

THE RELATIONSHIP OF INTENTIONS TO BUY AND
SUBSEQUENT PURCHASES OF FARM MACHINERY

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ABSTRACT

THE RELATIONSHIP OF INTENTIONS TO BUY AND SUBSEQUENT PURCHASES OF FARM MACHINERY

by Leland D. Lambert

This paper investigates the relationship between farmers intentions to purchase machinery and their subsequent actual purchases. A panel was questioned at the beginning of 1959 as to (1) the strength of their intentions to purchase, (2) the amount they intended to spend, (3) when they intended to buy, (4) whether they intended to buy a new or a used machine. Since the panel was the Michigan Mail-In Farm Account cooperators, information was available as to the farmers actual purchases from the account records at the end of the year. The survey of intentions was limited to investments estimated to cost more than \$500. This limited most of the analyses to seven of the larger machines: balers, bulk milk coolers, choppers, hay conditioners, tractors, combines, and corn pickers.

Both tabular and regression analyses were used to determine the correlation of purchases with intentions. The type of farm operation and income variables were considered in the multivariate analyses.

A single equation model was tried for the multivariate analyses and found to be inadequate. The "twin-linear" model which was used, estimated the probability of purchase with one equation and the size of purchase with a second equation. The analyses indicated that the probability of a purchase being made and the size of purchase are

dependent partially on different variables. The results were found to be significantly different for different machines.

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By

Leland D. Lambert

A THESIS

Submitted to the College of Agriculture of Michigan
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1964

1. The first step is to identify the problem or question that needs to be answered.

2. The second step is to gather relevant information and data.

3. The third step is to analyze the information and data to identify patterns and trends.

4. The fourth step is to develop a solution or answer based on the analysis.

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CHAPTER I

INTRODUCTION

Since 1928, Michigan State University through the cooperation of the Agricultural Extension Service, the Agricultural Economics Department, and the Agricultural Experiment Station has worked with interested farmers of Michigan on their farm accounting and business management problems. Until 1957 the program followed traditional procedures of gathering farm account books at the end of the year and processing the data obtained from them on hand calculators. Since 1957 two innovations have been employed: (1) information has been received monthly by mail and (2) data are processed currently using punched cards and electronic data processing equipment.

The potential value of these records for marketing research was envisioned and a "Plans to buy" project was begun in 1958. This project utilized the cooperation of participants in the extension accounting program and was financed with research funds made available by the U. S. Department of Agriculture.

Purpose

This study is a probe into the buying intentions of farmers and their subsequent purchases of farm machinery. Hopefully, the results of this study may help to increase the power of mathematical

models for predicting the demand for farm machinery from known variables such as:

- 1) Level of income.
- 2) Capital availability.
- 3) Profit expectations.
- 4) Intentions to buy.
- 5) Machinery prices.

Need for Study

Economists recognize that there are a host of factors which affect a potential buyers decision to purchase or not to purchase. In the aggregate, many of these factors exert such a minor effect that it is generally considered unprofitable to attempt to measure them. There is a need methodologically to determine if the effect of some of these variables can be captured indirectly by considering intentions (or the results of an intentions survey) as a proxy variable which will measure the combined effect of many of these minor variables.

At the micro level, there is a need for a better understanding and evaluation of the relative importance of factors that affect farmers decisions in buying. Such information would enable machinery manufacturers, machinery dealers, credit agencies and others to make better demand predictions.

SURVEY OF LITERATURE

Most of the early research utilizing intentions¹ in predictive work, did not include a means for evaluating the actual fulfillment rate of individual respondents (i.e., the ratio of intentions to purchases).

Starting in 1927, the Regional Shippers' Advisory Boards of the Association of American Railroads surveyed firms in an effort to anticipate boxcar requirements to aid the railroads in planning shipments.² Projections based on this study have been relatively inaccurate with an error exceeding a naive model.³

In 1946, Fortune magazine incorporated a survey of anticipations into their "Forum of Executive Opinion".⁴ Forecasts, incorporating these anticipations, had errors about 23 percent smaller than the error of a straight extrapolation.

In 1947, Dunn & Bradstreet started incorporating sales expecta-

¹Much of the early research in this area was summarized at the 1951 Conference on Research in Income and Wealth. The topic for this meeting was "Short-Term Economic Forecasting." The papers delivered at this meeting were published in Volume XVII of Studies in Income and Wealth, a report of the National Bureau of Economic Research, published by Princeton University Press, Princeton, N.J.

²Franco Modigliani and Owan H. Sauerlender, "Economic Expectations and Plans of Firms in Relation to Short-Term Forecasting," Studies in Income and Wealth, Vol XVII (1955), 264-267.

³For this paper a naive model is defined as one that predicts that whatever happened last year will happen again this year, e.g., if tractor sales increased 10% in the first quarter of 1958, a naive model would predict a 10% increase in the first quarter of 1959.

⁴Modigliani and Sauerlender, op. cit., 267-274.

tions into their routine questionnaires of the financial status of firms.⁵ The average error in forecasting from their studies has also exceeded the naive model.

The studies mentioned above do not give a direct correlation between anticipations and subsequent sales. The Shippers' report only gives information on anticipated physical shipments and subsequent actual shipments. There was no information gathered on actual sales in the other two studies.

One of the earliest studies correlating intentions and subsequent purchases was conducted jointly by the Office of Business Economics of the Department of Commerce, and the Securities and Exchange Commission.⁶ This survey was begun in 1948 and dealt with capital equipment only. Friend and Bronfenbrenner⁷ analyzed this study and concluded:

There is a wide disparity in the accuracy with which individual businessmen anticipate their capital outlays, though in the aggregate the positive and negative discrepancies tend to cancel out. The degree of accuracy is related to many different factors, including size of firm, amount of investment, and age of existing assets. The largest firms are much more accurate in their anticipations than the smallest firms. Similarly, firms planning large-scale investment (relative to existing assets) perform better than those planning minor expenditures. It is also interesting to note that where existing plant and equipment is relatively old, firms are less likely substantially to curtail their planned expenditures.

The predictive accuracy of this study was about the same as the

⁵Ibid., 274-277.

⁶Ibid., 304-307.

⁷Irwin Friend and Jean Bronfenbrenner, "Plant and Equipment Programs and Their Realization", *ibid.*, 55.

Fortune study.

A similiar study was carried out by the Canadian Government at about the same time.⁸

One of the earliest studies using intentions to purchase consumer goods was made by Lansing and Withey.⁹ Working with intentions to buy durable goods, they concluded:

- 1) Predicting of aggregate purchases is much easier than predicting the probability of an individuals actions.
- 2) Financial ability and change in financial status affects the fulfillment rate.
- 3) Trends and direction of change between surveys may be more significant than absolute percentage levels.
- 4) The correlation between intentions and purchases was better for higher priced items than for low priced items.
- 5) Six months would probably be a better time interval than one year.

In a subsequent study¹⁰ Lansing (and Klein) concluded:

We are convinced of the superiority of general forecasts for the economy. Ultimately we foresee a combination of survey data about the consumer sector with data from other sources in a model of the entire economy built for forecasting purposes...

All three of the broad types of variables which we considered--financial, demographic, and attitudinal--proved to be important...

In working with the attitudinal variables, we were particularly impressed with the importance of buying plans. The coefficient for this term in the equation was highly reliable, amounting to almost 4 1/2 times its own standard error.

⁸O. J. Firestone, "Investment Forecasting in Canada", *ibid.*, 113-259.

⁹John B. Lansing and Stephen B. Withey, "Consumer Anticipations: Their Use in Forecasting Consumer Behavior", Studies in Income and Wealth, op cit, 381-440.

¹⁰L. R. Klein and J. B. Lansing, "Decisions to Purchase Consumer Durable Goods", Journal of Marketing, Vol XX (October, 1955), 109-132.

Irving Schweiger¹¹ made a general evaluation of intentions for use in forecasting and concluded:

...estimates (based on expectations) have generally been correct as to direction, (but) the indications of amount of change in demand have been very rough...Consumers' ability and inclination to plan purchases can vary over time as greater or lesser certainty exists regarding availability of goods and credit, prospective incomes, etc. These factors widen the margin of error in interpreting intentions data. The experienced user can make allowance for such factors. This characteristic indicates, however, that intentions data cannot be handled in a mechanical fashion and that judgement is necessary to interpret them.

Robert Ferber¹² made a general evaluation of some of the methods that might be employed to forecast sales of consumer durable goods by means of sample surveys. His most significant findings were:

- 1) The population groups doing the most purchasing (on a per family basis) were also the ones doing the most planning.
- 2) Large items were more likely to be planned than small ones.
- 3) The planning horizon increased with the amount of contemplated expenditures.
- 4) The planning horizon varied by type of good.
- 5) Purchase plans were much more likely to be fulfilled if:
 - a) the approximate time of purchase was known,
 - b) they were accompanied by a high degree of certainty.
- 6) The majority of fulfilled plans were fulfilled not longer than one month beyond their scheduled date, where a date was given.
- 7) Fulfilled plans whose approximate timing was not known tended to be fulfilled even sooner than those for which approximate timing was given.

¹¹Irving Schweiger, "The Contribution of Consumer Anticipations in Forecasting Consumer Demand", Studies in Income and Wealth, Vol XVII (1955), 455-472.

¹²Robert Ferber, "Sales Forecasting by Sample Surveys", Journal of Marketing, Vol XX (July, 1955), 1-13.

8) Degree of fulfillment of plans varied by type of good.

9) Degree of fulfillment varied with the respondents present and expected future financial position.

Cromarty¹³ made an extensive study of the factors affecting the demand for farm machinery. His study was based on census data for the years 1923-54. Using multiple regression equations he concluded that:

A 10 percent change in net farm income has on the average resulted in a 5 percent change in the same direction of machinery purchases. A 10 percent change in the January 1 asset position has resulted in a 3 to 6 percent change in machinery purchases also in the same direction. There is good evidence to show that a 10 percent change in machinery prices will result in a 10 percent change in the opposite direction for machinery purchases.

There is not sufficient evidence to conclude that a large stock of machinery at the beginning of the year will result in smaller quantities being purchased during the year. Nor is it possible to conclude from the results of this analysis that increases in farm wage rates will result in more machinery being purchased, although higher industrial wages were associated with larger machinery purchases.

In the case of farm tractors, a 10 percent increase in net cash receipts for the previous year is associated with nearly a 2 to 4 percent increase in tractor shipments.

Jean Namias¹⁴ made a study of intentions and subsequent purchases of household durable goods. This study was based on data collected by the Survey Research Center of the University of Michigan in 1952 and 1953. (this data were also used by Lansing in his studies) She concluded:

¹³William A. Cromarty, The Demand for Farm Machinery and Tractors, Michigan State University Technical Bulletin 275 (November 1959).

¹⁴Jean Namias, "Intentions to Purchase Compared with Actual Purchases of Household Durables", Journal of Marketing, Vol 24 (July 1959) 26-30.

- 1) Consumers who say that they do not intend to buy a household product during a given period seem more likely to carry out their negative intentions than people who say they do intend to buy. Nevertheless, most of the purchases are likely to be made by the group of consumers who do not plan to buy.
- 2) Fulfillment of intention to buy is probably, in large measure, predicated on income.
- 3) The larger the holding of liquid assets, the greater seems the probability to buy.
- 4) The existence of personal debt does not seem to deter people from buying.
- 5) Consumers who say that they intend to buy seem more likely to buy if they have a favorable attitude about their personal financial situations, and express optimism about market conditions.
- 6) Consumers who live in towns, small cities, or the open country probably are more likely to carry out their intentions to buy durable household goods than are consumers in big cities.
- 7) For people under 45, the presence of children in the family tends to be associated with greater stability of intentions to buy than in other families.

Wright and Vincent¹⁵ working with the same data as was used for this study, made a comparison of intentions and subsequent purchases of tractors. They concluded:

- 1) Of the 935 farmers replying to the questionnaire in late December 1958, some 265, or 28 percent said there was "some chance" of them buying a tractor in 1959, while 670, or 72 percent, said there was "no chance".
- 2) Actual purchases were made by 134, or 50 percent, of the "some chance" men, and 91, or 14 percent, of the "no chance" men, for 225 tractor purchases.
- 3) Expenditures for tractors by the 50 percent "some chance"

¹⁵K. T. Wright and Warren Vincent, "Intended and Actual Tractor Purchases by Farmers in Michigan, 1959". Michigan State University Agricultural Experiment Station Quarterly Bulletin, Vol 44, (November 1961) 334-60.

men, amounted to 65 percent of the total intended, as they paid more than expected. Tractor purchases by the "no chance" men exceeded the deficit of the "some chance" men, so that total expenditures exceeded intentions by 6 percent.

- 4) Of the 265 "some chance" farmers, 20 said they were "very certain" they would purchase a tractor, 43 were "quite certain", 96 said there was a "fair chance", and 106 a "slight chance". The percentage actually purchasing was as follows: 65 percent of the "very certain", 72 percent of the "quite certain", 49 percent of the "fair chance", and 40 percent of the "slight chance".
- 5) When sorted in 1959 net income quartiles, 31 percent of the high income quartile men indicated "some chance" of purchasing, 32 percent of the second, 23 percent of the third, and 27 percent of the low-group. As to percentage of those actually purchasing, 52 percent of the high-income quartile purchased, 52 percent of the second group, 43 percent of the third, and 53 percent of the low-income quartile. Of the "no chance" men, 24 percent of the top-income quartile purchased tractors, 14 percent of the second group, 11 percent of the third, and 7 percent of the low-income group.
- 6) Combined purchases by both the "some chance" and the "no chance" men in the high-income group was 129 percent of that intended, 108 percent in the second group, 95 percent in the third, and 81 percent in the low-income group.
- 7) Twenty-four percent of the 225 tractors purchased were bought in the first quarter, 45 percent in the second, 13 percent in the third, and 18 in the fourth.
- 8) Total outlay for tractors by all men was 33 percent less than intended in the first quarter of the year, 15 percent above in the second, 36 percent above in the third, and almost four times as much as the small amount intended in the fourth quarter.
- 9) There was little difference in the percentages of the various "strength of intent" groups actually buying tractors that intended to, whether sorted by 1959 or 1958 income.

Wright¹⁶ made a subsequent study of machines other than tractors.

¹⁶K. T. Wright, "Purchases of Major Farm Machinery", Research report no. 3, Michigan State University Agricultural Experiment Station.

He concluded:

- 1) Farmers' actual expenditures for major machinery in the year considerably exceed their January intentions.
- 2) Strength of indicated intent to buy is a strong factor affecting actual expenditure per farmer.
- 3) About one-half as many "no chance" farmers actually buy as "some chance" men, but spend one-third less per farmer.
- 4) Predicting the time of the purchase, based upon indicated January intentions, cannot be made with much reliability, especially beyond six months.
- 5) Higher net cash income the previous year is associated with stronger intent to buy and higher machinery purchases per farmer.
- 6) Income level of farmers the previous year is somewhat more closely related to actual purchases than income level in the current year.
- 7) Strength of intent to buy, as indicated in January, and income level the previous year, are significant factors affecting actual machinery purchases, but there are other important factors also having an influence on purchases. Therefore, predictions on future expenditures for major machinery (other than tractors) by a group of farmers, based on knowledge of strength of intent to buy and income level the previous year, appear to have only a moderate amount of reliability.

Fisher¹⁷ made a study of the relationship between consumer durable goods expenditures and the three variables: assets, credit and intentions. This study was also based on data from the 1957 and 1958 Survey of Consumer Finances dealing with purchases of durable goods. A three stage estimation process was used in which the first stage dichotomized purchasers and non-purchasers, the second stage

¹⁷Janet A. Fisher, "Consumer Durable Goods Expenditures, With Major Emphasis on the Role of Assets, Credit and Intentions", Journal of the American Statistical Association, Vol 58 (September, 1963) 648-57.

dichotomized cash and credit purchasers and the third stage estimated the size of the net outlay.

Fisher concluded:

The results suggest that sensible, but not simple relationships do obtain between certain regressors representing assets and liabilities and purchasing behavior, and that past behavior does provide some extremely helpful clues to the future. The results of this analysis for 1957 also support and extend previously found relationships between purchasing intentions and subsequent behavior."

Huang¹⁸ made a study of the demand for automobiles using a statistical approach similar to that of Fisher. Huang termed his method a "twin-linear estimation technique". The first stage estimates the probability that a purchase will be made and the second stage estimates the size of the purchase. This study was also based on data from the 1957 and 1958 Survey of Consumer Finances. The author (Huang) was interested in estimating the "inventory effect", the "taste effect" and the "trade-in effect"¹⁹ associated with purchases of new automobiles. Huang concluded:

The consumer's net investment may or may not display the traditional stock effect; we must consider the character of his initial stock as well as his option to purchase new or used durables and to make a trade-in. There also needs to be more rigorous and detailed treatment of the effect of taste than has so far appeared in the literature. It seems that a proper empirical approach to the problems in this area requires simultaneous use of cross-section, panel and aggregative time-series data.

¹⁸David S. Huang, "Initial Stock and Consumer Investment in Automobiles", Journal of the American Statistical Association, Vol 58 (Sept, 1963) 789-798.

¹⁹The trade-in effect is the effect of inventories on the ability to purchase, i.e., a person with a late model used car can purchase a new car with less cash outlay than a person with no car inventory.

Tobin²⁰ made an evaluation of intentions and attitudes for predicting expenditures. His study was based on data from the 1953 Survey of Consumer Finances. In addition to intentions and attitudes, he included as objective variables: (1) current income, (2) change in liquid asset holdings from the previous year, (3) change in personal non-mortgage debt from the previous year. He concluded that intentions made a significant contribution to prediction but that attitudes were of questionable value.

Tobin's article was criticized by Katona²¹ and by Fisher²². They found evidence that attitudes were more important than intentions for prediction.

Mueller²³ made a comprehensive survey of the record of forecasts utilizing attitudes and intentions. She concluded:

In summary, the analysis indicates that discretionary spending by consumers is determined to a large extent by income level and the state of consumer optimism and confidence...If, as the data suggest, attitudes reflect the impact of more environmental factors than merely income change, and if complex combinations of these factors have a bearing on spending decisions, it follows that consumer spending is not wholly governed, nor well predicted, by the traditional financial variables...When attitudes

²⁰James Tobin, "On the Predictive Value of Consumer Intentions and Attitudes", The Review of Economics and Statistics, Vol. XLI, (February, 1959) 1-11.

²¹George Katona, "On the Predictive Value of Consumer Intentions and Attitudes: A Comment", The Review of Economics and Statistics, Vol. XLI (August, 1959) 317.

²²Janet A. Fisher, "Something More 'On the Predictive Value of Consumer Intentions and Attitudes'", The Review of Economics and Statistics, Vol. XLI (August, 1959) 317-319.

²³Eva Mueller, "Ten Years of Consumer Attitude Surveys: Their Forecasting Record", Journal of the American Statistical Association, Vol. 58 (December, 1963), 899-917.

are also taken into account, the predictive performance of buying intentions is not consistent from one test to another.

Wu²⁴ applied a two stage decision model to the theoretical hypothesis of stock adjustments. The probability of a purchase being made is estimated by the first stage and the size of purchase, given that a purchase is made, is estimated by the second stage. The general stock adjustment hypothesis is that:

$$q_t = \alpha(s_t^* - s_{t-1}) + d_t,$$

where

q_t = gross expenditure on durable goods in period t .

s_t^* = desired stock at the end of period t .

s_{t-1} = actual stock at beginning of period t .

d_t = depreciation in period t .

α = adjustment coefficient.

Various proxy variables were used by Wu to measure s_t^* . These included marital status, home ownership, number of children, income, change in income and others. Using data from the 1958 and 1959 Survey of Consumer Finances, the coefficients of multiple determination were .0955 and .1106 for the probability equations and .1359 and .1166 for the expenditure equations for the respective years. Wu concluded that:

...the determinants of probability of purchase and of net outlay are not completely the same. Many variables which show significant effects in the probability function do not appear to be significant in the net outlay function...One possibility is that it is the relative gap between desired and actual stocks which is important in determining the probability of purchase while the absolute gap is important in determining the net outlay.

²⁴De-Min Wu, "An Empirical Analysis of Household Durable Goods Expenditure". Unpublished paper presented at the winter Meetings of the Econometric Society in Boston, Mass., December, 1963.

Looking at previous research as a whole, there has been a trend toward viewing intentions and attitudes as having increasing importance in demand analysis. There has been a recent controversy as to whether intentions or attitudes have more power for predictive purposes.

Except for the Wright-Vincent studies, the previous research has been weak in several areas. There is a need for additional research to fill in these gaps which this study endeavours to accomplish.

Two of these weaknesses are in the reinterview process. Most of the previous studies did not get a quantitative measure of the degree of fulfillment, the respondents were only asked: "Did you or did you not make the intended purchase". All of the studies (with the exception mentioned above) which obtained fulfillment data, got their information concerning the fulfillment of plans by a reinterview process. This process has the following disadvantages:

- 1) The information obtained may be inaccurate either from erroneous reporting or forgetfulness of the respondent.
- 2) Measuring fulfillment by a reinterview may bias subsequent surveys, especially if the reinterview is made a short time after the survey of intentions.

This study avoids both of these problems by measuring the respondent's fulfillment rate from his accounting reports. These reports are mailed in monthly and the respondent has no knowledge that his fulfillment rate is being measured, thus subsequent surveys are not biased by reinterviewing, nor by forgetfulness.

The survey of intentions for this study was, to the respondent,

merely a part of a larger program which is a service to him, thus it is to be expected that rapport with the respondent would be superior to the conventional panel. The high rate of response (89%) is an indication that this was the case.

CHAPTER II

METHODOLOGY

CHARACTERISTICS OF STUDY

In this study more attention was given to the "cutting-point problem" than has been the case in previous research. Lansing²⁴ describes the problem as follows: (he is discussing a study in which there were only three classifications of strength of intent)

This method of measuring expectancies gives rise to the so-called cutting-point problem. Should one assume that only those categorized as "definitely will buy" are actually going to purchase? If not, should one include the entire "probably will buy" group in one's prediction or a fraction of them? If a fraction, then what fraction? The predictor needs to decide on some point on the scale so that persons above such a point are going to be regarded as future "purchasers" and those below that point as "non-purchasers". Or he has to devise a formula with fractional predictions from each grouping. The customary solution has been to present the entire scale and base one's interpretation on trend data using the entire column.

For this thesis the strength of intent was broken down into five categories, the respondent indicating his intent in terms of varying probability that he would make a purchase.

SOURCE OF DATA

History of Mail-In Accounting Project

The data for this study came from the Michigan mail-in farm

²⁴J. B. Lansing and S. B. Withey, op. cit., 416.

account program. The University started a farm record project in 1928 which has operated continuously since that time. This program was carried out in various ways until 1957 when it was converted to a mail-in type farm accounting system.

With the increasing importance of accounting records for tax purposes and as an aid to better management, the number of cooperators in the program expanded to a maximum of 1700 in 1957 but has stabilized at about 1150 during the 1960's. However, service to farmers is only one objective of the program. Another objective of the accounting project is to train extension agents in farm management and as a vehicle for getting specialists out on farms. The record summaries and the farms are used for case studies, class visits, tours and special research projects. Publishing the summary of each year's records provides a continuous source of input-output data and reasonable standards of performance for Michigan farm conditions.

Participation in the program is voluntary and at the time of this research the cooperators were charged merely a small fee covering the cost of materials needed in the operation.

Mechanics of Operation²⁵

- 1) Farmers are enrolled in the project by the county agricultural agent.
- 2) The cooperators mail in monthly, an itemized statement of financial transactions on uniform ledger sheets.

²⁵Everett M. Elwood, Seminar Notes on Educational Possibilities of Mail-In Accounting, Michigan State University Ag. Econ. Mimeo 847 (Sept. 26-27, 1961) The details of this program have changed somewhat since 1961.

- 3) When the reports are received at the University, each transaction is coded and punched into IBM cards.
- 4) At the end of the year, an accounting summary is prepared from the IBM cards and a copy is mailed to the farmer.
- 5) Farm management specialists visit all counties and with help of agents "check-in" all cooperators. This includes inventory records, crop production records and additional information. Questions arising out of monthly reports are clarified.

Also at the end of each year, the University Farm Management specialists compile a comparative summary for each of 17 areas of the state. These summaries contain information about:

- 1) The size, organization and operation of commercial farms in the area.
- 2) Trends that are taking place on commercial farms.
- 3) The range in gross farm income, expenses, net farm income, labor efficiency, etc.
- 4) Factors associated with profitable farm management.

These summaries provide a basis for making a comparative analysis of an individual farm. A copy of this summary is mailed to each cooperator.

If the Farm Management specialist believes a special condition exists on a specific farm, he may exclude the data on this farm from his area report. The general criteria for the separation is as follows:

- 1) If he believes the accounting report may be inaccurate.

- 2) If peculiar conditions such as fire, disease, sickness, etc., on a farm in a small subsample caused an extreme change in the average results from one year to another.
- 3) If the type of operation was atypical, such as a muck farm, which would contribute to misleading area averages.

For part of this study, the data which was excluded from these area reports was also excluded from the analysis. There was a total of 887 farms included in the 17 area reports.

THE GENERAL APPROACH

A brief summary of the general approach used in the study follows:

The members of the mail-in accounting project were surveyed by mail as to their intentions to purchase farm machinery during the following year. The respondents were asked to classify the strength of their intention to purchase into one of the following categories:

- 1) Very certain - have already started or am making arrangements.
- 2) Quite certain - considerably better than 50/50 chance. (of making purchase).
- 3) Fair chance - about 50/50 chance of making purchase.
- 4) Slight chance - less than a 50/50 chance of making a purchase.
- 5) No chance - of making a purchase.

The respondents were also asked to indicate the quarter of the year in which they intended to purchase a new or used machine, and the

amount of the estimated expenditure.

These intentions were then classified by strength of intent, quarter of intended purchase, and whether the intention was to purchase a new or used machine.

Tabular analyses were then made of the data to get a preliminary indication as to which variables should be considered for multivariate analysis. Then each of seven machines was analysed with multiple regression using a two equation model similar to those used by Fisher²⁶ and Huang²⁷. This model is elaborated in detail in Chapter VI.

²⁶Janet A. Fisher, op. cit.

²⁷David S. Huang, op. cit.

CHAPTER III

DATA PROCESSING

Questionnaire of Intentions

A questionnaire of intentions to buy was mailed to all of the mail-in account cooperators on December 22, 1958. There were 1042 or 89% who returned the questionnaire. There were 935 of these who both returned the questionnaire and completed the 1959 accounting year.

The questionnaire asked for purchase plans concerning major investments (arbitrarily defined as a purchase in excess of \$500). This included buildings and equipment as well as machinery. A copy of the questionnaire and the accompanying letter appear on appendix pages 106-110.

The analysis of the data required that an inference be made as to whether the respondent purchased his machine new or used. In 24 cases it was not possible to make a reasonable inference from the questionnaire of intentions and the accounting reports. Ten of these respondents were contacted by phone and the remainder by mail to obtain this information. The telephone contacts were made in January 1961 and the mail contacts in February 1961.

DATA ADJUSTMENTS

Some of the accounting records were incomplete since the

cooperator failed to complete the year. The intentions and incomplete purchase data for these respondents were excluded from the analysis.

In a few cases the respondent indicated an intent to buy a combine and/or corn picker and subsequently purchased a uni-harvester. As it did not seem reasonable to consider these as unfulfilled intentions, these intentions were reassigned to uni-harvester.

On a few of the questionnaires, the respondent indicated an intent to purchase but failed to indicate dollar intentions. In these cases the mean intent for that machine was assigned as the best estimate of the individuals intention.

In separating the purchases into new and used machines an inference was made using the following as clues:

- 1) In many cases the accounting report read "new machine purchased".
- 2) Whether the respondent intended to buy the machine new or used.
- 3) The size of the purchase in relation to the size of the intention.
- 4) The price paid in relation to the manufacturers list price for the model purchased.

As indicated above, in those cases in which a reasonable inference could not be made, the respondents were contacted for the information.

It is possible that some of the farmers may have failed to list, on their mail-in accounting report, machinery traded in. Most of

these errors would have been detected at the end of the year since a check is made with the farmers machinery inventory. Also, if a very large proportion of the purchase price was represented in the trade-in, the purchase price would have varied from the retail price and this would have been detected in drawing the inference as to whether the machine was new or used. Even if such an error were made it would not effect the aggregate purchase figures and would not effect most of the analyses which follow.

There were several farmers who purchased two machines of the same kind. In those cases in which there was no intent to purchase either machine, or an intent to purchase both machines, the purchases were summed and treated as a single purchase. In those cases in which one machine was intended and the other was not, the farmer was "divided" into two observations, one of which purchased as intended, the other making a purchase without intentions. In these cases, the degrees of freedom was reduced by the amount that n was inflated. There were twenty of these cases, fifteen of them being tractors.

MACHINES USED IN THE ANALYSIS

The original "Plans to buy" project was designed to study "Major" farm investments. By definition a major farm investment was considered to be any purchase costing \$500. or more. It is probable that many machines, such as grain drills and manure spreaders, could cost more or less than \$500., depending on the size and model. It is possible that the respondent intended to spend less than \$500., but actually spent more than \$500. In such a case he would not have

listed an intention to buy but would be tabulated on the records as making a purchase in excess of \$500.

For part of this analysis, such errors would seriously bias the results, for other parts of the analysis this possibility would not be important as the correlation is between only those respondents who had intentions and their subsequent purchases.

The machines which do not normally cost \$500. at retail were omitted. The remaining machines were classified into three categories:

Group I - There is a high degree of certainty that the machines in this category cost more than \$500. at retail. The machines in this category are: baler, combine, corn picker, hay conditioner, tractor, bulk milk cooler, chopper, uni-harvester, and picker sheller. These machines were included in all of the analyses.

Group II - This category includes gutter cleaners and silo unloaders. It was felt advisable to exclude these machines from part of the analysis for the following reasons: Gutter cleaner: There was no way of determining whether the intention and/or purchase was for a complete unit or for only part of a unit. (This was also a problem for milking equipment and wagons). Silo unloader: Many of the respondents indicated an intent to buy a silo for X dollars and subsequently bought a silo unloader for that figure. It seems reasonable to assume that some of these respondents actually intended to buy a silo unloader but, on the questionnaire of intentions,

indicated an intent to spend X dollars on the silo in the form of a silo unloader.

These machines were included in part of the tabular analyses but were excluded from the multivariate analyses.

Group III - This category includes those machines which could cost more than \$500. for the most expensive type and model, or could cost less than \$500. for a less expensive type and model. The machines in this category are: grain drill, manure spreader, pipeline milker, corn planter, manure loader, and wagon. These machines were excluded from most of the tabular analyses and all of the multivariate analyses.

DATA PROCESSING PROCEDURE

After the survey of intentions was returned by the respondent, the information was punched into IBM cards. At the end of the year, the following data was transferred onto these cards from the mail-in accounting cards:

- 1) The actual dollar purchases of farm machinery.
- 2) The 1958 and 1959 income.
- 3) The month of purchase.

An inference was then made as to whether the machine was purchased new or used and with or without trade. This data, and also the purchase of part interest, was added to the cards. Thus the data cards contained information concerning the respondents:

- 1) intended purchases in dollars.
- 2) actual purchases in dollars.

- 3) 1958 and 1959 income.
- 4) strength of intent to purchase.
- 5) quarter of intended purchase.
- 6) month of actual purchase.
- 7) intent to purchase a new or used machine.
- 8) actual purchase of new or used machine.
- 9) type of machine intended to purchase.
- 10) type of machine purchased.
- 11) type of farming operation.

The tabular analyses were then made by utilizing IBM card sorting equipment. A preliminary regression analysis was made using a Control Data 1604 computer. The remainder of the regression analyses were computed with a Control Data 3600 computer.

CHAPTER IV - ASSUMPTIONS AND HYPOTHESES

Assumptions

It is recognized that a large number of factors affect purchases, in addition to the ones measured in this study. For purposes of the statistical analysis, we formally assume that the net combined effect of these unmeasured factors can be treated as a random "disturbance", the distribution of which is the same from year to year. That is, if an unstudied variable biases purchases, then it is assumed that it biases purchases by a similar amount every year. Thus the regression coefficients from one year may be used to predict purchases for the following year. Some of these factors are listed below and are classified into two categories:

- A. The first category includes those factors which are believed to be constant, at least in the aggregate, and thus would not cause a significant difference between successive surveys.

The factors in this category are as follows:

- 1) It is possible that the process of the respondent recording his intentions may have some effect on his fulfillment rate. If this effect does bias the results, it is assumed to be a constant.
- 2) If the survey of intentions had been taken in mid-summer rather than midwinter, the fulfillment rate would likely have been higher on harvesting machinery

and lower for tillage implements. In comparing results from different surveys or surveys taken in different years, the questionnaires should all have the same mailing date to eliminate this variation.

- 3) Some respondents may have forgotten to enter expenditures on their accounting report. It is unlikely they would enter expenditures which they never actually made. Thus, there would be a bias downward. If it is assumed that such errors occur at random, then the bias would be relatively constant.
- 4) Machinery appearing on the January 1959 accounting report may have actually been purchased in 1958 and the entry delayed. Also, purchases made in December 1959 may not have been entered on the accounting report until January 1960. If it is assumed that such cases occur at random, then the January errors would tend to balance the December errors.
- 5) It is assumed that many machines were purchased because of an unanticipated failure of the existing machine. If it is assumed that in the aggregate such failures occur at a reasonably constant rate, then there would not be a significant variation between successive surveys.

Conversely, it is possible that the respondent anticipated a failure which did not occur. Although this is much less likely, it is also assumed to be relatively constant.
- 6) It is likely that there was some change in machinery

prices between the time of the survey of intentions and the respondents decision to purchase or not to purchase. It is assumed that if there was a price change it did not affect the decision to buy or not buy. A comparison of factory list prices, as reported by the National Retail Farm Equipment Association,²⁹ for the most popular makes and models appears on appendix pages 103 to 105. The average change in price for the machines compared follows:

	<u>Fall 58 to Spring 59</u>	<u>Fall 58 to Fall 59</u>
balers	+2.3%	+3.2%
combines	+0.5	+2.9
corn pickers	+1.1	+2.1
tractors	0.0	0.0
uni-harvesters	-0.3	+3.4
choppers	+2.1	-0.3
Total for all machines	+0.6	+1.7

This increase is similar to the wholesale price change

²⁹Official Tractor and Farm Equipment Guide (compiled by National Retail Farm Equipment Association), Farm Equipment Retailing, Inc., St. Louis, Missouri.

Prices quoted are F.O.B. factory suggested retail prices. Machines that had not been in production more than two years were excluded. Some reports indicate that the average prices paid for farm machinery during the period increased, however, these reports did not separate out the increased production cost and utility of the machines arising from changes in technology.

reported by "The Farm Cost Situation" publication:³⁰

In recent years, wholesale prices of farm machinery and equipment have increased about 3 percent during September-December. This was not true in 1959, when they rose less than one-half of 1 percent during the comparable period.

- 7) The respondent might not have been aware that an improved machine would be available and, therefore, did not intend to buy. It is assumed that this affect is reasonably constant from year to year.
- 8) The respondent may have changed his plans for such reasons as:
 - 1) toll road severence.
 - 2) rental changes.
 - 3) change in crop plans.
 - 4) added or reduced acreage.

It is assumed that such changes in operation are reasonably constant in the aggregate.

- 9) The respondents plans may have been upset by a disaster such as fire, hail, accident, windstorm, sickness, etc., which resulted in unanticipated expenditures which upset his fulfillment rate. Also, the respondent may have received unanticipated income such as prizes, inheritance, etc., which could influence his fulfillment rate upward. If it is assumed that, in the aggregate, these influences occur at random then there would not be a significant

³⁰The Farm Cost Situation, Agricultural Research Service, United States Department of Agriculture publication No. ARS 43-125 (FCS-28) May 1960.

variation in the aggregate fulfillment rate.

- 10) The respondent may have changed his plans because the hired man quit or his son was drafted into the service or returned from the service, etc. It is assumed that these developments occur at random.
- 11) If some respondents purchased machinery to emulate their neighbors, (which they had not otherwise intended to buy) this effect would increase the aggregate fulfillment rate. However, if such an effect is present, it is assumed to be reasonably constant.
- 12) It is assumed that there was no change in Government programs, or anticipation of future changes, that had a significant effect on the fulfillment rate.
- 13) In a few cases, the respondent purchased less than a full interest in the machine. In some of these cases the respondent may have intended to buy a full interest but actually purchased a part interest. Such an error would tend to bias the dollar fulfillment rate downward since the purchase would likely be less than the intended expenditure, however, these cases are likely to occur at random, and the aggregate bias in one survey would tend to equal the bias of the previous survey.

B. The second class of assumptions includes those factors which are believed to change from year to year but which change at a reasonably constant rate. Many of these changes would be

discounted by the respondents when they indicated their intentions to purchase. The assumptions in this category follow:

- 1) The respondent may have decided to adopt new technology that was not contemplated at the time of the intention survey, such as a green chopping program or minimum tillage. If it is assumed that this occurs at a reasonably constant rate, then there would not be a significant difference between successive surveys.
- 2) It is possible that a purchase may have been made because a custom machine was not available as the respondent had anticipated. Or conversely, the purchase may not have been made as planned because a custom machine became available which the respondent had not anticipated.

It is assumed if there is an aggregate secular change in this factor that it changes at a reasonably constant rate.

- 3) It is assumed that the equity requirements and other policies of the lending agencies were, in the aggregate, relatively constant throughout the year (1959). There was a slight increase in interest rates as reported by the publication "The Farm Cost Situation".³¹

A survey made by the American Bankers Association in September 1959, indicated

³¹U.S. Department of Agriculture, The Farm Cost Situation, Agriculture Research Service, ARS 43-144 (FCS-27), Nov. 1959, 27.

that bank rates to farmers have increased since last fall from 6.55 to 6.76 percent on non-real estate loans.

If it is assumed that this slight change in interest rates did not effect purchase plans or credit availability, then there would be no effect on the fulfillment rate.

Conditions Peculiar to the Year

Since about 1954, the dairy plants have exerted pressure in the form of premium payments or loss of market in an effort to convert to bulk handling systems. This has, no doubt, had an effect on the fulfillment rate of this particular equipment.

The "whole farm" soil bank farm program was in effect during 1959. This resulted in many marginal farmers "selling out"; which, no doubt, increased the supply of used machinery.

During the spring of 1959, the University Extension Service carried out an extensive educational program to acquaint farmers with the benefits of hay conditioning equipment. It is likely that this program affected sales of this type of equipment especially among the farmers in the Mail-In Accounting Project.

HYPOTHESES

It is recognized that a farmer's purchases of machinery are dependent on a large number of causes which vary in intensity and interact in a complex manner. It is also likely that many of these factors are dependent on the personality of the farmer. It is obviously unprofitable to attempt to measure all of these variables. The

forecaster must equate the marginal cost of measuring an additional variable with the estimated marginal value of prediction gained from that variable.

It is hypothesized that a significant part of the low level causes associated with purchases can be captured by measuring intentions to purchase. Stated in equation form we hypothesize that:

$$Y = f(X_1, X_2, \dots, X_d | X_{d+1}, \dots, X_k || X_{k+1}, \dots, X_n)$$

where Y = an individual's expenditure on a given item.

$X_1, X_2, \dots, X_d$ = those variables whose marginal value in prediction exceeds their cost of measurement.

$X_{d+1}, \dots, X_n$ = those variables which affect purchases but whose cost of measurement exceeds their value in prediction.

It is hypothesized that some of the variables in the second category ($X_{d+1}, \dots, X_k$) can be shifted to the first category by using the proxy variable, intentions, to measure them.

This paper concentrates on the variables $X_{d+1}, \dots, X_k$, although some of the variables $X_1, \dots, X_d$ are included in order to remove their affect.

In more specific terms, it is hypothesized that:

- I. There is a positive relation between strength of intent and subsequent purchases. That is, as the strength of intent increases, the probability of purchase increases.
- II. There is a positive relation between the size of the intended purchase and the size of the actual purchase. As the size of the intention increases, we can expect the size of the actual purchase to increase.

III. There is a negative relation between:

- a) the length of time between the date of the survey and
- b) the fulfillment rate

In other words, as the length of the planning span increases, the power of intentions data for prediction decreases.

CHAPTER V

TABULAR ANALYSES

The data were aggregated to get some idea of the gross relationships involved. The following tabulations were made:

A. Total dollar purchases made by each chance group as a percent of total purchases. This analysis includes data on both new and used machines purchased either with or without trade.

The "no chance" group was broken down into two subcategories:

- a) those who indicated no chance of purchasing any machine,
- b) those who indicated some chance of purchasing some machine other than the one they actually purchased.

The breakdown by quarters is on the basis of the quarter of purchase, i.e., if the respondent had intentions to purchase anytime during the year and made a purchase in the first quarter, then that purchase was tabulated into the first quarter. It was not possible to classify by quarter of intent because the no chance group did not indicate an intent. The results are tabulated in Table 1.

Observations:

- 1) The proportion of total dollar purchases, of specific machines, made by those respondents who indicated some intention of purchasing, declined steadily from 70% in

1. The first part of the document is a list of names and addresses.

2. The second part of the document is a list of names and addresses.

3. The third part of the document is a list of names and addresses.

4. The fourth part of the document is a list of names and addresses.

5. The fifth part of the document is a list of names and addresses.

6. The sixth part of the document is a list of names and addresses.

7. The seventh part of the document is a list of names and addresses.

8. The eighth part of the document is a list of names and addresses.

9. The ninth part of the document is a list of names and addresses.

10. The tenth part of the document is a list of names and addresses.

Table 1. Percentage of total dollar purchases grouped by strength

<u>Some Chance of Purchasing Machine Intended</u>					
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
<u>quarter</u> <u>of</u> <u>purchase</u>	<u>very</u> <u>certain</u>	<u>quite</u> <u>certain</u>	<u>fair</u> <u>chance</u>	<u>slight</u> <u>chance</u>	<u>(2+3+4+5)</u> <u>total</u> <u>some chance</u>
1st quarter	16.56	30.57	14.05	8.60	69.78
2nd quarter	5.08	9.75	19.19	12.50	46.52
3rd quarter	4.40	5.45	15.78	7.77	33.40
4th quarter	4.68	6.94	6.66	13.39	31.67

of intent to purchase and quarter of purchase.

7	8	9	10	11
<u>no chance</u> <u>this</u> <u>machine*</u>	<u>some chance</u> <u>of purchasing</u> <u>some machine</u>	<u>no chance</u> <u>anything</u>	<u>(7+9)</u> <u>total</u> <u>no chance</u>	<u>(8+9)</u> <u>total</u> <u>all</u>
16.63	86.41	13.59	30.22	100
30.35	76.87	23.13	53.48	100
35.10	68.50	31.50	66.60	100
38.72	70.39	29.61	68.34	100

*The respondents in this category had intentions to purchase one or more of the eleven machines included in the tabulation, however, the machine which was purchased was not one of those intended.

the first quarter to 31% in the fourth quarter. In other words, in the first quarter, 70% of the total dollar purchases were made by those respondents who had intentions to purchase that specific machine. In the fourth quarter only 31% of the total dollar purchases were made by those who had intended to purchase that machine. This trend tends to support hypothesis III, i.e., the shorter the planning span, the higher the fulfillment rate.

- 2) The proportion of total dollar purchases made by those respondents who indicated no chance of purchasing anything increased from 14% in the first quarter to 32% in the third quarter. (The fourth quarter percentage was only 30%). The trend for this group was not nearly as strong as for the some chance group.
- 3) The proportion of total dollar purchases made by those respondents indicating some chance of purchasing some machine (not necessarily the machine intended) varies from 86% in the first quarter to 69% in the third quarter.³² (The proportion in the fourth quarter was 70%). This is an indication that the respondents have a machinery "budget", i.e., if they have intentions to purchase machinery, they usually purchase machinery, even though it may not be the machine which they indicated on the questionnaire of intentions.

³²This proportion would likely have been higher if the study had not been limited to 11 machines.

B. A comparison of mean intended and mean actual purchases.

It was deemed desirable to know whether the actual purchases differed from intended purchases because the number of intentions differed from the number of purchases or because the size of the purchase differed from the size of the intention or whether both effects were operating.

This tabulation measures the ratio of mean actual purchase to mean intended purchase. The following data was excluded from this analysis:

- a) Those who purchased with a trade-in, since a purchase made with a trade would mask the relationship.³³
- b) Those respondents who intended to purchase with a trade-in.
- c) Purchases of used machines as the value varies with the age and condition.
- d) Those respondents who did not intend to purchase.

The results are tabulated in Table 2.

Observations:

The average expenditure was about equal to the average intention for nine of the fourteen machines. Of the five 'deviants', the average purchase exceeded the average intention in four of the five cases.

³³There was no way of knowing whether the respondent traded in the item intended.

Table 2. A comparison of Mean Intended and Mean Actual Purchases.

	<u>Ave. purchase</u> <u>Ave. intention</u>	<u>number of</u> <u>intentions</u>	<u>number of</u> <u>purchases*</u>
baler	104.2%	9	10.5
combine	139.2%	3	3
corn picker	---	1	0
hay conditioner	108.3%	32	22
tractor	113.5%	17	24
bulk tank	97.2%	10	11
chopper	95.4%	24	14
gutter cleaner	103.2%	17	5
silo unloader	103.0%	16	10
picker sheller) uni-harvester)	96.9%	1	2.5
corn planter	80.4%	7	7
grain drill	118.4%	3	5
manure spreader) manure loader)	103.7%	11	13
pipeline milker	102.7%	7	9
wagon	104.9%	26	16

*The number of purchases exceeds the number of intentions in some cases as those respondents indicating intent to buy with trade but actually bought without trade were included in the calculation of mean dollar purchase.

C. Fulfillment rates by categories.

This tabulation was designed to measure the effect on the fulfillment rate of the three variables:

- a) strength of intent,
- b) quarter of intended purchase,
- c) whether the intended purchase was for a new or used machine.

The data was classified by these categories. As there were some respondents who failed to indicate the quarter of intended purchase an additional column was added for the no response category. This made a total of forty categories.

The following data was excluded from this analysis:

- a) those respondents who did not report intentions to buy.
- b) the group II and III machines. (These machines are described on page 24).

This tabulation was designed to measure the aggregate fulfillment rate for each of the forty separate categories. There was considerably more data in some categories than in others. For better visual interpretation of the results, a three-dimensional diagram is shown in Figure 1. This figure should be interpreted as follows:

- 1) the fulfillment ratio figures were made proportional to the lesser of the two quantities:
 - a) aggregate dollar intentions
 - b) aggregate dollar purchases
- 2) The figures in black indicate the purchase of new machinery

1st quarter	2nd quarter	3rd quarter	4th quarter	quarter not indicated	
^{1.17} 94	^{.67} .85	^{.70}		^{1.44}	very certain
^{1.24} 94	^{.80} .62	^{.56}		^{.74}	quite certain
^{.82} .77	^{.72} .57	^{.17} .26	^{.91} .94	^{.42}	fair chance
^{.24} .75	^{.68} .51	^{.89} .50	^{.55} .69	^{.39} .57	slight chance

Figure 1

"Quantity of data"

UNDER \$10,000

10,000 TO 20,000

20,000 TO 30,000

30 TO 40,000

40 TO 50,000

OVER 50,000

as a proportion of intentions, i.e., the ratio:

$$\frac{\text{aggregate dollar purchases}}{\text{aggregate dollar intentions}}$$

- 3) The figures in red indicate a similar ratio for used machinery.
- 4) The figures for new machinery are shown on the front plane and used machinery on the back plane.

These proportion figures are a measure of the degree to which a respondent in a given category can be expected to fulfill his intentions.

Observations:

- 1) There is a weak positive (direct) relationship between the fulfillment rate and the strength of intent to purchase, i.e., as the strength of intent increases, the fulfillment rate increases. However, the difference appears to break down into only two categories with the very certain and quite certain groups in one category and the fair chance and slight chance in the second category.
- 2) There is a strong negative (inverse) relationship between the fulfillment rate and the length of time between the date of the survey and the date of the intended purchase, i.e., the longer the planning span, the lower the fulfillment rate. This relationship tends to support hypothesis III.
- 3) The fulfillment rate of used machinery is slightly more sensitive to the other two variables than is the fulfillment rate for new machinery. That is, as the degree of

certainty increases and the planning span decreases, the fulfillment rate for used machines increases faster and reaches a higher level than new machines.

Summary:

Although the data is sparse in some of the subcategories, the tabular analyses generally support the hypotheses. For most machines, farmers do an accurate job of projecting the amount of money they will spend on a machine providing they do make a purchase. The indicated strength of intent to purchase and the length of planning span are both indicators of the probability of a purchase being made.

The tabular analyses indicated that all of the intentions variables should be included in the multivariate analyses. There was, also, an indication as to which machines should be considered for further analyses.

CHAPTER VI

MULTIVARIATE ANALYSIS

The tabular analyses indicated that there were a limited number of observations in some of the subcategories when the data were cross-classified. For this reason a decision was made to limit the multivariate analyses to the seven classes of machines with the larger number of purchases. These machines were: (1) baler, (2) bulk milk cooler, (3) field chopper, (4) hay conditioner, (5) tractor, (6) combine or uni-harvester, (7) corn picker or picker sheller. The range of the data and the means for intentions and purchases for these machines is tabulated in table 3.

A single equation model was tried on tractors and found to be inadequate due to the problem of indivisibilities in purchases, i.e., the equation predicted many purchases in the range 0-\$800., yet very few purchases were made in this range since a tractor is not divisible into increments this small.

The model used is essentially a two stage process in which the first stage estimates the probability of purchase and the second stage estimates the size of purchase given that a purchase was made.

Both equations were assumed to be linear functions. The independent variables used were:

A. Income variables.

- 1) Current disposable income defined as total cash receipts

1. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

2. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

3. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

4. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

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15. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

16. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

17. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

18. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

19. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

20. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

21. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

22. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

23. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

24. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

25. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

Table 3. Range of Data.

machine	intentions			purchases		
	low	high	mean	low	high	mean
Baler	400	2000	1080.64	175	2100	947.86
Bulk milk cooler	1000	3500	2499.64	1000	3974	2279.68
Chopper	100	2550	1305.25	300	3259	1205.02
Hay conditioner	100	1100	731.18	107	1200	697.02
Tractor	200	5000	1699.91	97	5746	1949.27
Combine or uni-harvester	300	7000	1743.33	140	8560	2174.88
Corn picker or picker sheller	300	2000	1299.54	102	3200	1018.32

minus total case expenses plus purchases of machinery and improvements. Purchases of machinery and improvements were thus omitted from expenses in order to arrive at the amount of money which was available prior to any purchases of machinery and improvements being made.

- 2) Disposable income lagged one year, i.e., the 1958 disposable income.
- 3) Change in disposable income from the previous year.

B. Type of operation.

It was deemed desirable to take into account the type of farm operation. This was difficult since most of the farms in the sample were dairy farms. However, an arbitrary separation was made with the dairy farms being subdivided. These types of operation were then entered into the equations as a dummy variable system. The criterion for the separation was based on the arbitrary definitions used by the Extension Farm Management staff. The farms were grouped as follows:

Crop Farms: Farms with crops as a primary enterprise were placed in this classification. There were 90 farms in this category.

Atypical Farms: As indicated earlier in the paper, this classification includes those farms which had situations sufficiently peculiar to be excluded from the area summaries used for comparative purposes by the Extension Farm Management Specialists. There were 196 farms in this category.

Grade A Dairy Farms: These farms had grade A milk production as a primary source of income. As a secondary enterprise these farms had either crops or hogs or else no other secondary source of income. There were 459 farms in this category.

Grade B Dairy or Other Livestock: As a primary source of income these farms had one of the following enterprises: (1) Manufacturing milk, (2) Retail milk, (3) Calf production, (4) Beef production, (5) Hog production, (6) Sheep production. There were 86 farms in this category.

Miscellaneous: Most of the farms in this classification had Grade A dairy as a primary enterprise but had something other than hogs or crops as a secondary enterprise and were thus excluded from the Grade A Dairy Classification above. Also, included in this category were those farms with one of the following as a primary source of income: (1) Poultry, (2) Horses, (3) Fur animals, (4) Labor off farm, (5) Timber production. There were 118 farms in this category.

- C. Intention variables. The intention variables (for the machine intended) were broken down into three sets of dummy variables. One set is concerned with whether the intent was to purchase a new or a used machine, another set deals with the strength of intent and the third set considers the length of planning span. These sets overlap with the dollar intentions set for the subset of respondents who did not have purchase plans. This con-

tributed to intercorrelations, especially in the baler equations, since there were no intentions to purchase balers in the third or fourth quarters.

The relationships between these sets can be illustrated as shown in Figure 2. For the three sets of dummy variables, one subset was dropped in each equation to avoid singularity.

D. Intentions to purchase other machines.

- 1) For the probability equations this variable was measured as the number of other machines which farmer t had intentions to purchase. This number included both new and used machinery intentions but was limited to the seven machines used in the multivariate analysis.
- 2) For the equations estimating the size of purchase (henceforth called the expenditure equations) this variable was measured as the number of dollars which farmer t intended to spend on other machines.

The preliminary regression analyses were made on tractors using the single equation model:

$$Y_t = \alpha + \sum \beta_i X_{it} + u_t$$

where Y_t = actual expenditure on tractors by farmer t .

α = constant term.

X_i = independent variables used as regressors.

u_t = population residuals. These arise from the effects

Figure 2

	intent 1st quarter	
	intent 2nd quarter	
	intent 3rd quarter	
	intent 4th quarter	
	intent no quarter	
<u>VERY CERTAIN OF PURCHASE</u>	<u>NO CHANCE OF PURCHASE</u>	\$ EXPENDITURES INDICATED
<u>QUITE CERTAIN OF PURCHASE</u>	<u>NO \$ EXPENDITURES INDICATED</u>	
<u>FAIR CHANCE OF PURCHASE</u>	<u>neither new nor used machine intended</u>	
<u>SLIGHT CHANCE OF PURCHASE</u>	<u>new machine intended</u>	
	<u>used machine intended</u>	

of relevant excluded variables and deviations from linearity.

For the corresponding sample variables we shall use the symbols:

y_t = observed expenditure on tractors by farmer t .

a = constant term.

x_1 = independent variables used as regressors.

e_t = unexplained residuals. These arise from the effects of relevant excluded variables, deviations from linearity and errors of measurement.

The results of the first single equation estimate on tractors was labeled equation 1, and is tabulated in Table 4 in the appendix. The details of subsequent regression analyses are also tabulated in the appendix. A graphical analysis of the unexplained residuals indicated that a single equation model was not a good approximation due to indivisibilities in purchases. The single equation predicted many purchases of less than \$500. In almost all of these cases there was no purchase made since most tractors, even used ones, cost more than this.

In an effort to eliminate this problem a "twin-linear" model was tried. This is the type of model used by Huang, Fisher and Wu which was discussed earlier in the survey of literature. The reasoning underlying this two stage model is that Y can be divided into two parts:

$$Y_t = f(P_t, Q_t)$$

where P_t = the probability that farmer t will make a purchase.

Q_t = the size of farmer t 's purchase providing that he does make a purchase.

Thus, one equation is used to estimate P_t and a second equation is used to estimate Q_t . That is, equations of the form

$$P_t = \alpha_1 + \sum_{i=1}^k \beta_i X_{it} + u_{1t}$$

$$Q_t = \alpha_2 + \sum_{i=1}^k \beta_i X_{it} + u_{2t}$$

An estimate was made for tractors using this model. The observations on P_t were treated as a dummy variable with a value of 1 if the farmer made a purchase and zero if no purchase was made. Since the u_{1t} are not normally distributed, the significance of the results cannot be tested with rigor. However, the t-ratio is still an indication as to the relative importance of different variables. The observations on Q_t were the actual expenditures, thus the significance can be tested rigorously.

If the same variables are used to estimate P and Q , then it can be reasoned that $Y = PQ$ ³⁴. An attempt was made to estimate P and Q using similar independent variables. The details of these equations are tabulated as equations 2 and 3 (tables 5 and 6) in the appendix. These results indicate that the same variable may have considerably different effects on P and Q . For example, a comparison of some of the regression coefficients from the tractor equations follow:

³⁴David S. Haung, op cit, pg 794.

<u>independent variable</u>	<u>P equation</u>		<u>Q equation</u>	
	<u>coeff.</u>	<u>t-ratio</u>	<u>coeff.</u>	<u>t-ratio</u>
intent to buy in 1st quarter	.2230	2.505	-83.84	-0.231
dollar intentions \$(000)	.0393	1.164	\$624.02	4.690
grade B dairy or other livestock type farm	-.0559	-0.981	749.72	2.066

Similar results would be expected from a priori reasoning since, for example, a farmer buying in the second quarter is not likely to spend more per unit than a farmer buying in the first quarter. However, as the planning span increases, the probability of buying as intended is likely to be lower since intervening variables have had more time to operate.

Thus, we can conclude that P and Q depend on different things. However, if we use different independent variables to estimate P and Q can we still say that $Y = PQ$? A rigorous proof of this did not appear in the literature reviewed and could not be located elsewhere. An empirical test was made to determine whether the results of the two methods were identical. This was done by re-estimating P and Q using only those variables which indicated a significant contribution to prediction in the respective equations. (equations 4 and 5, tables 7 and 8 in the appendix). We shall call these estimates P' and Q'.

The altered model then has the form:

$$P'_t = a_1 + \sum_{i=1}^f b_i X_{it} + e_{1t}$$

$$Q'_t = a_2 + \sum_{i=1}^g b_i X_{it} + e_{2t}$$

where some but not all i are identical.

$\hat{Q}_t$ was then multiplied by $\hat{P}_t$ to get the estimated money expenditures which we shall call $\hat{M}_t$. That is,

$$\hat{M}_t = \hat{P}_t \hat{Q}_t$$

$\hat{M}_t$ was then entered into a recursive equation as an independent variable. That is:

$$y_t = a_1 + b_1 \hat{M}_t + e_t$$

If it is true that $Y_t = P_t Q_t$, then y_t should equal $\hat{M}_t + e_t$, that is, a_1 should equal zero and b_1 should equal 1. The actual results were:

$$a_1 = \$1.45$$

$$b_1 = 1.0063$$

For this paper, it is assumed that these small discrepancies are due to rounding error and that we can conclude that $Y_t = P_t Q_t$.

Using this modified model, estimates of $\hat{P}_t$ and $\hat{Q}_t$ were made for the other six machines considered in the analysis. The details of these analyses are tabulated in the appendix.

Summary:

A single equation regression analysis was made on tractors and found to be weak due to indivisibilities in purchases. A 'twin-linear' model was then tried and found to be more appropriate (for explanatory purposes) since the probability of a purchase being made and the size of purchase were found to be dependent, at least in part, on different variables. This development led to the question, "if the probability of purchase and the size of purchase are estimated using different variables, can these two figures be multiplied to obtain an estimate of expenditures?" An empirical check indicated an affirmative answer to this question.

CHAPTER VII

CONCLUSIONS

In interpreting the regression coefficients it is helpful to keep in mind that there is overlap in the intentions variables. Thus an "intender" will "accumulate" predicted purchases from all four of the intentions variables:

- 1) intent to buy new or used machine
- 2) amount intended to spend in dollars
- 3) strength of intent to buy
- 4) length of planning span

For this reason, an interpretation of the coefficients from the viewpoint of prediction should consider the coefficients within their matrix rather than individually. For example, suppose we wish to predict the amount of money farmer t will spend providing he buys a new tractor. Reference to equation 5 (table 8) indicates a regression coefficient for this variable of \$660.88. In comparison with farmer z who did not intend to purchase, it would seem that farmer t is likely to spend less than farmer z. However, we must also consider that farmer t also indicated the amount of money he intended to spend. Suppose this amount was \$2000. Then from the coefficient for this variable we add $(2)(\$602.90) = \1205.80 . Thus these two intentions variables taken together give predicted purchases of \$544.92 more for farmer t than for farmer z who had zero for both variables.

Although this thesis does not develop a predicting equation, this is the manner in which such an equation may be utilized for forecasting purposes. A comparison of the effects of the variables follows:

INCOME LEVEL

The disposable income lagged one year (1958 income) was entered into the probability equations for the six machinery categories excluding the category corn pickers and picker shellers. The 1959 or current disposable income was used as a regressor in this equation. The regression coefficients for this variable in the different equations follows: (The coefficient indicates the change in probability of purchase per \$1,000 change in income level).

	<u>regression coefficient</u>	<u>t-ratio</u>
balers (Eqn. 7, Table 10)	-.0001	-0.04
bulk tanks (Eqn. 8, Table 11)	-.0002	-0.12
choppers (Eqn. 9, Table 12)	.0022	1.37
hay conditioners (Eqn. 12, Table 15)	.0066	3.18
tractors (Eqn. 4, Table 7)	.0069	2.55
combines and uni-harvesters (Eqn. 11, Table 14)	.0034	2.18
corn pickers and picker shellers (1959 disposable income) (Eqn. 10, Table 13)	.0049	3.20

These results indicate that income level has a different effect on different machines. For balers, bulk tanks and choppers, the regression coefficients were either small or negative and insignificant. For the remainder of the machines the coefficients were small but would be

significant³⁵ if the t-test were applicable.

The tractor and baler equations were re-estimated using current rather than lagged income. (Equations 19 and 21).

The regression coefficients were:

	<u>coefficient</u>	<u>t-ratio</u>
tractors	.0066	2.42
balers	-.0000	-0.02

These results indicate that there is no significant difference in the predictive power of current vs. lagged income.

Income level was included as a variable in five of the equations estimating expenditures.³⁶ The regression coefficients follow: (The coefficient indicates the number of dollars change in purchases per \$1,000 change in income level).

	<u>regression coefficient</u>	<u>t-ratio</u>
bulk tanks (Eqn. 14, Table 17)	\$ 10.78	0.81
choppers (Eqn. 15, Table 18)	25.09	2.02
tractors (Eqn. 5, Table 21)	18.69	1.29
combines and uni-harvesters (Eqn. 16, Table 19)	135.49	3.47
corn pickers & picker shellers (1959 income, Eqn. 17, Table 20)	17.82	1.11

³⁵For this thesis, a 5% level of significance is used with a one tailed t-test.

³⁶See page 46 for a description of this variable. Due to a misplaced IBM card, there was a minor error in the first regression analyses estimating expenditures. When these equations were re-estimated, most of those variables which were not directly affected by the error and were not significant were omitted from the second estimate. (Equations 5 and 13-21).

These results indicate that income level has a sizeable influence only on combines and uni-harvesters. The coefficient for choppers is small but significant. All of the coefficients are positive indicating that large farms make larger purchases than small farms. There is, also, an indication that different machines are affected differently. Thus, it may be dangerous to infer from one machine to another.

CHANGE IN INCOME

This variable is the 1959 disposable income minus the 1958 disposable income. The regression coefficients for the probability equations follow: (The coefficient indicates the change in probability of purchase per \$1,000 change in disposable income).

	<u>regression coefficients</u>	<u>t-ratio</u>
tractors (Eqn. 4, Table 7)	.0046	1.57
tractors (Eqn. 9, Table 22)	-.0018	-0.59
balers (Eqn. 7, Table 10)	-.0003	-0.13
bulk tanks (Eqn. 8, Table 11)	-.0007	-0.41
choppers (Eqn. 9, Table 12)	.0012	0.72
hay conditioners (Eqn. 12, Table 15)	.0002	0.09
combines and uni-harvesters (Eqn. 11, Table 14)	.0046	2.76
corn pickers & picker shellers (Eqn. 10, Table 13)	-.0039	-2.16

These results did not support the^apriori belief that income change is an important variable. However, there was a fairly high intercorrelation between income change and income level: .4963 with 1958 income and -.4031 with 1959 income.

Change in income was included as a variable in only one of the expenditure equations, the estimate for combines and uni-harvesters. The coefficient in this equation was \$122.29 with a t-ratio of 3.37.

INTENTIONS TO PURCHASE (measured in dollars)

This variable was entered into the expenditure equations. The regression coefficients follow; (The coefficient indicates the number of dollars change in purchases per \$1,000 change in intentions to purchase.

	<u>regression coefficient</u>	<u>t-ratio</u>
tractors (Eqn. 5, Table 8)	\$602.90	4.86
balers (Eqn. 13, Table 16)	980.82	4.19
bulk tanks (Eqn. 14, Table 17)	270.49	1.92
choppers (Eqn. 15, Table 18)	351.14	1.29
combines (Eqn. 16, Table 19)	747.24	3.21
corn pickers & picker shellers (Eqn. 17, Table 20)	93.24	0.48
hay conditioners (Eqn. 18, Table 21)	251.28	1.61

The results indicate that this variable is of considerable importance. The coefficients are large and significant or nearly significant in five of the seven equations. The lack of significance in the corn picker equation can probably be attributed to the longer length of planning span.

The sum of dollar intentions to purchase machines other than the one intended was entered as a variable in the tractor equation. The

coefficient was \$125.90 with a t-ratio of 1.49.

The number of other machines intended was entered as a variable in six of the probability equations. The regression coefficients were:

	<u>regression coefficients</u>	<u>t-ratio</u>
tractors (Eqn. 19, Table 22)	.0395	1.47
balers (Eqn. 7, Table 10)	-.0001	-0.01
bulk tanks (Eqn. 8, Table 11)	.0135	1.15
choppers (Eqn. 9, Table 12)	.0057	0.47
hay conditioners (Eqn. 12, Table 15)	.0054	0.35
combines & uni-harvesters (Eqn. 11 Table 14)	.0065	0.55

The positive (generally) coefficients are an indication that farmers do have a "machinery budget". That is, if a farmer has intentions to purchase machine X, then he is more likely to purchase machine Y than a farmer who has no intentions to purchase any machine. However, the relationship is too weak and insignificant to be of much value in prediction.

TYPE OF OPERATION

The type of farm was divided into five categories and entered into the equations in order to remove the effects of this variable. As was expected a priori, the type of operation had different effects on different machines.

INTENTION TO PURCHASE NEW OR USED MACHINE

These variables were entered into the equations as dummy variables.

The coefficients for the probability equations were as follows:

		<u>regression coefficient</u>	<u>t-ratio</u>
tractors (Eqn. 4, Table 7)	new	.2015	2.86
	used	.1278	1.90
balers (Eqn. 7, Table 10)	new	.6782	7.13
	used	.6892	6.32
bulk tanks (Eqn. 8, Table 11)	new	.1892	2.80
choppers (Eqn. 9, Table 12)	new	.0988	1.54
	used	.1405	1.74
hay conditioners (Eqn. 12, Table 15)	new	.3100	3.37
combines (Eqn. 11, Table 14)	new	.5637	7.23
	used	.6343	7.01
corn pickers & picker shellers (Eqn. 10, Table 13)	new	-.0790	-0.74

Most of the coefficients were very high and would be significant if the t-test were applicable. This is an indication that this variable has considerable predictive power. However, intercorrelations may be affecting these coefficients since the sub-category, "intent to purchase new or used" would also have a strength of intent, quarter of intended purchase and size of intended purchase. The highest intercorrelation was .70 between "fair chance strength of intent" and "intent to buy new" in the hay conditioner equation. Other intercorrelations were less than .60 with this variable.

Stated intention to purchase a new or used machine was also used as a variable in the expenditure equations. The coefficients follow:

		<u>regression coefficient</u>	<u>t-ratio</u>
balers (Eqn. 13, Table 16)	new	\$-826.79	-2.61
	used	-865.03	-3.56
bulk tanks (Eqn. 14, Table 17)	new	-308.22	-0.90
	used	-426.59	-1.16
choppers (Eqn. 15, Table 18)	new	- 64.46	-0.16
	used	-426.59	-1.16
hay conditioners (Eqn. 18, Table 21)	new	-119.88	-1.01
	used	-904.85	-4.04
tractors (Eqn. 5, Table 8)	new	-660.88	-2.04
	used	-929.69	-1.55
combines and uni-harvesters (Eqn. 16, Table 19)	new	-255.35	-0.34
	used	-929.69	-1.55
corn pickers & picker shellers (Eqn. 17, Table 20)	new	-266.67	-0.99

This variable had considerably different effects on the probability than on the expenditure equations. The coefficients in the probability equations were large and positive.

STRENGTH OF INTENT

The questionnaire of intentions asked the respondent to indicate the degree of certainty which he attached to his purchase plans.

These responses were entered into the equations as dummy variables.

The coefficients for the probability equations follow:

	<u>regression coefficient</u>	<u>t-ratio</u>	<u># of observations</u>
balers (equation 7)			
very certain	-.0144	-0.10	7
quite certain	.0662	0.56	12
fair chance	-.1702	-1.45	14
bulk tank (equation 8)			
very certain	.4383	3.31	7
quite certain	.1436	1.34	12
fair chance	.0104	0.10	9
choppers (equation 9)			
very certain	.8856	6.01	4
quite certain	.5498	6.87	19
fair chance	.1701	2.30	26
hay conditioners (equation 12)			
very certain	.5606	2.87	3
quite certain	.0749	0.56	8
fair chance	.1282	1.23	23
tractors (equation 2)			
very certain	.1573	1.51	20
quite certain	.1757	2.14	38
fair chance	.0239	0.40	93
combines (equation 11)			
very certain	.2558	1.61	3
quite certain	.4820	4.26	8
fair chance	.0399	0.44	28
corn pickers & picker shellers (equation 10)			
very certain or quite certain	.7961	7.66	14
fair chance	.4264	4.11	12

The results are somewhat erratic, probably due to the small number

of observations in some categories and to the intercorrelations with other variables. The highest intercorrelation was .70 between "fair chance" and "intent to purchase new" hay conditioner. The second highest was .61 between "fair chance" and intent to purchase combine in the second quarter. However, the coefficients for the very certain and quite certain categories are generally large and would be significant in eight out of thirteen cases if the t-test were applicable.

LENGTH OF PLANNING SPAN

The farmers were asked to indicate the quarter of the year in which they planned to make their purchases. This variable was entered into the equations as a dummy variable system. The coefficient for the fourth quarter was negative and insignificant in the tractor probability equation. Since there was a small number of observations in this sub-category in the other equations, a decision was made to combine the third and fourth quarter observations with the category which did not have intentions. The coefficients were as follows:

	<u>regression coefficient</u>	<u>t-ratio</u>	<u># of observations</u>
tractors (equation 2)			
first quarter	.2230	2.51	87
second quarter	.0673	0.79	105
third quarter	.1066	0.98	25
fourth quarter	-.0978	-0.61	8
balers (equation 21)			
first quarter	-.1401	-0.68	10
second quarter	-.3273	-1.69	30
third quarter			0
fourth quarter			0
bulk tanks (equation 8)			
first or second quarter	.2312	2.27	18
third quarter			8
fourth quarter			5
choppers (equation 20)			
first quarter	-.1058	-1.03	11
second quarter	.2144	2.76	41
third quarter			6
fourth quarter			1
combines (equation 11)			
first quarter	-.1541	-1.56	13
second quarter	-.3753	-4.23	24
third quarter			9
fourth quarter			1

It is difficult to explain the large negative coefficients for the machines other than tractors. A priori reasoning and the results of the tabular analyses indicate a relationship similar to what was obtained in the tractor equations. A possible explanation is that the effects of these variables is being captured by those other variables which are highly intercorrelated. This is apparent in the baler probability equations. (equations 7 and 21) The intercorrelations for the dummy intentions variables in these equations is shown in Figure 3.

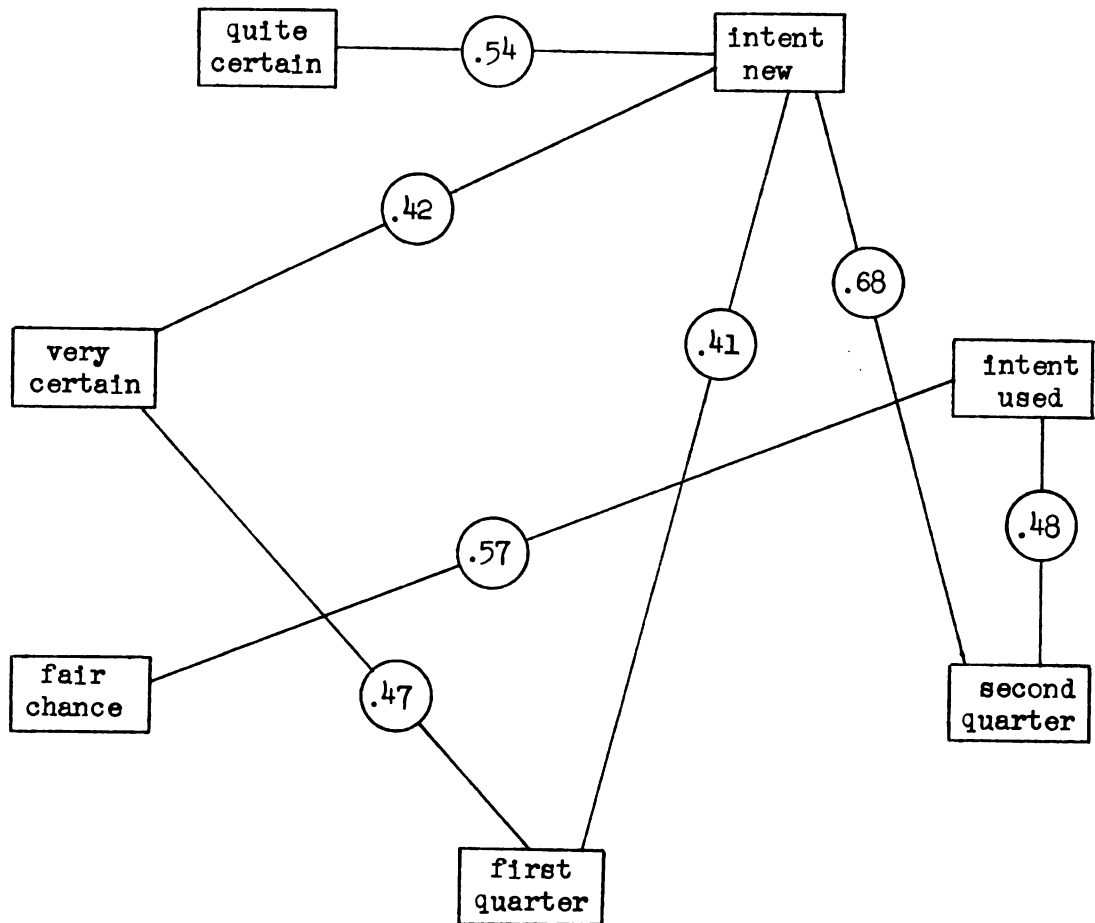


Figure 3

intercorrelations exceeding .40

A comparison of the coefficients in these two equations follows:

	<u>regression coefficients</u>	
	<u>eqn. 7</u>	<u>eqn. 21</u>
intent to buy new baler	.6782	.9816
intent to buy used baler	.6891	.9060
very certain intent to buy	-.0144	- -
quite certain intent to buy	.0662	- -
fair chance intent to buy	-.1702	- -
intent to buy 1st quarter	.2055	-.1401
intent to buy 2nd quarter	- -	-.3273
standard error of estimate	.2645	.2639
coefficient of determination	.2242	.2280

The negligible differences in the standard error of estimate and the coefficient of determination is an indication that the questionnaire could be shortened without appreciably affecting the results.

COEFFICIENTS OF DETERMINATION

A comparison of the standard errors of estimate and the coefficients of determination follow:

	$\overline{R}^2$	S_u
Probability equations:		
tractors, equation 2 (table 5)	.1618	.3981
tractors, equation 4 (table 7)	.1666	.3970
tractors, equation 19 (table 22)	.1664	.3970
balers, equation 7 (table 10)	.2242	.2645
balers, equation 21 (table 24)	.2279	.2639
bulk tanks, equation 8 (table 11)	.1438	.2271
choppers, equation 9 (table 12)	.1698	.2319
choppers, equation 20 (table 23)	.1728	.2315
hay conditioners, equation 12 (table 15)	.1136	.2979
combines & uni-harvesters, equation 11 (table 14)	.2035	.2255
corn pickers & picker shellers equation 10 (table 13)	.1589	.2284
Expenditure equations:		
tractors, equation 3 (table 6)	.1491	\$1174.87
tractors, equation 5 (table 8)	.1679	1163.26
balers, equation 13 (table 16)	.2422	442.86
bulk tanks, equation 14 (table 17)	.0456	623.79
choppers, equation 15 (table 18)	.1590	617.04
hay conditioners, equation 18 (table 21)	.0665	198.82
combines & uni-harvesters, equation 16 (table 19)	.4608	1521.85
corn pickers and picker shellers, equation 17 (table 20)	.0143	628.29

The results indicate less variation between machines in the probability equations. Part of the low coefficients for the hay conditioner equations can probably be attributed to the adoption of new technology that was not contemplated at the time of the survey of intentions. The low coefficients for the bulk tank equations are likely due partially to the abnormal pressure exerted by the dairy plants in 1959. The low coefficient in the corn picker expenditure equation may be partially due to the longer length of planning span required for this machine.

Comparing the probability and expenditure equations for the remaining machines, i.e., tractors, balers, choppers, and combines, there is an indication that there is more variation in the expenditure equations than in the probability equations. Also, the coefficients for the expenditure equations are slightly higher than for the probability equations. This implies that the size of purchase can be predicted with more accuracy than the probability of purchase. For those machines for which more than one equation was estimated using different variables, there was a very small difference in either the coefficient of determination or the standard error of estimate.

General Conclusions

There is considerable evidence to support the main hypothesis that intentions can make a significant contribution to prediction of purchases.

The level of income was found to be of less importance than was expected a priori. The effects of current and lagged income was found to be essentially the same. The change in income from the pre-

vious year had considerably less importance than other studies have indicated.

The same variable was often found to have significantly different effects on the probability of purchase than on the size of purchase. Also, it was found that a given variable often has significantly different effects on different machines, thus it is dangerous to infer from one machine to another.

Both the tabular and multivariate analyses indicated that purchase plans of longer than six months duration are of questionable value for prediction.

SUGGESTIONS FOR FURTHER STUDY

In order for this study to be useful in predictive work the following conditions are necessary:

- 1) There must be a consistent relation between the behavior of the panel and the behavior of the population.
- 2) There must be a consistent relationship between the proportion of purchasers who have intentions and those who do not.

Additional research would determine whether or not these relationships are consistent.

Further research is also needed to determine how best to fit the results of this study into a model built specifically for forecasting purposes. Although this thesis is a cross section study, the "plans to buy" project collected data over a three year period. Thus, the coefficients determined in this study for 1959 could be

utilized with the 1960 and 1961 intentions data to make predictions for these years. The accuracy of these predictions could then be determined by examining the record of actual purchases from the mail-in farm account records for these years.

High intercorrelations between the dummy intentions variables indicate that the survey of intentions could be shortened somewhat without reducing the coefficient of determination significantly. The predictive power might be increased by replacing some of these variables with questions concerning attitudes rather than intentions.

For the twin-linear model used in this paper to be justified for predictive work, it should have superior predictive power over a single equation model. An empirical check was made to determine if this were true. This was done by calculating $\hat{M}$ for tractors by multiplying equation 4 by equation 5, i.e., $\hat{M}_t = \hat{P}_t \hat{Q}_t$. $\hat{M}$ was then entered into the recursive equation $y_t = a + b_1 \hat{M}_t + e_t$. Since the constant term is near zero (\$1.45), the coefficient is near one (1.006), the e term represents the error term for the twin-linear model. Also, the R^2 for this equation is the coefficient of determination for the model. R^2 was then adjusted for degrees of freedom by counting the number of variables used in the two equations together.

Then an estimate was made using a single equation model with the same variables as was used in the twin-linear model. A comparison of the coefficients of determination follows:

	<u>$\bar{R}^2$</u>	<u>S_e</u>
twin-linear model (Eqn. 22, Table 25)	.1778	\$957.95
single equation model (Eqn. 6, Table 9)	.1794	962.63

The results indicate that the twin-linear model is not superior in predictive ability to a single equation model. Further research could determine if this is true for all of the machines.

In a few of the equations, the variable "intentions to purchase machines other than the one being estimated" was entered into the equation. For this study, the category "other machines" included only the six machinery categories not including the machine being estimated. The coefficient for this variable might have been higher if all intentions to purchase any machine had been included. Further research might also include intentions to invest in improvements as well as other machinery.

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A P P E N D I X

Description of Variables used in the Multivariate Analyses

$\hat{Y}$ - Estimated expenditures (using a single equation model).

$\hat{M}$ - Estimated expenditures (using twin-linear model).

$\hat{P}$ - Estimated probability of purchase being made.

$\hat{Q}$ - Estimated size of purchase given that a purchase was made.

1958 income \$(000) - The disposable income lagged one year. This figure is computed as: Total cash receipts - total cash expenses + purchases of machinery and improvements - sales of machinery and improvements. The regression coefficients are expressed per \$1,000 of income.

1959 income \$(000) - The current disposable income. The regression coefficients are expressed per \$1,000 of income.

change in income \$(000) - 1959 income minus 1958 income as they are defined above. The regression coefficients are expressed per \$1,000 change in income.

\$ intent, this machine (000) - The number of dollars the farmer stated that he intended to spend on the machine in question, i.e., the machine which is being treated as a dependent variable. The regression coefficients are expressed per \$1,000 of intentions.

\$ intentions, other machines - The number of dollars the farmer intended to spend on machines other than the one being treated as a dependent variable. The regression coefficients are expressed per \$1,000 of other intentions.

atypical farm - Farms which were excluded from the area summaries used for comparative purposes by the Extension Farm Management

Specialists.

B dairy or other livestock - Farms on which the primary source of income came from (1) Manufacturing milk, (2) Retail milk, (3) Calf production, (4) Beef production, (5) Hog production, and/or (6) Sheep production.

of intentions, other machines - Of the seven major machines analyzed, this figure indicates the number of machines which the farmer intended to buy excluding the machine being analyzed.

KEY TO SYMBOLS AND ABBREVIATIONS

P equation - An equation estimating the probability of a purchase being made.

Q equation - An equation estimating the size of a purchase given that a purchase is made.

coef - coefficient

corr - correlation

t-ratio - The regression coefficient divided by its standard error.

S_e - standard error of estimate

n - number of observations

df - degrees of freedom

$\bar{R}^2$ - coefficient of multiple determination adjusted for degrees of freedom.

Table 4. Equation 1: Tractor Expenditures

$$\hat{Y} = a + \sum b_1 x_1$$

$\bar{R}^2 = .3199$ $S_e = \$876.70$ $n = 933$ $df = 914$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	\$ -18.83	93.74	- .2009	
1958 income \$(000)	13.58	6.14	2.2125	.0724
change in income \$(000)	9.93	6.51	1.5254	.0500
\$ intent, this machine (000)	419.86	74.37	5.6459	.1821
\$ intentions, other machines	118.33	35.79	3.3058	.1078
intent to buy new machine	11.83	213.17	.0555	.0018
intent to buy used machine	-86.76	168.79	-.5140	-.0169
very certain intent to buy	325.81	229.82	1.4177	.0465
quite certain intent to buy	381.63	181.01	2.1083	.0690
fair chance intent to buy	4.31	134.73	.0320	.0011
*purchased without intent	1741.62	124.01	14.0441	.4185
intent to buy 1st quarter	467.37	196.05	2.3839	.0780
intent to buy 2nd quarter	63.99	188.33	.3398	.0112

See page 78 for a detailed description of the variables.

*This variable includes that subcategory who made a purchase but did not register an intention of purchasing. It was used in the tabular analyses and was erroneously included in this regression analysis. It was excluded in subsequent analyses since the forecaster has no prior knowledge of which observations will fall into this subcategory.

Equation 1 continued

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
intent to buy 3rd quarter	-18.26	238.72	- .0765	-.0025
intent to buy 4th quarter	-363.84	355.53	-1.0234	-.0336
atypical farm	-16.85	103.15	- .1635	-.0054
grade A dairy farm	57.77	91.88	.6288	.0206
B dairy or other livestock	54.77	125.65	.4359	.0143
crop farm	-42.41	125.51	- .3379	-.0111

Table 5. Equation 2: Tractor Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1618$ $S_e = .3981$ $n = 934$ $n = 916$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.1241	.0423	2.9361	
1958 income \$(000)	.0065	.0028	2.3559	.0770
change in income \$(000)	.0046	.0030	1.5467	.0506
\$ intent, this machine (000)	.0393	.0338	1.1635	.0381
\$ intentions, other machines	.0134	.0162	.8311	.0272
intent to buy new machine	.1416	.0968	1.4627	.0479
intent to buy used machine	.1201	.0766	1.5687	.0513
very certain intent to buy	.1573	.1044	1.5073	.0493
quite certain intent to buy	.1757	.0822	2.1381	.0699
fair chance intent to buy	.0239	.0612	.3908	.0128
intent to buy 1st quarter	.2230	.0890	2.5051	.0818
intent to buy 2nd quarter	.0673	.0855	.7870	.0258
intent to buy 3rd quarter	.1066	.1084	.9838	.0322
intent to buy 4th quarter	-.0978	.1614	-.6060	-.0199
atypical farm	-.0727	.0467	-1.5592	-.0510
grade A dairy farm	.0141	.0416	.3396	.0111
B dairy or other livestock	-.0559	.0570	-.9812	-.0321
crop farm	-.0507	.0568	-.8924	-.0292

Table 6. Equation 3: Tractor Expenditures

$$\hat{Q} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1491$ $S_e = 1174.87$ $n = 225$ $df = 209$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	1314.50	266.57	4.9312	
1958 income \$(000)	23.42	15.09	1.5516	.1031
change in income \$(000)	13.83	15.82	.8744	.0583
\$ intent, this machine (000)	624.02	133.04	4.6904	.2991
\$ intentions, other machines	113.15	86.46	1.3086	.0871
intent to buy new machine	-577.59	396.11	-1.4581	-.0970
intent to buy used machine	-788.30	335.60	-2.3489	-.1551
very certain intent to buy	20.90	393.40	.0531	.0036
Quite certain intent to buy	17.32	285.93	.0606	.0041
intent to buy 1st quarter	- 83.84	363.11	- .2309	-.0154
intent to buy 2nd quarter	-167.12	348.46	- .4796	-.0320
intent to buy 3rd quarter	-458.02	450.32	-1.0171	-.0678
atypical farm	518.85	299.82	1.7306	.1149
grade A dairy farm	186.77	244.50	.7639	.0510
B dairy or other livestock	749.72	362.92	2.0658	.1367
crop farm	5.94	332.59	.0179	.0012

Table 7. Equation 4: Tractor Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1666$ $S_e = .3970$ $n = 934$ $df = 924$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.1393	.0275	5.0589	
1958 income \$(000)	.0069	.0027	2.5535	.0830
change in income \$(000)	.0046	.0029	1.5668	.0511
intent to buy new machine	.2015	.0706	2.8555	.0928
intent to buy used machine	.1278	.0672	1.9014	.0619
very or quite certain intent	.1646	.0646	2.5469	.0828
intent to buy 1st quarter	.2694	.0769	3.5049	.1136
2nd or 3rd quarter intent	.1178	.0697	1.6914	.0551
B dairy or other livestock) crop farm)	-.0656	.0346	-1.8983	-.0618
atypical farm	-.0867	.0331	-2.6187	-.0852

Table 8. Equation 5: Tractor Expenditures

$$\hat{Q} = a + \sum b_i x_i$$

$\bar{R}^2 = .1679$ $S_e = 1163.26$ $n = 225$ $df = 217$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	1493.64	170.63	8.7539	
1958 income	18.69	14.52	1.2871	.0842
\$ intent, this machine (000)	602.90	123.97	4.8633	.3042
\$ intentions, other machines	125.90	84.53	1.4895	.0973
intent to buy new machine	-660.88	324.66	-2.0356	-.1325
intent to buy used machine	-904.85	224.23	-4.0354	-.2561
atypical farm	373.04	221.39	1.6850	.1099
B dairy or other livestock	604.21	296.89	2.0351	.1324

Table 9. Equation 6: Tractor Expenditures

$$\hat{Y} = a + \sum b_1 x_1$$

$R^2 = .1794$ $S_e = 962.63$ $n = 934$ $df = 921$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	166.12	68.20	2.4357	
1958 income \$(000)	16.78	6.69	2.5083	.0817
change in income \$(000)	13.34	7.11	1.8780	.0613
\$ intent, this machine (000)	389.91	80.52	4.8421	.1563
\$ intentions, other machines	64.20	38.93	1.6490	.0538
intent to buy new machine	- 97.24	227.66	- .4271	-.0140
intent to buy used machine	-243.95	171.59	-1.4217	-.0464
very or quite certain intent	365.13	158.35	2.3058	.0752
intent to buy 1st quarter	516.21	189.15	2.7291	.0889
2nd or 3rd quarter intent	92.83	171.12	.5425	.0177
atypical farm	- 73.73	80.47	- .9163	-.0299
B dairy or other livestock	124.21	148.13	.8385	.0274
crop farm	-140.49	110.87	-1.2671	-.0414

Table 10. Equation 7: Baler Probability

$$\hat{P} = a + \sum b_i x_i$$

$\bar{R}^2 = .2242$ $S_e = .2645$ $n = 947$ $df = 933$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0499	.0282	1.7663	
1958 income \$(000)	-.0001	.0019	-.0423	-.0014
change in income \$(000)	-.0003	.0020	-.1285	-.0042
intent to buy new machine	.6782	.0951	7.1319	.2271
intent to buy used machine	.6891	.1091	6.3157	.2023
very certain intent to buy	-.0144	.1431	-.1009	-.0033
quite certain intent to buy	.0662	.1181	.5604	.0183
fair chance intent to buy	.1702	.1173	1.4510	-.0474
intent to buy 1st quarter	.2055	.1054	1.9489	.0636
atypical farm	.0175	.0310	.5631	.0184
grade A dairy farm	.0341	.0275	1.2427	.0406
B dairy or other livestock	.0068	.0377	.1799	.0059
crop farm	-.0032	.0376	-.0845	-.0028
# of intentions, other mach ^g	-.0001	.0136	-.0079	-.0003

Table 11. Equation 8: Bulk Milk Cooler Probability $\hat{P} = a + \sum b_i x_i$

$\bar{R}^2 = .1438$ $S_e = .2271$ $n = 949$ $df = 936$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0697	.0241	2.8948	
1958 income \$(000)	-.0002	.0016	- .1158	-.0038
change in income \$(000)	-.0007	.0017	- .4081	-.0133
intent to buy new machine	.1892	.0677	2.7965	.0910
very certain intent to buy	.4383	.1324	3.3113	.1076
quite certain intent to buy	.1436	.1068	1.3448	.0439
fair chance intent to buy	.0104	.1046	.0999	.0033
1st or 2nd quarter intent	.2312	.1019	2.2686	.0740
atypical farm	-.0369	.0266	-1.3855	-.0452
grade A dairy farm	-.0139	.0236	- .5884	-.0192
B dairy or other livestock	-.0760	.0323	-2.3503	-.0766
crop farm	-.0505	.0322	-1.5711	-.0513
# of intentions, other mach. ^g	.0135	.0117	1.1544	.0377

Table 12. Equation 9: Chopper Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1698$ $S_e = .2319$ $n = 948$ $df = 934$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0497	.0247	2.0142	
1958 income \$(000)	.0022	.0016	1.3662	.0446
change in income \$(000)	.0012	.0017	.7249	.0237
intent to buy new machine	.0988	.0642	1.5384	.0513
intent to buy used machine	.1405	.0806	1.7439	.0569
very certain intent to buy	.8856	.1474	6.0088	.1928
quite certain intent to buy	.5498	.0801	6.8668	.2191
fair chance intent to buy	.1701	.0739	2.3014	.0751
intent to buy 1st quarter	-.3509	.0868	-4.0432	-.1811
atypical farm	-.0259	.0272	-.9513	-.0311
grade A dairy farm	-.0151	.0241	-.6265	-.0205
B dairy or other livestock	-.0521	.0331	-1.5731	-.0514
crop farm	-.0449	.0329	-1.3626	-.0445
# of intentions, other mach ^s	.0057	.0121	.4677	.0153

Table 13. Equation 10: Corn Picker Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1589$ $S_e = .2284$ $n = 949$ $df = 942$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0050	.0150	.3304	
1959 income \$(000)	.0049	.0015	3.1984	.1037
change in income \$(000)	-.0038	.0018	-2.1597	-.0702
very or quite certain intent	.7961	.1039	7.6619	.2422
fair chance intent to buy	.4264	.1038	4.1067	.1326
intent to buy new machine	-.0790	.1066	-.7412	-.0241
grade A dairy farm	.0194	.0150	1.2962	.0422

Table 14. Equation 11: Combine Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .2035$ $S_e = .2255$ $n = 946$ $df = 931$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	-.0175	.0240	- .7323	
1958 income \$(000)	.0034	.0016	2.1787	.0711
change in income \$(000)	.0046	.0017	2.7591	.0899
intent to buy new machine	.5637	.0779	7.2319	.2303
intent to buy used machine	.6344	.0904	7.0136	.2237
very certain intent to buy	.2558	.1592	1.6062	.0525
quite certain intent to buy	.4820	.1132	4.2591	.1380
fair chance intent to buy	.0399	.0905	.4408	.0144
intent to buy 1st quarter	-.1541	.0990	-1.5566	-.0509
intent to buy 2nd quarter	-.3753	.0886	-4.2339	-.1372
atypical farm	.0454	.0265	1.7143	.0560
grade A dairy farm	.0288	.0234	1.2296	.0402
B dairy or other livestock	.0371	.0324	1.1450	.0374
crop farm	.0513	.0322	1.5932	.0521
# of intentions, other mach ^s	.0065	.0118	.5528	.0181

Table 15. Equation 12: Hay Conditioner Probability $\hat{P} = a + \sum b_i x_i$

$\bar{R}^2 = .1136$ $S_e = .2979$ $n = 949$ $df = 937$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0349	.0317	1.1025	
1958 income \$(000)	.0066	.0021	3.1806	.1034
change in income \$(000)	.0002	.0022	.0874	.0029
intent to buy new machine	.3100	.0921	3.3669	.1093
very certain intent to buy	.5606	.1952	2.8719	.0934
quite certain intent to buy	.0749	.1331	.5629	.0184
fair chance intent to buy	.1282	.1045	1.2268	.0401
atypical farm	-.0270	.0349	-.7727	-.0252
grade A dairy farm	.0483	.0309	1.5636	.0510
B dairy or other livestock	-.0202	.0425	-.4754	-.0155
crop farm	-.0759	.0424	-1.7919	-.0584
# of intentions, other mach. ^s	.0054	.0154	.3520	.0115

Table 16. Equation 13: Baler Expenditures

$$\hat{Q} = a + \sum b_1 x_1$$

$\bar{R}^2 = .2422$ $S_e = 442.86$ $n = 93$ $df = 87$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	969.52	84.73	11.4423	
\$ intent, this machine (000)	980.83	233.97	4.1921	.4061
intent to buy new machine	-826.79	316.28	-2.6141	-.2670
intent to buy used machine	-865.03	242.84	-3.5622	-.3533
grade A dairy farm	-157.59	99.88	-1.5778	-.1650
B dairy or other livestock	-223.53	178.56	-1.2519	-.1315

Table 17. Equation 14: Bulk Milk Cooler Expenditures

$$\hat{Q} = a + \sum b_i x_i$$

$$\bar{R}^2 = .0456 \quad S_e = 623.79 \quad n = 61 \quad df = 56$$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	2191.25	163.40	13.4100	
1958 income \$(000)	10.78	13.26	.8130	.1080
\$ intent, this machine (000)	270.49	140.55	1.9246	.2491
intent to buy new machine	-308.22	344.36	- .8951	-.1188
grade A dairy farm	-160.43	173.01	- .9272	-.1230

Table 18. Equation 15: Chopper Expenditures

$$\hat{Q} = a + \sum b_i x_i$$

$\bar{R}^2 = .1590$ $S_e = 617.04$ $n = 65$ $df = 59$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	865.97	144.06	6.0113	
1958 income \$(000)	25.09	12.44	2.0165	.2519
\$ intent, this machine (000)	351.14	272.29	1.2896	.1642
intent to buy new machine	- 64.46	397.18	- .1623	-.0210
intent to buy used machine	-426.59	366.92	-1.1626	-.1484
B dairy or other livestock	514.02	404.48	1.2708	.1619

Table 19. Equation 16: Combine Expenditures

$$\hat{Q} = a + \sum b_1 x_1$$

$$R^2 = .4608$$

$$S_e = 1521.85$$

$$n = 62$$

$$df = 55$$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	448.98	421.23	1.0659	
1958 income \$(000)	135.49	39.04	3.4705	.4147
change in income \$(000)	122.29	36.32	3.3674	.4044
\$ intent, this machine (000)	747.24	232.80	3.2099	.3884
intent to buy new machine	-255.35	761.33	- .3354	-.0440
intent to buy used machine	-929.69	598.30	-1.5539	-.1999
crop farm	399.68	555.21	.7199	.0941

Table 20. Equation 17: Corn Picker Expenditures $\hat{Q} = a + \sum b_1 x_1$

$R^2 = .0143$ $S_e = 628.29$ $n = 63$ $df = 58$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	853.06	180.81	4.7180	
1959 income \$(000)	17.82	16.05	1.1103	.1443
\$ intent, this machine (000)	93.24	195.59	.4767	.0625
intent to buy new machine	-266.67	268.98	- .9914	-.1291
crop farm	443.34	380.68	1.1646	.1512

Table 21. Equation 18: Hay Conditioner Expenditures

$$\hat{Q} = a + \sum b_i x_i$$

$$R^2 = .0665 \quad S_e = 198.82 \quad n = 107 \quad df = 103$$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	691.13	21.91	31.5504	
\$ intent, this machine (000)	251.28	155.70	1.6139	.1571
intent to buy new machine	-119.88	118.87	-1.0085	-.0989
crop farm	-310.57	104.41	-2.97	-.2813

Table 22. Equation 19: Tractor Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .1664$ $S_e = .3970$ $n = 934$ $df = 924$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0723	.0269	2.6846	
1959 income \$(000)	.0066	.0027	2.4157	.0786
change in income \$(000)	-.0018	.0031	- .5924	-.0193
intent to buy new machine	.1957	.0704	2.7780	.0903
intent to buy used machine	.1266	.0672	1.8822	.0613
very or quite certain intent	.1718	.0647	2.6568	.0864
intent to buy 1st quarter	.2686	.0769	3.4948	.1133
2nd or 3rd quarter intent	.1190	.0697	1.7065	.0556
grade A dairy farm	.0613	.0262	2.3421	.0762
# of intentions, other mach. ^s	.0395	.0268	1.4712	.0480

Table 23. Equation 20: Chopper Probability

$$\hat{P} = a + \sum b_1 x_1$$

$R^2 = .1728$ $S_e = .2315$ $n = 948$ $df = 939$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0257	.0143	1.7942	
1959 income \$(000)	.0021	.0014	1.5305	.0499
intent to buy new machine	-.0363	.0825	-.4401	-.0144
intent to buy used machine	-.0352	.0990	-.3556	-.0116
very or quite certain intent	.5295	.0805	6.5754	.2097
fair chance intent to buy	.1579	.0736	2.1544	.0698
intent to buy 1st quarter	-.1058	.1023	-1.0344	-.0337
intent to buy 2nd quarter	.2144	.0778	2.7570	.0896
grade A dairy farm	.0096	.0152	.6287	.0205

Table 24. Equation 21: Beler Probability

$$\hat{P} = a + \sum b_1 x_1$$

$\bar{R}^2 = .2279$ $S_e = .2639$ $n = 947$ $df = 940$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	.0563	.0163	3.4496	
1959 income \$ (000)	-.0000	.0016	- .0157	-.0005
intent to buy new machine	.0816	.1920	5.1136	.1644
intent to buy used machine	.0960	.1922	4.7136	.1518
intent to buy 1st quarter	-.1401	.2059	-.6801	-.0222
intent to buy 2nd quarter	-.3273	.1936	-1.6908	-.0550
grade A dairy farm	.0280	.0174	1.6100	.0524

Table 25. Equation 22: Tractor Expenditures

$$\hat{M} = \hat{P} \hat{Q} \quad (\text{or Equation 4 times Equation 5})$$

$$R^2 = .1778 \quad S_e = 957.95 \quad n = 934 \quad df = 921$$

<u>independent variables</u>	<u>regression coef</u>	<u>std error of coef</u>	<u>t-ratio</u>	<u>partial corr coef</u>
constant term	1.4549	45.4541	.0320	
$\hat{P} \hat{Q}$	1.0063	.0679	14.8258	.4340

A Comparison of Machinery prices³⁷

	F. O. B. Factory Price		
	<u>Fall 1958</u>	<u>Spring 1959</u>	<u>Fall 1959</u>
Balers:			
A. C. Roto-Baler	1545	1637	1637
Case Mod 133	1675	1784	1742
J. D. Mod 214-T	2081	2081	2082
IHC Mod 46-T	1738	1738	1857
New Holland Mod 68-T	<u>1679</u>	<u>1679</u>	<u>1679</u>
Totals	8718	8919	8997
Change from Fall 1958 to Spring 1959 = 2.3%			
Change from Fall 1958 to Fall 1959 = 3.2%			
Combines:			
A. C. Mod 66 6' P.T.O.	1581	1675	1675
A. C. Mod T3 10' Self Propelled	4790	4790	4790
Case Mod 75 P.T.O. 7'	1633	1633	1633
J. D. Mod 30 P.T.O. 7'	2057	2056	2136
IHC Mod 76 7' P.T.O.	1963	1963	1963
Massey-Ferg. Mod 82 10' S.P.	<u>6206</u>	<u>6206</u>	<u>6563</u>
Totals	18230	18323	18760
Change from Fall 1958 to Spring 1959 = 0.5%			
Change from Fall 1958 to Fall 1959 = 2.9%			

³⁷From the Official Tractor and Farm Equipment Guide, op. cit.

	F.O.B. Factory Price		
	<u>Fall 1958</u>	<u>Spring 1959</u>	<u>Fall 1959</u>
Uni-Harvesters:			
M. M. Base Unit	\$3378	3378	3510
combine	1830	1830	1924
picker, 2 row	1748	1748	1773
chopper	831	831	831
J. D. Mod 55 Combine 12' S.P.	6190	6190	6450
model 10 picker sheller, 2 row	<u>1519</u>	<u>1466</u>	<u>1538</u>
Totals	15496	15443	16026
Change from Fall 1958 to Spring 1959 =	-0.3%		
Change from Fall 1958 to Fall 1959 =	+3.4%		
Choppers:			
A. C. P.T.O.	\$1235	1309	1309
Case Mod 221	1311	1377	1377
J. D. Mod 10	1059	1059	859
Fox F544	1658	1693	1693
IHC Mod 20-C	1298	1298	1298
New Holland Mod 610	<u>1733</u>	<u>1733</u>	<u>1733</u>
Totals	8294	8469	8269
Change from Fall 1958 to Spring 1959 =	+2.1%		
Change from Fall 1958 to Fall 1959 =	-0.3%		
 TOTALS FOR ALL MACHINES	 \$88886	 89442	 90439
Change from Fall 1958 to Spring 1959 =	+0.6%		
Change from Fall 1958 to Fall 1959 =	+1.7%		

F.O.B. Factory Price

<u>Fall</u> <u>1958</u>	<u>Spring</u> <u>1959</u>	<u>Fall</u> <u>1959</u>
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Corn Pickers:

J.D. 227	\$2272	2275	2379
IHC 2-PR	2158	2265	2265
IHC Mod "34-HM-20"	1517	1517	1517
M. M. "Huskor" 2 Row Mounted	2079	2079	2079
New Idea Mod 21	<u>1844</u>	<u>1844</u>	<u>1844</u>
Totals	9870	9980	10084

Change from Fall 1958 to Spring 1959 = +1.1%

Change from Fall 1958 to Fall 1959 = +2.1%

Tractors:

A. C. WD 45	\$2575	2575	2575
Case "LA"	3496	3454	3454
J. D. 520	3135	3085	3085
J. D. 720 Diesel	4991	4991	4991
Ford FTD 12 Diesel	2945	3249	3249
IHC 350	3402	3181	3181
IHC 450	4204	4138	4138
Massey Ferguson 444	<u>3530</u>	<u>3630</u>	<u>3630</u>
Totals	28278	28303	28303

Change from Fall 1958 to Spring 1959 = +0.0%

Change from Fall 1958 to Fall 1959 = +0.0%

(cover letter mailed with questionnaires)

December 22, 1958

Dear Mail-In Cooperator:

Would you please fill in the enclosed questionnaire and return it to me?

This is not directly related to your income tax record or your farm business analysis report, but is a part of the research to the Mail-In Accounting Project.

This is the second phase of an experiment started a year ago when the 1958 cooperators were asked to indicate their plans to make investments in 1959. When all records are in, we will compare the 1959 intentions with actual purchases. The purpose is to see if it is possible to do in agriculture something that has been successful and useful in industry--namely to get reasonably accurate advance intentions to invest. You will be given a copy of the results.

We, who are conducting the research, feel it will be most valuable if we do this over a period of years.

The questionnaire is not difficult. It can probably be done in five minutes. I would be grateful if you would do it today. Return it in the enclosed self-addressed envelope which requires no postage.

Sincerely,

Warren H. Vincent
Associate Professor

WHVem

Enclosures - 2

1. Questionnaire
2. Self-addressed envelope

"PLANS TO BUY" SURVEY

Michigan Mail-In Accounting Project

Name _____ County _____ Farm No. _____

1. In the next year, that is in 1960, what are the chances you will buy a TRACTOR?

☐ Some chance. *(Go to Ques. 2)

☐ No chance. (Go to Ques. 7)

IF THERE IS SOME CHANCE OF BUYING:

2. How certain are you that you will buy a tractor? (Mark one.)

☐ "Very certain" - have already made or am making a deal. (Go to Ques. 4)

☐ "Quite certain" - considerably better than a 50/50 chance. (Go to Ques. 4)

☐ "Fair chance" - about 50/50. (Go to Ques. 3.)

☐ "Slight chance" - considerably less than a 50/50 chance. (Go to Ques. 3.)

IF FAIR OR SLIGHT CHANCE:

3. What does this depend on? _____
- _____
- _____

4. About when do you think you might buy it?

☐ January, February, March

*IF YOU PLAN TO BUY MORE THAN ONE TRACTOR:

Answer for the first you plan to buy and check here

- ☐ April, May, June
- ☐ July, August, September
- ☐ October, November, December
5. Do you plan to buy it new or used?
- ☐ New ☐ Used
6. Do you plan to have a trade-in?
- ☐ Yes, and I expect to pay about \$_____ above the trade-in.
- ☐ No, and I expect to pay about \$_____ in total.
7. In the next year, that is 1960, what are the chances you will buy any OTHER FARM EQUIPMENT (including auto) which will cost more than \$500 each?
- ☐ Some chance. (Go to Ques. 8.) ☐ No chance. (Go to Ques. 15.)

IF THERE IS SOME CHANCE OF BUYING:

8. What equipment do you plan to buy?

(Use one column for each item.)

9. For each, indicate how certain you are that you will buy it.

"Very certain" - have already made or am making a deal.

"Quite certain" - considerably better than 50/50 chance.

Item 1	Item 2	Item 3	Item 4
☐	☐	☐	☐
☐	☐	☐	☐

Item 1	Item 2	Item 3	Item 4
☐ New ☐ Used	☐ New ☐ Used	☐ New ☐ Used	☐ New ☐ Used
☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
☐ \$ ☐ \$	☐ \$ ☐ \$	☐ \$ ☐ \$	☐ \$ ☐ \$

"Fair chance" - about 50/50 chance.

"Slight chance" - considerably less than 50/50 chance.

10. For each item, indicate about when you think you might buy it.

January, February, March

April, May, June

July, August, September

October, November, December

11. Do you plan to buy it new or used?

12. Do you plan to have a trade-in?

13. For each item where trade is expected, indicate amount above trade-in it will cost.

14. For each item where no trade-in is expected, indicate about how much you expect it to cost without a trade-in.

15. In the next year, that is in 1960, what are the chances you will do any MAJOR CONSTRUCTION or REMODELING PROJECTS to your farm buildings (other than the house) each of which will cost more than \$1000?

☐ Some Chance. (Go to Question 16.) ☐ No Chance. (Go to ques. 19.)

• IF THERE IS SOME CHANCE OF CONSTRUCTION OR REMODELING:
(Use one column for each project.)

PROJECT I	PROJECT II	PROJECT III
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
\$ _____	\$ _____	\$ _____

16. What do you plan to do?

17. For each project, indicate how certain you are that you will do it.

"Very certain" - have already started or am making arrangements.

"Quite certain" - considerably better than 50/50 chance.

"Fair chance" - about 50/50.

"Slight chance" - less than a 50/50 chance.

18. For each project, indicate about how much you expect it to cost you

TO BE FILLED IN BY EVERYONE:

19. What comments (if any) would you care to make about plans to invest in tractors, other machinery and building improvements projects planned for 1960?

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