necessary to arrive at width in whole foot increments:
 1. $W = \frac{\text{_____ HP} \times 375}{[(((117 + 17(5.0)) \times (5/3.25)^2) + 125) \times 5.0]}$
 2. $\text{MPH} = \frac{\text{_____ HP} \times 375}{[(((117 + 17(\text{_____ mph})) \times 2.37) + 125) \times \text{_____ ft}]}$
 - c. Assume planter and driller size for above size tractor (draft of these implements is less than seedbed preparation implements; therefore, subjective judgment is to be used in sizing number of rows and width):
 1. Planter: _____ 30" rows
 2. Drill: _____ feet (sprouts at 4" intervals)
3. Performance Capacity:
 - a. Seedbed preparation task ac/hr capacity:
 $= \frac{\text{_____}(2b2) \times \text{_____}(2b1) \times .7 \text{ eff}}{8.25} = \text{_____}$
 - b. Seeding task ac/hr capacity:
 $= \frac{4.5 \text{ mph} \times \text{_____}(2c2) \times .65 \text{ eff}}{8.25} = \text{_____}$
 - c. Proportion of an hour spent in seedbed preparation:
 $= \frac{[1 \text{ acre prepped} \times \text{_____}(3b)]}{[(1 \text{ acre seeded} \times \text{_____}(3a)) + (1 \text{ acre prepped} \times \text{_____}(3b))]}$
 - d. Composite performance rating (ac/hr):
 $= \text{_____}(3a) \times \text{_____}(3c) = \text{_____}$

Exhibit D.3. Sizing and Performance Capacity Rating Calculations Worksheet: Harvesting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS.

1. Self-propelled combine units size = _____ Horsepower

2. Cornhead size = _____ 30" rows

3. Grain platform size = _____ feet

4. Performance Capacity:

a. Harvesting corn:

$$= [3.5 \text{ mph} \times \text{_____ rows} \times 30"/12" \times .7 \text{ eff}] / 8.25$$

$$= \text{_____}$$

b. Harvesting wheat and/or soybeans:

$$= [\text{_____ mph} \times \text{_____ ft} \times .75 \text{ eff}] / 8.25 = \text{_____}$$

Note: speed adjusted in (b) such that (b) = 1.53 x (a)

5. Efficiency factors:

a. Corn (base crop) = 1.0

b. Wheat = _____ (4b) / _____ (4a) x .75 = _____

c. Soybeans = _____ (4b) / _____ (4a) x .85 = _____

TABLE D.1

Values Used in Association with Exhibit D.1 Worksheet to Develop Table 6.25 Land
Preparation Machinery Units' Size and Performance Measures

Value	Unit									
	1	2	3	4	5	6	7	8	9	10
1. Size (Horsepower)	50	75	90	100	110	120	150	175	200	250
2b1. Width (shanks)	1.44	2.16	2.6	2.88	3.17	3.46	4.33	5.05	5.77	7.21
2b2. Width (shanks)	2	2	3	3	3	3	5	5	6	7
Speed (mph)	3.61	5.41	4.33	4.81	5.29	5.77	5.41	5.05	4.81	5.15
2b3. Width (feet)	6	6	9	9	9	9	12	15	18	21
2d1. Width (feet)	4.59	6.88	8.26	9.18	10.10	11.01	13.77	16.06	18.35	22.94
2d2. Width (feet)	5	7	8	9	10	11	14	16	18	23
Speed (mph)	4.75	4.95	5.10	5.06	5.03	5.0	4.95	5.0	5.06	4.99
3a. Capacity (ac/hr)	1.84	2.75	3.31	3.67	4.04	4.41	5.51	6.43	7.35	9.18
3b. Capacity (ac/hr)	2.02	2.94	3.46	2.86	3.27	4.67	5.88	6.79	7.73	9.74
3c. Time (hour)	.35	.35	.34	.34	.35	.35	.35	.35	.34	.35
3d. Capacity Rating (ac/hr)	1.30	1.92	2.27	2.53	2.79	3.05	3.83	4.44	5.07	6.36

TABLE D.2

Values Used in Association with Exhibit D.2 Worksheet to Develop Table 6.26 Planting Machinery Units' Size and Performance Measures

Value	Unit									
	1	2	3	4	5	6	7	8	9	10
1. Size (Horsepower)	50	75	90	100	110	120	150	175	200	250
2b1. Width (feet)	6.22	9.33	11.19	12.44	13.68	14.92	18.65	21.76	24.87	31.09
2b2. Width (feet)	6	9	11	12	14	15	19	22	25	31
Speed (mph)	5.13	5.13	5.06	5.13	4.91	4.98	4.93	4.95	4.98	5.01
2bc1. Width (rows)	4	4	6	6	8	8	12	12	18	24
2bc2. Width (feet)	10	10	15	15	20	20	30	30	45	60
3a. Capacity (ac/hr)	2.61	3.92	4.72	5.22	5.83	6.33	7.94	9.24	10.55	13.188
3b. Capacity (ac/hr)	3.55	3.55	5.32	5.32	7.09	7.09	10.64	10.64	15.95	21.27
3c. Time (hour)	.58	.48	.53	.50	.55	.53	.57	.54	.60	.62
3d. Capacity Rating (ac/hr)	1.51	1.86	2.50	2.64	3.20	3.34	4.55	4.95	6.35	8.14

TABLE D.3

Values Used in Association with Exhibit D.3 Worksheet To
Develop Table 6.27 Harvesting Machinery Units'
Size and Performance Measures

Values	Unit			
	1	2	3	4
1. Size (horsepower)	100	145	165	200
2. Size (rows)	4	6	8	12
3. Size (feet)	15	20	24	30
4a. Capacity (ac/hr)	2.97	4.45	5.99	8.91
4b. Speed (mph)	3.33	3.75	4.16	5.35
Capacity (ac/hr)	4.54	6.82	9.09	13.63
5b. Efficiency factor	1.15	1.15	1.15	1.15
5c. Efficiency factor	1.30	1.30	1.30	1.30

Exhibit D.4. Cost of Land Preparation Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS.

Unit Size _____		Horsepower Size _____	
Item	Per Unit Cost	No. Units	Item Cost
_____ HP Tractor	\$ _____	1 tractor	\$ _____
Heavy Subsoiler	1,000	_____ shanks	_____
Heavy Tandem Disc	900	_____ feet	_____
1/2 Ton Pickup	6,000	1/4 pickup	1500
Subtotal			\$ _____
Miscellaneous Items (1% of Subtotal)			_____
TOTAL COST			\$ _____

SOURCE: Dick Aseltine, Theisiers, Inc., John Deere Agricultural Equipment, Mason, MI, October 30, 1980.

Exhibit D.5. Cost of Planting Machinery Units; Illustrative
Inputs Complement Data Set for IFLMAPS.

Item	Per Unit Cost	No. Units	Item Cost
_____ HP Tractor	\$ _____	1 tractor	\$ _____
Field Cultivator	470	_____ feet	_____
Sprayer	210	_____ feet	_____
Spring Tooth Harrow	100	_____ feet	_____
Planter	1500	_____ rows	_____
Drill	567	_____ feet	_____
Row Cultivator	420	_____ rows	_____
1/2 Ton Pickup	6000	1/4 pickup	_____
Subtotal			\$ _____
Miscellaneous Items (1% of Subtotal)			_____
TOTAL COST			\$ _____

SOURCE: Dick Aseltine, Theisiers, Inc., John Deere
Agricultural Equipment, Mason, MI, October 30, 1980.

Exhibit D.6. Costs of Harvesting Machinery Units; Illustrative Inputs Complement Data Set for IFLMAPS.

Item	Per Unit Cost	No. Units	Item Cost
HP Machine	\$ _____	1	\$ _____
row cornhead	_____	1	_____
feet grain platform	_____	1	_____
1/2 Ton Pickup	6,000	1/4 pickup	1500
Subtotal			\$ _____
Miscellaneous Items (1% of Subtotal)			_____
TOTAL COST			\$ _____

SOURCE: Dick Aseltine, Theisiers, Inc., John Deere Agricultural Equipment, Mason, MI, October 30, 1980.

TABLE D.4

List Machinery Prices; Illustrative Input Complement
Data Set for IFLMAPS

	Price
50 horsepower tractor	\$15,000
75 horsepower tractor	19,300
90 horsepower tractor	25,000
100 horsepower tractor	28,000
110 horsepower tractor	31,000
120 horsepower tractor	35,500
150 horsepower tractor	47,000
175 horsepower tractor	58,000
200 horsepower tractor	63,600
250 horsepower tractor	74,000
Heavy subsoiler (per shank)	1,000
Heavy tandem disk (per foot)	900
Field cultivator (per foot)	470
Spring tooth harrow (per foot)	100
Sprayer (boom and tank--per foot)	210
Planter (per 30" row)	1,500
Drill (per foot)	567
Row cultivator (per 30" row)	420
100 horsepower combine	45,000
145 horsepower combine	64,000
165 horsepower combine	75,000
200 horsepower combine	90,000
4 30" row cornhead	10,600
6 30" row cornhead	14,300
8 30" row cornhead	18,600
12 30" row cornhead	29,100
15 foot grain platform	7,000
20 foot grain platform	8,100
24 foot grain platform (includes transport trailer @ \$500)	9,700
30 foot grain platform (includes transport trailer @ \$500)	12,500

SOURCE: Dick Aseltine, Theisiers, Inc., John Deere Agricultural Equipment, Mason, MI, October 30, 1980.

NOTE: With respect to tractors and grain platforms, interpolation and extrapolation of the original data was required in a few cases in order to price the cited size.

SELECTED BIBLIOGRAPHY

SELECTED BIBLIOGRAPHY

- Ackoff, Russell. "Management Misinformation Systems." Management Science. Application Series 14(1967):B147-B156.
- American Society of Agricultural Engineers. "Agricultural Machinery Management." Agricultural Engineers Yearbook--1979, pp. 244-255.
- Anderson, Jock R. "Simulation: Methodology and Applications in Agricultural Economics." Review of Marketing Agricultural Economics 43(1974a):3-55.
- _____. "Sparse Data, Estimational Reliability, and Risk Efficient Decisions." American Journal of Agricultural Economics 56(1974b):564-572.
- Anderson, Jock R., John L. Dillon and Brian Hardaker. Agricultural Decision Analysis. Ames, Iowa: The Iowa State University Press, 1977.
- Anderson, Kim B. and John Holt. "A User-Oriented Model for Incorporating Risk Into Short-Run Decisions." Southern Journal of Agricultural Economics 9(1977):105-110.
- Arrow, Kenneth J. "The Economics of Information." The Computer Age: A Twenty-Year View, ed. M. L. Dertouzos and J. Moses, pp. 306-317. Cambridge, Mass.: The MIT Press, 1979.
- Aseltine, Dick. Theisiers, Inc., John Deere Agricultural Equipment, Mason, MI. Interview, October 30, 1980.
- Babb, Emerson M. "Business Games as a Marketing Extension Tool." Journal of Farm Economics 46(1964):1024-1028.
- _____. "Electronic Data Processing." Paper presented at Conference for USDA-Land Grant College Committee on Computer Applications in Agriculture. Purdue University, West Lafayette, Indiana, 1971.
- Babb, E. M. and L. M. Eisgruber. Management Games for Teaching and Research. Chicago: Educational Methods, Inc., 1966.
- Baker, C. B. and S. T. Sonka. "Effects of Lending Practices and Marketing Options on Risk Management." Market Risks in Agriculture: Concepts, Methods and Policy Issues. Department of Agricultural Economics, Texas A&M University, Technical Report No. 78-1, 1978, pp. 38-58.

- Bakker-Arkema, Fred. Michigan State University, East Lansing, MI. Interview, 1979.
- Baquet, A. E., A. N. Halter, and F. S. Conklin. "The Value of Frost Forecasting: A Bayesian Appraisal." American Journal of Agricultural Economics 58(1976):511-520.
- Barry, Peter J. and John R. Brake. Financial Strategies and Economic Decisions of the Firm. Department of Agricultural Economics Staff Paper AER 185, Michigan State University, 1971.
- Barry, Peter J. and Edwin D. Maberly. "Price Expectations and Producer Marketing Strategies." Market Risks in Agriculture: Concepts, Methods and Policy Issues. Department of Agricultural Economics, Texas A&M University, Technical Report No. 78-1, 1978, pp. 59-70.
- Barry, Peter J. and David R. Willmann. "A Risk-Programming Analysis of Forward Contracting with Credit Constraints." American Journal of Agricultural Economics 58(1976):62-70.
- Beck, A. E. "Simulation as an Aid to Decision-Making in Animal Disease Control Campaigns--A Case Study." Proceedings of the Third National Conference of the Australian Society for Operation Research, Adelaide, Australia: 1977, 413-428.
- Becker, Manning H. "Discussion: Representative Farms--Guides for Decision Making?" Journal of Farm Economics 45(1963):1455-1457.
- Benjamin, Gary L. and Larry J. Connor. Economies of Size of Machinery Systems on Southern Michigan Cash-Grain Farms. Department of Agricultural Economics Staff Paper AER 112, Michigan State University, 1968.
- Bessler, David A. "On the Elicitation of Subjective Probabilities." Paper presented at Western Agricultural Economics Association meeting, Las Cruces, New Mexico, 1980.
- Binswanger, Hans P. "Attitudes Toward Risk: Experimental Measurement in Rural India." American Journal of Agricultural Economics 62(1980):395-407.
- Black, J. Roy. Michigan State University, East Lansing, MI. Interviews, 1979-1980.
- Black, J. Roy and George K. Dike. "Sales Options for Corn and Soybeans." Mimeographed. East Lansing, MI: Michigan State University, 1979.
- Black, J. Roy, Stephen B. Harsh, Duane Erickson, Royce Hinton, Allan Lines and Paul Wright. Crop Farm Planning Guide--TELPLAN 18. Department of Agricultural Economics, Michigan State University.

- Blackie, Malcolm J. and J. Barry Dent. "Analyzing Hog Production Strategies with a Simulation Model." American Journal of Agricultural Economics 58(1976):39-46.
- Blackie, M. J. and J. B. Dent, eds. Information Systems for Agriculture. London: Applied Science Publishers, Ltd., 1979.
- Boehlje, Michael D. and Vernon R. Eidman. "Simulation and Gaming Models: Application in Teaching and Extension Programs." American Journal of Agricultural Economics 60(1978):987-992.
- Boehlje, Michael, Vernon Eidman and Odell Walker. "An Approach to Farm Management Education." American Journal of Agricultural Economics 55(1973):192-197.
- Boehlje, M. and S. Griffin. "Financial Impacts of Government Support Price Programs." American Journal of Agricultural Economics 61(1979):285-296.
- Bolen, K. R., C. B. Baker and R. A. Hinton. "Marketing Corn and Soybeans Under Conditions of Market Risk." Illinois Agricultural Economics (1978):12-19.
- Bonnen, James T. "Improving Information on Agriculture and Rural Life." American Journal of Agricultural Economics 57(1975):753-763.
- Bowers, Wendell. Modern Concepts of Farm Machinery Management. Champaign, IL: Stipes Publishing Co., 1970.
- Brook, Roger. Michigan State University, East Lansing, MI. Interviews, September-October, 1980.
- Brown, Thomas G. and Arthur J. Collins. Large Commercial Family Farms Information Needs and Services. A Report of the National Extension Study Committee, Cooperative Extension, University of Missouri, 1978.
- Bullock, J. Bruce. "Social Costs Caused by Errors in Agricultural Production Forecasts." American Journal of Agricultural Economics 58(1976):76-80.
- Bullock, J. Bruce and Samuel H. Logan. "An Application of Statistical Decision Theory to Cattle Feedlot Marketing." American Journal of Agricultural Economics 52(1970):234-241.
- Butler, Leslie James. "Some Aspects of Agricultural Price Instability." Ph.D. thesis, Michigan State University, 1979.
- Calvin, Linda S., Ron C. Mittelhammer and Douglas L. Young. "Theoretical Criteria and a Proposed Empirical Method for Computing Historical Risk Measures." Paper presented at American Agricultural Economics Association meeting, Urbana, Illinois, 1980.

- Candler, Wilfred and Michael Boehlje. "Use of Linear Programming in Capital Budgeting with Multiple Goals." American Journal of Agricultural Economics 53(1971):325-330.
- Carlson, Gerald A. "A Decision Theoretic Approach to Crop Disease Production and Control." American Journal of Agricultural Economics 52(1970):216-223.
- Carlyn, Marcia. "An Assessment of the Myers-Briggs Type Indicator." Journal of Personality Assessment 41(1977):461-473.
- Carman, Garth. "The Relationship of Producer Attributes to Risk Preference and Management." Type III Seminar, Department of Agricultural Economics, Michigan State University, 1979.
- Carter, Harold O. "Representative Farms--Guides for Decision Making?" Journal of Farm Economics 45(1963):1448-1457.
- Chicago Board of Trade. 1976 Statistical Annual Cash and Futures Data--Grains, Metals and Forest Products, 1976.
- _____. 1977 Statistical Annual Cash and Futures Data--Grains, Metals and Forest Products, 1977.
- _____. 1978 Statistical Annual Cash and Futures Data--Grains, Metals and Forest Products, 1978.
- _____. 1979 Statistical Annual Cash and Futures Data--Grains, Metals and Forest Products, 1979.
- Cochran, Mark. Ph.D. thesis, Michigan State University, forthcoming.
- Cohen, K. J. and E. Rhenman. "The Role of Management Games in Education and Research." Management Science 7(1961):131-166.
- Condra, G. D. "An Economic Feasibility Study of Irrigated Crop Production in the Pecos Valley of Texas." Ph.D. thesis, Texas A&M University, 1978.
- Conklin, Frank S. and Kenneth O. Hanson. "Information for Decision Making under Uncertainty: Its Value and Values." Market Risks in Agriculture: Concepts, Methods and Policy Issues. Department of Agricultural Economics, Texas A&M University. Technical Report No. 78-1, 1978, pp. 90-99.
- Connor, Larry J. and Warren H. Vincent. "A Framework for Developing Computerized Farm Management Information." Canadian Journal of Agricultural Economics 18(1970):70-75.
- Cothorn, James H. "Marketing Outlook Information and Information Systems in Unstable Markets." Western Journal of Agricultural Economics 1(1977):136-141.

- Croft, B. A., R. L. Tummala, Helmut Riedl and S. M. Welch. "Modelling and Management of Two Prototype Apple Pest Subsystems." Modeling for Pest Management: Concepts, Techniques and Applications, eds. R. L. Tummala, D. L. Haynes and B. A. Croft, pp. 97-119. Michigan Agricultural Experiment Station Michigan State University, 1976.
- Cromarty, William A. and Walter M. Myers. "Needed Improvements in Application of Models for Agriculture Commodity Price Forecasting." American Journal of Agricultural Economics 57(1975):172-187.
- Crowder, Richard T. "Statistical vs. Judgment and Audience Considerations in the Formulation and Use of Econometric Models." American Journal of Agricultural Economics 54(1972):779-783.
- Davis, Gordon B. Management Information Systems: Conceptual Foundations, Structure and Development. New York: McGraw-Hill Book Co., 1963.
- Davis, Joe T. and Larry D. Jones. "An Intermodel Delivery System for Agricultural Marketing and Weather Data." Mimeographed. Lexington, KY: University of Kentucky, 1979.
- Debertin, D. L., G. A. Harrison and R. J. Rades. "A Management Game for Measuring the Returns to Information in Corn and Soybean Production." Purdue University Agricultural Experiment Station Bulletin 57, 1974.
- Debertin, David L., Gerald A. Harrison, Robert J. Rades, and Lawrence P. Bohl. "Estimating the Returns to Information: A Gaming Approach." American Journal of Agricultural Economics 57(1975):316-321.
- Debertin, David L., Charles L. Moore, Sr., Larry D. Jones and Angelos Pagoulatos. Impacts of a Computerized Management Decision Making Model on Farmers. Department of Agricultural Economics Staff Paper 88, University of Kentucky, 1979.
- Debertin, David L., Angelos Pagoulatos and Garnett L. Bradford. "Computer Graphics: An Educational Tool in Production Economics." American Journal of Agricultural Economics 59(1977):573-576.
- Debertin, David L., Robert J. Rades, and Gerald A. Harrison. "Returns to Information: An Addendum." American Journal of Agricultural Economics 58(1976):321-323.
- Debertin, David L., Lynn W. Robbins and Larry D. Jones. "Kentucky's ANSER: The Agricultural Network Serving Extension and Research." American Journal of Agricultural Economics 61(1979):546-550.
- DeMichele, Don W. "An Evaluation of Modeling, Systems Analysis and Operations Research in Defining Agricultural Research Needs and Priorities in Pest Management." Iowa State Journal of Research 49(1975):597-621.

- Dent, J. B. and M. J. Blackie. Systems Simulation in Agriculture. London: Applied Science Publishers, Ltd., 1979.
- Department of Agricultural Economics. MSU Agriculture Model Quarterly Report. East Lansing, MI: Michigan State University, 1981.
- Dewey, John. "The Continuum of Ends-Means." Ethical Theories, ed. A. I. Melden. New York: Prentice Hall, Inc., 1950.
- Dike, George K. Michigan State University, East Lansing, MI. Interview, 1980.
- Dike, George K. and Ed Rister. Shrinks and Discounts. Department of Agricultural Economics Staff Paper 77-97, Michigan State University, 1978.
- Dillon, Jim. "This Bank Puts Foot Down on Overholding Grain." Successful Farming, Machinery Issue 1981, p. 6.
- Dillon, John L. and Pasquale L. Scandizzo. "Risk Attitudes of Subsistence Farmers in Northeast Brazil: A Sampling Approach." American Journal of Agricultural Economics 60(1978):425-435.
- Dobson, W. D. "The Adequacy of U.S. Agricultural Marketing and Price Information." Market Information and Price Reporting in the Food and Agricultural Sector. Proceedings of meeting of North Central Regional Committee 117, Madison, Wisconsin, 1979.
- _____. "Computer Simulation Models: The Need for an Applications Orientation." Canadian Journal of Agricultural Economics 18(1970):175-178.
- Doll, John P. "Obtaining Preliminary Bayesian Estimates of the Value of a Weather Forecast." American Journal of Agricultural Economics 53(1971):651-655.
- Doster, D. H. "Extension Uses of Simulation in Evaluating Corn Harvesting Systems." Department of Agricultural Economics, Purdue University, 1970.
- Eisgruber, Ludwig M. "Managerial Information and Decision Systems in the U.S.A.: Historical Developments, Current Status and Major Issues." American Journal of Agricultural Economics 55(1974):930-937.
- _____. "Developments in the Economic Theory of Information." American Journal of Agricultural Economics 60(1978):901-907.
- Emery, Walter L., ed. Commodity Year Book 1980. New York: Commodity Research Bureau, Inc., 1980.
- Ferris, John. "Advanced Grain Marketing Workshop for Southeastern Michigan." Mimeographed. East Lansing, MI: Michigan State University, 1978.

- _____. An Analysis of the Seasonal Cash Price Pattern on Michigan Corn, Wheat and Soybeans for 1958-79. Department of Agricultural Economics Staff Paper 79-6, Michigan State University, 1980.
- _____. Probability Forecasts on U.S. Corn Prices. Department of Agricultural Economics Staff Paper 81-1, Michigan State University, 1981a.
- _____. Michigan State University, East Lansing, MI. Interview, February, 1981b.
- _____. Using the Fundamentals of the Grain and Soybean Markets to Predict Prices. Department of Agricultural Economics Staff Paper 81-2, Michigan State University, 1981c.
- Fishel, Walter L. "Organization and Control of the U.S. Food System." Mimeographed. Wooster, OH: Ohio Agricultural Research and Development Center, 1981.
- Forster, D. Lynn. "Developments in the Economic Theory of Information: Discussion." American Journal of Agricultural Economics 60(1978):906-907.
- Fox, Danny G. and J. Roy Black. "A System for Predicting Performance of Growing and Finishing Beef Cattle." Report of Beef Cattle-Feeding Research 1977. Michigan Agricultural Experiment Station Research Report 328, February 1977, pp. 141-162.
- Fox, D. G., R. G. Crickenberger, W. G. Bergen and J. R. Black. "A Net Protein System for Predicting Protein Requirements and Feed Protein Values for Growing and Finishing Cattle." Report of Beef Cattle-Feeding Research 1977. Michigan Agricultural Experiment Station Research Report 328, February 1977, pp. 163-176.
- Fredericks, Eldon E., Stephen B. Harsh, Edward Rister and Deb Vergeson. "News Releases Delivered by Computers." Agricultural Communicators in Education Quarterly 62(1979):21-26.
- Freebairn, J. W. "An Evaluation of Outlook Information for Australian Agricultural Commodities." Review of Marketing and Agricultural Economics, 46(1978):294-314.
- French, Charles E. "Selected Alternative Programs for Bringing the Real World to the Undergraduate Classroom." American Journal of Agricultural Economics 56(1974):1163-1175.
- Fuller, Earl and Vernon Eidman. "Control Systems for Farm Operations Management: An Essay." Mimeographed. St. Paul, Minnesota: University of Minnesota, 1978.
- Gabriel, Stephen C. and C. B. Baker. "Concepts of Business and Financial Risk." American Journal of Agricultural Economics 62(1980):560-564.

- Gasnier, Jim. A. G. Edwards & Sons, Inc., Lansing, MI. Interview, October, 1980.
- Gebremeskel, Tesfaye and C. Richard Shumway. "Farm Planning and Calf Marketing Strategies for Risk Management: An Application of Linear Programming and Statistical Decision Theory." American Journal of Agricultural Economics 61(1979):363-370.
- Gunnelson, G., W. D. Dobson and S. Pamperin. "Analysis of the Accuracy of USDA Crop Forecasts." American Journal of Agricultural Economics 54(1972):639-645.
- Guralnik, David B., ed. Webster's New World Dictionary of the American Language. Paperback edition. New York: Popular Library, 1977.
- Halter, Albert N. and Gerald W. Dean. Decisions Under Uncertainty with Research Applications. Cincinnati: South-Western Publishing Co., 1971.
- _____. "Use of Simulation in Evaluating Management Policies Under Uncertainty: Application to a Large Scale Ranch." Journal of Farm Economics 47(1965):557-573.
- Hardin, M. L. "A Simulation Model for Analyzing Farm Capital Investment Alternatives." Ph.D. thesis, Oklahoma State University, 1978.
- Harmon, W. L. "Evaluating the Growth Potential of Irrigated Farms with Diminishing Water Supplies: A Multiple Goals Approach to Decision-Making." Ph.D. thesis, Oklahoma State University, 1973.
- Harmon, W. L., R. E. Hatch, V. R. Eidman and P. L. Claypool. An Evaluation of Factors Affecting the Hierarchy of Multiple Goals. Oklahoma Agricultural Experiment Station Technical Bulletin T-134, 1972.
- Harris, H. M., Jr. "University Outlook Programs: A Review and Some Suggestions." Southern Journal of Agricultural Economics 8(1976):139-144.
- Harris, Tiffin and G. Nelson. "Considering Your Attitudes in Making Risky Decisions." Slide Tape Package. Department of Agriculture and Resource Economics, Oregon State University, 1978.
- _____. "Controlling Risk in Your Farm Business." Slide Tape Package. Department of Agriculture and Resource Economics, Oregon State University, 1978.
- _____. "Dealing with Risk in Making Farm Decisions: An Introduction." Slide Tape Package. Department of Agriculture and Resource Economics, Oregon State University, 1978.
- _____. "Guiding Risky Decisions with a Payoff Matrix." Slide Tape Package. Department of Agriculture and Resource Economics, Oregon State University, 1978.

- _____. "Using Probabilities in Making Farm Decisions." Slide Tape Package. Department of Agriculture and Resource Economics, Oregon State University, 1978.
- Harsh, Stephen B. "The Developing Technology of Computerized Information Systems." American Journal of Agricultural Economics 60(1978):908-914.
- _____. "Management on a Chip." Paper presented at the North Central Regional 113 Committee Meeting, St. Louis, MO, 1981.
- _____. A Progress Report on Telplan Activities. Department of Agricultural Economics Staff Paper 80-56, Michigan State University, 1980.
- _____. Michigan State University, East Lansing, MI. Interviews, 1980-1981.
- Harsh, Stephen B. and Eldon E. Fredericks. "COMNET--Proposed Computer System for the College of Agriculture and Natural Resources." Mimeographed. East Lansing, MI: Michigan State University, 1980.
- Harsh, Stephen B. and Myron P. Kelsey. "Income Tax Management Analysis--A TELPLAN Program." User's Manual: TELPLAN 05. Department of Agricultural Economics, Michigan State University, 1979.
- Hatch, R. E. "Growth Potential and Survival Capability of Southern Plains Dryland Farms: A Simulation Analysis Incorporating Multiple-Goal Decision Making." Ph.D. thesis, Oklahoma State University, 1973.
- Hazell, P. B. R. and P. L. Scandizzo. "Farmers' Expectations, Risk Aversion, and Market Equilibrium under Risk." American Journal of Agricultural Economics 59(1977):204-209.
- Headley, J. C. and A. B. Carlson. "Problem Solving--The Decision Process and Management Behavior." Journal of Farm Economics 45(1963):1219-1225.
- Henderson, Dennis R. "Market Information: Some Research Issues." Market Information and Price Reporting in the Food and Agricultural Sector. Proceedings of conference sponsored by North Central Regional Committee 117, Madison, Wisconsin, 1979.
- Henderson, John C. and Paul C. Nutt. "The Influence of Decision Style on Decision Making Behavior." Management Science 26(1980):371-386.
- Hepp, Ralph E. and Thomas M. Olson. Information Needs and Sources for Michigan Small Farm Operations. Department of Agricultural Economics Report 372, Michigan State University, 1980.
- Hill, L. D. Farmers' Grain Marketing Patterns in the North Central Region. Illinois Agricultural Experiment Station Research Bulletin 754, 1976.

- Hogarth, Robin M. "Cognitive Processes and the Assessment of Subjective Probability Distributions." Journal of American Statistical Association 70(1975):271-289.
- Holt, John and Kim B. Anderson. "Decision Trees: A Guide to Risky Decisions." Slide Tape Package. Department of Agricultural Economics, Oklahoma State University, 1978.
- . "Teaching Decision Making Under Risk and Uncertainty to Farmers." American Journal of Agricultural Economics 60(1978):249-253.
- Hopkin, John A., Peter J. Barry and C. B. Baker. Financial Management in Agriculture. Danville, IL: The Interstate Printers & Publishers, Inc., 1973.
- Hoskin, Roger L. "An Economic Analysis of Alternative Saginaw Valley Crop Rotations—An Application of Stochastic Dominance Theory." Ph.D. thesis, Michigan State University, 1981.
- Huffman, W.E. "Decision Making: The Role of Education." American Journal of Agricultural Economics 56(1974):85-97.
- Hunt, Donnell. Farm Power and Machinery Management. Seventh edition. Ames, Iowa: The Iowa State University Press, 1977.
- Hutton, R. F. and H. R. Hinman. A General Agricultural Firm Simulator. Department of Agricultural Economics and Rural Sociology Report 72, Pennsylvania State University, 1968.
- . "Mechanics of Operating the General Agricultural Firm Simulator." Agricultural Production Systems Simulation, ed. V. R. Eidman, pp. 21-64, Stillwater: Oklahoma State University, 1971.
- Ikerd, John. "Using Probability Estimates in Outlook Work." Paper presented at the Southern Regional Outlook Conference, Atlanta, Georgia, 1979a.
- . Integrated Risk Management for Beef Cattle Producers. Department of Agricultural Economics AE-7925, Oklahoma State University, 1979b.
- Infanger, Craig L., Lynn Robbins and David L. Debertin. "Interfacing Research and Extension in Information Delivery Systems." American Journal of Agricultural Economics 60(1978):915-922.
- Johnson, Glenn L. Michigan State University, East Lansing, MI. Interview, February, 1981.
- . "Some Lessons from the IMS." Paper presented at the Agricultural Development Council, Inc. Conference on Risk and Uncertainty in Agricultural Development, CIMMYT, Mexico, 1977.

- Johnson, Glenn L., Albert N. Halter, Harald R. Jenson and D. Woods Thomas. A Study of Managerial Processes of Midwestern Farmers. Ames, Iowa: The Iowa State University Press, 1961.
- Johnson, Glenn L. and Lewis K. Zerby. What Economists Do About Values--Case Studies of Their Answers to Questions They Don't Dare Ask. East Lansing, MI: Michigan State University, 1973.
- Johnson, Glenn L., Thomas J. Manetsch, Marvin L. Hayenga, Albert N. Halter, Tom W. Carroll, Michael H. Abkin, Derek R. Byerlee, Kwong-Yuan Chang, Gloria Page and Earl Kellogg. A Generalized Simulation Approach to Agricultural Sector Analysis with Special Reference to Nigeria. East Lansing, MI: Michigan State University, 1971.
- Johnson, S. R. and Gordon C. Rausser. "Systems Analysis and Simulation: A Survey of Applications in Agricultural and Resource Economics." A Survey of Agricultural Economics Literature, Vol. 2, ed. Lee R. Martin, pp. 202-301. Minneapolis: University of Minnesota Press, 1977.
- Jones, Calvin, Paul B. Sheatsley, and Arthur L. Stinchcombe. Dakota Farmers and Ranchers Evaluate Crop and Livestock Surveys. National Opinion Research Center Report No. 128, Chicago, Illinois, 1979.
- Jones, Larry D. "Using Business Management Games as Research Tools in Food Retailing--A Case Study." Southern Journal of Agricultural Economics 7(1975):205-210.
- Jones, Larry D., David L. Debertin and Charles L. Moore, Sr. "Using Computerized Decision-Making Models in Extension Farm Management Programs: Issues and the Kentucky Approach." North Central Journal of Agricultural Economics 1(1979):155-160.
- Jones, Larry D., D. Milton Shuffett, Steve Callahan, John C. Gamble and Charles L. Moore. "Educational Television as an Extension Delivery System for Teaching Future Market Concepts." American Journal of Agricultural Economics 59(1977):577-579.
- Jung, C. G. Psychological Types. London: Routledge and Kegan Paul, 1923.
- Keeney, Ralph L. "A Decision Analysis with Multiple Objectives: The Mexico City Airport." Bell Journal of Economics and Management Science (1973):101-117.
- Kenyon, David and Craig Cooper. "Selected Fundamental and Technical Pricing Strategies for Corn." North Central Journal of Agricultural Economics 2(1980):137-144.
- King, Robert P. "Operational Techniques for Applied Decision Analysis Under Uncertainty." Ph.D. thesis, Michigan State University, 1979.

- King, Robert P. and Lindon J. Robison. "Implementation of the Interval Approach to the Measurement of Decision Maker Preference." Department of Agricultural Economics working paper, Michigan State University, forthcoming.
- Klinefelter, D. A., S. T. Sonka and C. B. Baker. "Selection and Screening of Marketing Options for Risk Evaluation." Risk Analysis in Agriculture: Research and Educational Developments. Department of Agricultural Economics AE-4492, University of Illinois, 1980.
- Knight, Frank. History and Method of Economics. Chicago: University of Chicago Press, 1956.
- Kropp, Russell P. "Curriculum Development: Principles and Methods." American Journal of Agricultural Economics 55 (1973):735-739.
- Kubichek, David. Merrill Lynch Pierce Fenner & Smith, Inc., East Lansing, MI. Interview, March 23, 1981.
- LaDue, Eddy L. A Comparison of Remote Access Systems for Use of Computerized Management Decision Aids by Extension Field Staff. Department of Agricultural Economics A.E. Research 76-14, Cornell University, 1976.
- _____. "A Computerized Farm Business Simulator for Research and Farm Planning." Ph.D. thesis, Michigan State University, 1971.
- LaDue, E. L., and W. H. Vincent. Systems Theory and Simulation: A Critique of Literature. Department of Agricultural Economics Report 261, Michigan State University, 1974.
- Lee, George E. and Raymond C. Nicholson. "Managerial Information (Recording, Data, and Decision) Systems in Canada." American Journal of Agricultural Economics 55(1973):921-929.
- Lee, Warren F., Michael D. Boehlje, Aaron G. Nelson and William G. Murray. Agricultural Finance, Seventh edition. Ames, Iowa: The Iowa State University Press.
- Leuthold, Raymond M. "On Climbing Information Theory and Bayesian Analysis." Canadian Journal of Agricultural Economics 19(1971):26-34.
- Lin, William, G. W. Dean and C. V. Moore. "An Empirical Test of Utility vs. Profit Maximization in Agricultural Production." American Journal of Agricultural Economics 56(1974):497-508.
- Loewer, Otto J., Jr., G. M. White and D. G. Overhults. Economics of Drying, Storage and Feed Processing, 4 parts. Kentucky Agricultural Cooperative Extension Service, Parts I-III, 1975; Part IV, 1976.
- Longworth, John W. "From War-Chess to Farm Management Games." Canadian Journal of Agricultural Economics 18(1970):1-11.

- _____. "Management Games and the Teaching of Farm Management." The Australian Journal of Agricultural Economics 13(1969):58-67.
- Lutgen, Lynn H. and Glenn A. Helmers. "Simulation of Production-Marketing Alternatives for Grain Farms Under Uncertainty." North Central Journal of Agricultural Economics 1(1979):23-30.
- Manderscheid, Lester V. Michigan State University, East Lansing, MI. Interview, February, 1981.
- Manetsch, Thomas J. and Gerald L. Park. Systems Analysis and Simulation with Applications to Economics and Social Systems, Part I. Department of Electrical Engineering and System Science, East Lansing, MI: Michigan State University, 1977.
- Mapp, Harry P., Jr., Michael L. Hardin, Odell L. Walker and Tillak Persaud. "Analysis of Risk Management Strategies for Agricultural Producers." American Journal of Agricultural Economics 61(1979):1071-1077.
- Marion, Bruce W. "Research Priorities and Procedures." Market Information and Price Reporting in the Food and Agricultural Sector. Proceedings of conference sponsored by North Central Regional Committee 117, Madison, Wisconsin, 1979.
- Marquardt, Ray. "An Evaluation of the Relative Price-Forecasting Accuracy of Selected Futures Markets" Commodity Markets and Futures Prices, ed. Raymond M. Leuthold, pp. 125-142. Chicago: The Chicago Mercantile Exchange, 1979.
- Marten, John F. "Marketing Strategies for the Cash Grain Farmer." Paper presented at North Central Regional Farm Management Workshop, Madison, Wisconsin, 1976.
- Menz, Kenneth M. and John W. Longworth. "An Integrated Approach to Farm Management Education." American Journal of Agricultural Economics 58(1976):551-556.
- Meyer, Jack. "Choice Among Distributions." Journal of Economic Theory 14(1977):326-336.
- _____. "Increasing Risk." Journal of Economic Theory 11(1975):119-132.
- Michigan Agricultural Experiment Station. NC-117 file. East Lansing, MI: Michigan State University, 1981.
- Michigan Agricultural Reporting Service. "Selling Corn: Alternatives to the Cash Market." Agriculture Across Michigan, 1980.
- Michigan Department of Agriculture. Michigan Agricultural Statistics July 1980. Lansing, MI: Michigan Agricultural Reporting Service, 1980.

- Miller, Doug. U.S.D.A. Agricultural Stabilization and Conservation Service, East Lansing, MI. Interviews, January-December, 1980.
- Moore, Charles L., Sr., Joe T. Davis and David Debertin. "Kentucky's ANSER and Green Thumb." Paper presented at Programmable Calculators and Minicomputers in Agricultural Decision Making symposium, Hot Springs, Arkansas, 1980.
- Morgan, Dan. Merchants of Grain. New York: The Viking Press, 1979
- Morrow, Al. "How Long Should You Store Grain?" Wallaces Farmer, December, 1977.
- Morse, George W. "Use of Linear Programming in Capital Budgeting with Multiple Goals: Comment." American Journal of Agricultural Economics 56(1974):453-455.
- Musser, Lynn Mather and Wesley N. Musser. "Psychological Research on Decisions Under Uncertainty: Implications for Agricultural Economics." Paper presented at Western Agricultural Economics Association meeting, Las Cruces, New Mexico, 1980.
- Musser, Wesley N., Judy Ohannesian and Fred J. Benson. "A Safety First Model of Risk Management for Use in Extension Programs." North Central Journal of Agricultural Economics 3(1981):41-46.
- Myers, Isabel Briggs. Introduction to Type, Second edition. Gainesville, FL: Center for Application of Psychological Type, Inc., 1976.
- Myers, Walter M. "Combining Statistical Techniques with Economic Theory for Commodity Forecasting." American Journal of Agricultural Economics 54(1972):784-789.
- Nelson, A. Gene. "The Case for and Components of a Probabilistic Agricultural Outlook Program." Western Journal of Agricultural Economics 5(1980):185-193.
- _____. "The Case for Probabilistic Outlook Information for Agricultural Commodities." Paper presented at Great Plains and Western States Outlook Conference, Moscow, Idaho, 1979.
- Nelson, A. Gene, George L. Casler and Odell L. Walker. Making Farm Decisions in a Risky World: A Guidebook. Oregon State University Cooperative Extension Service, 1978.
- Nelson, A. Gene and Tiffin D. Harris. "Designing an Instructional Package: The Use of Probabilities in Farm Decision Making." American Journal of Agricultural Economics 60(1978):993-997.
- Nelson, A. Gene and Ted Nelson, Co-Leaders, "National Extension Workshop: Dealing with Risk in Farm Decision Making," Denver, Colorado, 1978.

- Neter, John and William Wasserman. Applied Linear Statistical Models. Homewood, IL: Richard D. Irwin, Inc., 1974.
- Nixon, C. J. "Farm Tax Management Simulation Model: Its Description and Application to Alternative Disinvestment Strategies." M.S. thesis, Texas A&M University, 1977.
- Olson, Carl E. and Martin J. Owens. "Risk Management Strategies Used by Range Livestock Producers." Risk Management in Agriculture: Behavioral, Managerial and Policy Issues. Department of Agricultural Economics A.E. 4478, University of Illinois, 1979.
- Osteen, Craig, D., Edward B. Bradley and L. Joe Moffit. The Economics of Agricultural Pest Control: An Annotated Bibliography, 1960-80. USDA ESCS Bibliographies and Literatures of Agriculture No. 14, 1981.
- Patrick, G. F. and L. M. Eisgruber. "The Impact of Managerial Ability and Capital Structure on Growth of the Farm Firm." American Journal of Agricultural Economics 50(1968):491-506.
- Patrick, George F., Suzanne H. Whitaker, and Brian F. Blake. "Farmer's Goals and Risk Aversion: Some Preliminary Analysis." Paper presented at Western Regional Research Committee W-149 meeting, Tucson, Arizona, 1980.
- Patrick, George F. and James B. Kliebenstein. "Multiple Goals in Farm Firm Decision-Making: A Social Science Perspective." Paper presented at Western Agricultural Economics Association meeting, Las Cruces, New Mexico, 1980.
- Pearson, Karl. Grammar of Science. London: Adams and Charles Black, 1900.
- Penson, John B., Jr. and Dean Hughes. "Incorporation of General Economic Outcomes in Econometric Projections Models for Agriculture." American Journal of Agricultural Economics 61(1979):151-157.
- Perrin, Richard K. "The Value of Information and the Value of Theoretical Models in Crop Response Research." American Journal of Agricultural Economics 58(1976):54-61.
- Persaud, Tillak and Harry P. Mapp, Jr. "Analysis of Alternative Production and Marketing Strategies in Southwestern Oklahoma: A MOTAD Approach." Risk Analysis in Agriculture: Research and Educational Developments, Department of Agricultural Economics A.E. 4492, University of Illinois, 1980, 115-130.
- Popper, Karl R. The Logic of Scientific Discovery. New York: Harper and Row, Publishers, 1965.
- Posner, Richard A. "An Economic Theory of Privacy." AEI Journal of Government and Society. American Enterprise Institute for Public Policy Research, 1978.

- Purcell, Wayne. Agricultural Marketing: Systems, Coordination, Cash and Futures Prices. Reston, Virginia: Reston Publishing Company, Inc., 1979.
- Rae, Allan N. "Stochastic Programming, Utility and Sequential Decision Problems in Farm Management." American Journal of Agricultural Economics 53(1971a):448-460.
- _____. "An Empirical Application and Evaluation of Discrete Stochastic Programming in Farm Management." American Journal of Agricultural Economics 53(1971b):625-638.
- Richardson, James W. Mimeographed notes presented at Planning Conference--Farm Branch, ESS, USDA, Stillwater, Oklahoma, January, 1980.
- Richardson, J. W. and G. D. Condra. "Evaluating Alternative Farm Sizes in the El Paso Valley of Texas: A Survival/Success Approach." Texas Agricultural Experiment Station Technical Article TA-15378, 1979.
- Ricks, Donald J. Extension Marketing Today--Scope, Challenges and Opportunities. Department of Agricultural Economics Staff Paper 79-47, Michigan State University, 1979.
- Robbins, Lionel. The Nature and Significance of Economic Science. London: Macmillan & Co., Ltd., 1946.
- Roberts, Dayton Young and Hong Yong Lee. "Personalizing Learning Processes in Agricultural Economics." American Journal of Agricultural Economics 59(1977):1022-1026.
- Robison, Lindon J. and Robert P. King. Specification of Micro Risk Models for Farm Management and Policy Research. Department of Agricultural Economics Report No. 349, Michigan State University, 1978.
- Rosenberg, Scott E. and J. Roy Black. A User-Oriented Field Time Prediction Model For Michigan Farmers. Forthcoming Agricultural Economics Report from the Department of Agricultural Economics, Michigan State University.
- Rosenberg, H. Z. and James R. Gray. "Reduction of Price Variation in a Producer's Market." Journal of Farm Economics 44(1962):219-221.
- Rossmiller, George E., ed. Agricultural Sector Planning--A General System Simulation Approach. Department of Agricultural Economics, East Lansing, MI: Michigan State University.
- Runes, D. D. Dictionary of Philosophy--Ancient--Medieval--Modern. Totowa, NJ: Littlefield, Adams and Co., 1961.

- Schermerhorn, Richard W. "Identifying Extension's Marketing Clientele and Adapting Economic Information to Their Needs." Southern Journal of Agricultural Economics 1(1969):113-118.
- Schlaifer, Robert. Probability and Statistics for Business Decisions--An Introduction to Managerial Economics Under Uncertainty. New York: McGraw-Hill Book Co., 1959.
- Schneeberger, K. C. "Gaming as a Farm Management Teaching Device: A Development and Analysis." Southern Journal of Agricultural Economics 1(1969):53-58.
- Schwab, Gerald D. "Game Survey." Mimeographed. East Lansing, MI: Michigan State University, 1974.
- _____. Michigan State University, East Lansing, MI. Interviews, 1980.
- _____. Rates for Custom Work in Michigan. Michigan Cooperative Extension Service Bulletin E-458, July, 1980.
- Schwab, Gerald D., Sherill B. Nott, Myron P. Kelsey, Archibald R. Johnson, Zane R. Helsel, W. C. Search. Michigan Crops and Livestock Estimated 1980 Budgets. Department of Agricultural Economics Staff Paper AER 371, Michigan State University, 1980.
- Scott, John T., Jr. and Chester B. Baker. "A Practical Way to Select an Optimum Farm Plan Under Risk." American Journal of Agricultural Economics 54(1972):657-660.
- Selley, Roger. "Efficiency Criteria and Their Use in Identifying Risk Preferences." Mimeographed. Tucson, Arizona: University of Arizona.
- Shaffer, Ron E. "The Developing Technology of Computerized Information Systems: Discussion." American Journal of Agricultural Economics 60(1978):913-914.
- Shane, Ronald L. and Gordon L. Myer. "Profitability of Alfalfa Hay Storage Using Probabilities: An Extension Approach." Western Journal of Agricultural Economics 5(1980):123-127.
- Siebert, John W. "The Cash in Your Cash Grain Marketing Alternatives." Mimeographed. West Lafayette, IN: Purdue University.
- Sjo, John. "In Quest of Learning-Teaching Excellence: A Viewpoint." American Journal of Agricultural Economics 58(1976):557-559.
- Skees, Jerry. Michigan State University, East Lansing, MI. Interviews, January, 1981a.
- _____. Ph.D. thesis, Michigan State University, forthcoming in 1981b.

- Skees, J. R., M. E. Rister, R. C. Brook, S. B. Harsh, F. W. Bakker-Arkema. On-Farm Grain Handling Costs--Engineering and Economic Factors. Department of Agricultural Economics Staff Paper 79-83, Michigan State University, 1979.
- Smith, Adam. Theory of Moral Sentiments, 1759.
- Smith, Garry L. and Lee F. Schrader. "An Analysis of the Accuracy of Crop Reports for Corn and Soybeans." Purdue Farm Management Report. Department of Agricultural Economics, Purdue University, 1977.
- Smyth, David J. "Effect of Public Price Forecasts on Market Price Variation: A Stochastic Cobweb Example." American Journal of Agricultural Economics 55(1973):83-88.
- Tulu, Mehmet Y. "Simulation of Timeliness and Tractability Conditions for Corn Production Systems." Ph.d. thesis, Michigan State University, 1973.
- Van Hoozer, Gary. "Set Grain Sale Goals to Beat the Average." Big Farmer Entrepreneur 1980, pp. 7-8.
- Walker, Odell L. and A. Gene Nelson. Agricultural Research and Education Related to Decision-Making Under Uncertainty: An Interpretative Review of Literature. Oklahoma Agricultural Experiment Station Research Report P-747, 1977.
- Walker, Odell L. and A. Gene Nelson. "Dealing with Risks in the Management of Agricultural Firms: An Extension/Teaching Viewpoint." Risk Analysis in Agriculture: Research and Educational Developments. Department of Agricultural Economics A.E. 4492, University of Illinois, 1980, pp. 22-53.
- Weber, Mike T., George K. Dike and J. Roy Black. Pricing/Marketing Workshops. Mimeographed notes. East Lansing, MI: Michigan State University, 1978-79.
- Yeutter, Clayton. "Marketing Problems: Why the Search for an Alternative?" Proceedings, National Symposium on Electronic Marketing of Agricultural Commodities, ed. Thomas L. Sporleder, College Station, Texas: Texas A&M University, 1980, pp. 11-24.
- Young, Douglas L. "Risk Preferences of Agricultural Producers: Their Use in Extension and Research." American Journal of Agricultural Economics 61(1979):1063-1070.
- Young, Douglas L. "The Use and Estimation of Objective Probability Measures." Paper presented at Western Agricultural Economics Association meeting, Las Cruces, New Mexico, 1980.
- Zusman, P., and A. Amiad. "Simulation: A Tool for Farm Planning Under Conditions of Weather Uncertainty." Journal of Farm Economics 47(1965):574-594.