MEASURING UTILITY OF WEALTH AMONG FARM MANAGERS

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

Albert Nelson Halter

1956

THESIS

This is to certify that the

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Glenn L. Johnson
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MEASURING UTILITY OF WEALTH AMONG FARM MANAGERS

By

Albert Nelson Halter

A THESIS

Submitted to the College of Advanced Graduate Studies of Michigan
State University of Agriculture and Applied Science
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DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

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MEASURING UTILITY OF WEALTH AMONG FARM MANAGERS

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AN ABSTRACT

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Approved Glenn L. Johnson

ABSTRACT

Both historical and recent developments of the concept of measurable utility provided the basis for deducing the hypotheses tested in this thesis. The first hypothesis is that there exists a technique by which utility of wealth can be measured. The second hypothesis is that a correspondence can be discovered relating past and present characteristics of individuals to future managerial behavior via estimates of numerical utility.

The formal model developed by von Neumann and Morgenstern, further explicated by Friedman and Savage, and applied to farming situations by Johnson, provided the operational prerequisites and theorems for finding a correspondence between utility entities and numbers.

The Interstate Managerial Survey provided data for testing the hypotheses. A set of questions asked 529 farm managers in seven midwestern states whether or not they would accept certain odds in hypothetical risk taking and insurance situations. The questions were constructed so that the elements of the questions could be identified with the relevant aspects of the model. The answers to the questions were thus either consistent or inconsistent with the specifications of the model.

The main analysis derived utility curves for the farmers who gave consistent answers. From the utility curves estimates of <u>relative</u> marginal utility were made. These estimates, which are interpersonally comparable, were related to other characteristics of the farm managers

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interviewed. Since these estimates are relative to the assignment of an origin and a unit of measure, they are useful for predicting behavior but not for making welfare economic recommendations. The variables which were found to be related to the estimates of relative marginal utility include: (1) net worth, (2) gross income, (3) debt position, (4) type of farming and (5) concern for the two types (statistical) error.

In general, as the marginal utility per dollar of additional wealth increases, (a) the individual's amount of debt increases, and (b) he tends to be engaged in more risky types of farming. As the marginal disutility per dollar of lost wealth increases, (a) the individual's net worth and income decreases, (b) he tends to be engaged in less risky types of farming and (c) he is more concerned about not taking action when he should.

It was concluded that the technique used in the Interstate Managerial Survey provides some estimates of cardinal utility which distinguish individuals on the basis of meaningful managerial behavior. Further, it was concluded either (1) that in some cases the technique either was not used as extensively as it should have been or (2) that the interviewers had difficulty in communicating the questions to the farmers. These shortcomings were made explicit and remedial steps proposed.

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CHAPTER I

INTRODUCTION

This thesis, looked at from a vantage point which provides a broad prospective, concerns the nature of man. The theoretical or formal propositions presented about his nature apply in every situation, i.e., explain all of his motivated behavior. The empirical content of the thesis concerns the nature of a limited field of men, specifically farm managers.

As in any scientific investigation the objectives are to describe reality with theoretical and empirical laws and predict the course of reality on the basis of these laws. The description will be of the behavior of individuals in specified situations; these situations are regarded as risky, changing or uncertain, since there is incomplete knowledge of the future. Behavior in managerial studies is called decision making. Description of this type of behavior in these situations is important, not only to the scientist, but to individual farmers, teachers, politicians and administrators who can use such facts in combination with ethical propositions in formulating statements concerning both public and private policies. These individuals construct recommendations about how to reconcile the ethical philosopher's concept about "what ought to be" with the scientist's concepts about "what is."

The predictions concern what decisions or behavior can be expected under certain circumstances. These predictions, of interest to the scientist fr

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scientist from the standpoint of systematic knowledge, are of ultimate importance to the individual policy maker. It is these individuals who upon the basis of the scientists' descriptions and predictions attempt to preserve, alter or leave unattended the existing situation.

The method of scientific inquiry involves deducing hypotheses from a theoretical structure and subjecting them to empirical tests. If empirical laws can be established from this procedure, then broader theories relating these laws to other empirical laws can be formulated. This process is intended to lead to more complete knowledge concerning the nature of the universe.

In order to grasp the content of the thesis the theoretical nature of man must first be stated. Obviously the entire theory can not be tested by one study and only a few particular hypotheses can be tested; nevertheless, the results and conclusions must reflect upon and question the entire theoretical structure.

Theoretical Nature of Man

Man is thought to be an animal that is possessed of a free will; he is motivated by his desire for pleasure and aversion from pain,[1] and is basically constituted to maximize this pleasure. A free will means man has freedom of alternative choice; this means he possesses

[1]This conception of psychological hedonism is easily confused with ethical hedonism and with ethical utilitarianism. Ethical hedonism maintains that pleasure is the only positive ultimate value, i.e., intrinsic good; whereas ethical utilitarianism maintains that the right act is the act which, of all those open to the individual, will produce the greatest amount of pleasure in the world at large.

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the ability to choose among alternative possibilities of action. This procedure of choosing between alternative courses of action is called decision making. It is assumed to be a conscious rational procedure; that is, man intentionally uses his reasoning power to deduce his alternative courses of action. It is supposed that his desire for pleasure and aversion from pain corresponds to a scale; this means the act that produces the greatest pleasure is at the top of the scale and the act that produces the greatest pain at the bottom. He naturally chooses the acts that produce the maximum amount of pleasure. An apparent difficulty arises when comparing qualities of pleasure or pain. It seems that there is another dimension of pleasure besides just its quantity. However, this difficulty is overcome by supposing utility as the factor abstractable from every human experience and thus the true motivating agent. Definitions of utility as being isomorphic to hedonistic pleasure, satisfaction or gratification, have been equally meaningless from an operational point of view. None of the terms have been given meaning by a set of operations or propositions of empirical significance. (For purposes of this thesis the term utility will be used to denote a certain set of operations that makes it possible to set up a correspondence between utility and numbers.) This thesis is concerned with the measurability of utility and its usefulness in making predictions concerning human behavior.

The history of the measurability of utility is not only interesting but provides the background for understanding the complications involved. The next section will review three aspects of this history. These are:

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(1) the initial theorizing concerning utility, (2) the intermediate stage of forming concepts concerning its measurability, and (3) a recent stage involving experimental attempts at quantifying utility.

As a review of the literature regarding utility is beyond the scope of this thesis and has already been done by others,[1] only revelant examples of the literature pertaining to the above three aspects will be considered.

Review of Literature

Utility theory was brought to the forefront about the beginning of the nineteenth century by Jeremy Bentham.[2] He suggested the measurement of quantities of pleasure and pain; however, his purpose was different than the one proposed above. His primary objective was to construct a more rational system of civil and criminal law. Thus from its inception, utility was construed to be both a motivating factor and a moral factor. It was thought that, from the intrinsic nature of man, rules and principles could be discovered that would prescribe "right" action for men. This thesis attempts to abandon the notion that utility has a moral connotation and restricts itself only to the motivating implications.[3]

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[1]G. J. Stigler, "The Development of Utility Theory I and II," Journal of Political Economy, Vol. 57 (October, 1950).

[2]Jeremy Bentham, Introduction to the Principles of Morals and Legislation. (Oxford: Clarendon Press, 1789).

[3]M. Friedman, and L. S. Savage, "The Expected-Utility Hypothesis and the Measurability of Utility," Journal of Political Economy, Vol. 60 (December, 1952), p. 474. The authors point out the widespread confusion in using "the same word-utility-to stand for two quite different things: on the one hand a quantity that it is useful to regard an individual as maximizing in interpreting his behavior and predicting

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This procedure is based upon the author's belief that "no study of what men do can avail to teach us what they ought to do."

Later in the nineteenth century three economists, Jevons, Menger, and Walras attempted to make explicit the consequences of the measurability of utility in the concept of marginal utility. Of the measurability of utility Jevons said:

> A unit of pleasure or of pain is difficult even to conceive; but it is the amount of these feelings which is continually prompting us to buying and selling, borrowing and lending, labouring and resting, producing and consuming, and it is from the quantitative effects of the feelings that we must estimate their comparative amounts.[1]

In constructing a way to measure utility he employed the familiar measuring stick of money.

> The price of a commodity is the only test we have of the utility of the commodity to the purchaser; and if we could tell exactly how much people reduce their consumption of each important article when the price rises, we could determine, at least approximately the variation of the final degree of utility. . . . For the first approximation we may assume that the general utility of a person's income is not affected by the changes of price of the commodity; so that, if in the equation
>
> $$\phi x = m \cdot \psi c$$
>
> we may have many different corresponding values for x and m, we may treat ψc, the utility of money, as a constant, and determine the general character of the function ϕx, the final degree of utility.[2]

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his reactions to changed circumstances, and, on the other hand, a quantity that he 'should' maximize or that society 'should' maximize or help him to maximize."

[1]W. S. Jevons, The Theory of Political Economy (4th ed.; London: Macmillan and Co., Limited, 1911), p. 11.

[2]Op. cit., pp. 146-147. The final degree of utility is its marginal utility.

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[2]Op. cit.

[3]Leon Wa...
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[4]Op. cit.

Although Menger gives no empirical technique for measuring utility he attempts to distinguish value and utility.

> Utility is the capacity of a thing to serve for the satisfaction of human needs, and hence (provided the utility is recognized) it is a general prerequisite of goods-character . . . what distinguishes a non-economic good from a good-subject to the quantitative relationship responsible for economic character is the circumstance that the satisfaction of human needs does not depend upon the availability of concrete quantities of the former but does depend upon the availability of concrete quantities of the latter. For this reason the former possesses utility, but only the latter, in addition to utility, possesses also that significance for us that we call value.[1]

A translator's note[2] points out that Menger thought the concept "utility" is entirely objective and lacking in psychological content. He pictures it as an abstract relation between a species of goods and a human need.

Walras does a masterly job of avoiding the empirical job of measuring utility. Instead he says,

> I shall. . . assume the existence of a standard measure of intensity of wants or intensive utility, which is applicable not only to similar units of the same kind of wealth but also to different units of various kinds of wealth. . . .[3]
>
> Analytically, if we are given effective utilities as functions of the quantities consumed according to the equations . . . and . . . then the "rarete's" are designated by the derivatives, . . . and . . . .[4]

The translator of Walras' work points out that it would have been better to have chosen a word less vague and less ambiguous than

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[1]Carl Menger, Principles of Economics, trans. and edit. J. Dingwall and B. F. Hoselitz (Glencoe, Ill.: Free Press, 1950), p. 119.

[2]Op. cit., p. 118, No. 6.

[3]Leon Walras, Elements of Pure Economics, trans. William Jaffé (Homewood, Ill.: Richard D. Irwin, Inc., 1926), p. 117.

[4]Op. cit., p. 120.

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"rarete's" to express his mathematically precise concept; but it was clearly out of filial piety that he perpetuated in his own work his father's favourite term.[1] He also points out that "rarete's" has the same significance as Jevons' "final degree of utility" which Jevons defines as the differential coefficient of total utility considered as a function of quantity.[2]

Although the main application of utility theory has been to the concept of demand, more serious attention to the measurability of utility functions than was given by the preceding three economists was given by Fisher, Pareto, and Marshall.

Fisher constructed a technique for measuring utility after formulating the following mathematical system.[3]

Postulate: Each individual acts as he desires

(1) Definition of utility:

utility of A $\geqq$ utility of B
if the given individual at the given time prefers A to B or neither

(2) $\dfrac{\text{utility of d A}}{\text{utility of d B}} = n$
if the utility of d A = utility of ndM (M total)
and utility of d B = utility of d M

(3) $\dfrac{d\ V}{d\ A}$ = marginal utility

(4) $\dfrac{d\ V}{d\ A}$ = unit of utility (util) A being given

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[1] Ibid., p. 506.

[2] Ibid., p. 506.

[3] I. Fisher, Mathematical Investigations in the Theory of Value and Prices (New Haven: Yale University Press, 1936).

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$$(5) \quad \int_0^A \frac{d\,V}{d\,A} \cdot d\,A = \text{total utility}$$

$$(6) \quad A \cdot \frac{d\,V}{d\,A} = \text{utility value}$$

$$(7) \quad \int_0^A \frac{d\,V}{d\,A} \cdot d\,A - A\,\frac{d\,V}{d\,A} \equiv \text{gain}$$

Assumption: $\frac{d\,V}{d\,A} \equiv$ Function of A only

Corallaries: From definition and postulate, when B is exchanged for A

$$\frac{d\,V}{d\,B} \cdot B = \frac{d\,V}{d\,A} \cdot A$$

From (2) and assumption, in the equation:

$\frac{\text{utility of d A}}{\text{utility of d B}} = n$, the value of n is independent of the particular commodity and of its quantity n used in the definition.

The method of measuring the marginal utility was to utilize data of family budgets and prices so as to compare the wants of two typical families of different incomes, in the same community, by using as a yardstick or criterion, a third family having identical tastes, but differing in the amount of income and living under a different scale of prices for foods, rents, clothing and other items of consumption.[1] Further details of the technique are of no consequence here; however, a quotation found later in the same paper sheds light on Fisher's ultimate purpose. ". . . according to which way this product differs

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[1]Irving Fisher, A Statistical Method for Measuring "Marginal Utility" and Testing the Justice of a Progressive Income Tax in Economic Essays Contributed in Honor of John Bates Clark (New York: Macmillan, 1927), pp. 159.

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Pareto in addition to arguing that the slopes of indifference curves can be deduced from budgetary data wondered if a unique total utility surface could be integrated. He answered by saying that a unique total utility function could be constructed if the consumer could tell the magnitude of the utility gained by moving from one indifference curve to a second relative to the utility gained by a move to a third indifference curve. Pareto doubted that the consumer could rank these utility differences.[2]

In Marshall's analysis of demand he makes an assumption of constant marginal utility of money. However, in regard to risk taking and insuring, which is more appropriate to what is to follow, he says:

> . . . from the general law that the utility to anyone of an additional £1 diminishes with the number of pounds he already has, involves an economic loss, even when conducted on perfectly fair and even terms. For instance, a man who having £600 makes a fair even bet of £100, has now an expectation of happiness equal to half that derived from £700, and half that derived from £500; and this is less than the certain expectation of the happiness derived from £600, because by hypothesis the difference between the happiness got from £600 and £500 is greater than the difference between the happiness got from £700 and £600. . . , the direct converse . . ., is that a theoretically fair insurance against risks is always an economic gain. . . .[3]

Perhaps the most outstanding feature of the development of utility theory through Marshall has been the emphasis upon the consequences of

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[1]Ibid., p. 185.

[2]From secondary sources. Stigler, op. cit., p. 381.

[3]Alfred Marshall, Principles of Economics (4th ed.; London: Macmillan, 1947), p. 135.

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utility measurement derived by the use of the mathematics of physics, e.g., calculus and differential equations. It is not until von Neumann and Morgenstern conceived economic behavior as a game of strategy that the mathematics of set theory and probability theory played a role in utility measurement. They point out that under the conditions on which the conventional utility concept is based, very little extra intuition is necessary to reach a numerical utility. They say:

> . . . We expect the individual . . . to possess a clear intuition whether he prefers the event A to the 50-50 combination of B or C, or conversely. It is clear that if he prefers A to B and also to C, then he will prefer it to the above combination as well; similarly, if he prefers B as well as C to A, then he will prefer the combination too. But if he should prefer A to, say B, but at the same time C to A, then any assertion about his preference of A against the combination contains fundamentally new information. Specifically: If he now prefers A to the 50-50 combination of B and C, this provides a plausible base for the numerical estimate that his preference of A over B is in excess of his preference of C over A.[1]

These notions which have been made explicit by application of mathematics by von Neumann and Morgenstern will be used in the latter chapters of this thesis. However, it remains to point out some of the consequences of this new approach. There are essentially two groups of individuals who have tried experimentally to measure utility; these are economists[2] and statisticians.[3]

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[1]J. von Neumann, and O. Morgenstern, Theory of Games and Economic Behavior (Princeton: Princeton University Press, 1947).

[2]The amount of literature in economic journals is increasing so rapidly that it would go beyond the scope of this thesis to present a complete bibliography. The references cited usually contain references to other literature. A good source of reference material up to 1953 is A. A. Alchian, "The Meaning of Utility Measurement," American Economic Review, Vol. 43 (March, 1953), pp. 26-50.

[3]The interest in utility measurement by statisticians is evident from the surge in literature. It is not the purpose of this thesis to

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Experiments performed by economists, such as Mosteller and Nogee, were attempts to measure utility experimentally using real money. However, the size of gain was small in comparison to what would be considered a return on investment in a farm enterprise to a farm manager. Mosteller and Nogee's subjects were 17 Harvard students and national guardsmen, 14 of whom finished the experiment. Their conclusions, though tentative, were that subjects did choose among uncertain prospects on the basis of the utilities of the amounts of money involved and on the basis of the probabilities associated with each.

One respect in which the recent work of the statisticians differs from that of the economists is that as they proceed they are developing a decision making model of which utility measurement is only a part. The economists believe they already have a decision making model in what they call marginal analysis and that utility measurement is the only component lacking before the model will predict behavior.

The statisticians' point of view is illustrated in the quotation from Suppes:

> . . . The increasing advocacy of subjective probability is surely due to the increasing awareness that the foundations of statistics are most properly constructed on the basis of a general theory of decision making. In a given decision situation, subjective elements seem to enter in three ways: (i) in the determination of a utility function (or its negative, a loss function) on the set of possible consequences, the actual consequence being determined by the true state of nature and the decision taken; (ii) in the determination of an *a priori*

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compile a complete bibliography but the references cited usually contain references to other literature. A good source of reference material is P. Suppes and W. Muriel, "An Axiomatization of Utility Based on the Notion of Utility Differences," *Management Science*, Vol. 1 (April-July, 1955).

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probability distribution on the states of nature; (iii) in the determination of other probability distributions in the decision situation.[1]

One of the experiments in utility measurement carried out by Davidson and Suppes used a linear programming model to measure cardinal utility and to predict further choices. The general procedure was as follows:[2]

> Music students were used as subjects, with long-playing records as outcomes. Each subject came to three sessions; all testing was done individually. In the first session a utility curve for six records was determined by the linear programming method. . . . In the second session a utility curve was found for another set of six records, two of which were drawn from the set used in the first session to permit the construction of a joint curve. The joint curve was used to predict choices between untested combinations of the ten records used in the two sessions, and these predictions were tested in a third session.

Experiments carried out by Edwards[3] attempt to emphasize the importance of subjective probability. He says people have

> a consistent, stable pattern of preferences among probabilities in gambling situations, and that this pattern of preferences among probabilities is another factor, in addition to the subjective value of money, which may cause human behavior to differ strictly

from the expected utility hypothesis.

Before proceeding in the next section to the literature that was the inspiration for this study, consider two important characteristics

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[1]P. Suppes, The Role of Subjective Probability and Utility in Decision Making, Tech. Report No. 3, Project No. 1053, Office of Ordnance Research (June 1, 1955).

[2]D. Davidson, and P. Suppes, Experimental Measurement of Utility by Use of a Linear Programming Model. Technical Report No. 3, Office of Naval Research (April 2, 1956).

[3]W. Edwards, "Experiments on Economic Decision Making in Gambling Situations," Seminar on the Application of Mathematics to the Social Sciences (University of Michigan, November, 1952).

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of the development of utility theory in summarizing the above discussion. (1) The two connotations of utility in economic literature make the word ambiguous for scientific research, and (2) The use of probability in measuring utility of specified objects or events, for example money income, raises the question of subjective probability and the utility attached to probability distributions. Any discussion or empirical work concerning the measurability of utility can not be carried out without consideration of these two notions. Some further discussion of these two ideas will be presented at appropriate places in this thesis.

There remain two contributions to utility theory which are so important to this thesis that they must be singled out. The problem under discussion in this thesis is so intimately related to this previous work that a statement of the hypotheses to be tested can not be undertaken until the works of Friedman and Savage at the University of Chicago and Johnson at the University of Kentucky and Michigan State University have been studied.

Following the approach introduced by von Neumann and Morgenstern, Friedman and Savage produced an argument concerning the shape of the utility function for monetary gains and losses which was intended to rationalize the reactions of individuals to risk.[1] The two classes of risk situations to which individuals react are those regarded as

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[1]M. Friedman and L. J. Savage, "The Utility Analysis of Choices Involving Risk," Journal of Political Economy, 56 (August 1948), pp. 279-304 or M. Friedman, and L. J. Savage, "The Utility Analysis of Choices Involving Risk," Readings in Price Theory, ed. G. J. Stigler and K. E. Boulding (Homewood, Ill.: Richard Irwin, Inc., 1952).

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gambling and insurance. In addition they react to other economic phenomena involving risk. The hypothesis proposed as stated by Friedman and Savage (Chapter III uses the von Neumann--Morgenstern notation) is:

> In choosing among alternatives open to it, whether or not these alternatives involve risk, a consumer unit (generally a family, sometimes an individual) behaves as if (a) it had a consistent set of preferences; (b) these preferences could be completely described by a function attaching a numerical value--to be designated "utility"--to alternatives each of which is regarded as certain; (c) its objectives were to make its expected value as large as possible.[1]

The conceptual experiment for determining the utility function offered by Friedman and Savage is not the one used in this thesis. However, the procedure they offered, although somewhat impractical, is an alternative to the one used. They suggest:[2]

> Select any two incomes, say $500 and $1,000. Assign any arbitrary utilities to these incomes, say 0 utiles and 1 utile, respectively. This corresponds to an arbitrary choice of origin and unit of measure. Select any intermediate income say $600. Offer the consumer unit the choice between (A) a chance _a_ of $500 and (1-_a_) of $1,000 or (B) a certainty of $600, varying _a_ until the consumer unit is indifferent between the two. . . .
>
> . . . In this way the utility attached to every income between $500 and $1,000 can be determined.

Friedman and Savage say that a utility function obtained in this way can be used to compute the utility attached to any sets of possible monetary outcomes and associated probabilities and to predict which of a number of such sets will be chosen. The function they hypothesize to describe the utility of money income has the following properties:[3]

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[1]_Ibid._, p. 287.

[2]_Ibid._, p. 292.

[3]_Ibid._, p. 303.

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(a) utility rises with income, i.e., marginal utility of money income everywhere positive; (b) it is convex from above below some income, concave between that income and some larger income, and convex for all higher incomes, i.e., diminishing marginal utility of money income for incomes below some income, increasing marginal utility of money income for incomes between that income and some larger income, and diminishing marginal utility of money income for all higher incomes.[1]

One of Johnson's contributions to the field of farm management has been his recognition that the Friedman and Savage hypothesis concerning consumer behavior in risky situations has applications to many of the risky events occurring in farming. He pointed out in a book[2] written jointly with L. A. Bradford and later at the Bozeman Risk and Uncertainty Conference[3] that farm managers need not have either a positive preference for stability in order to insure or a preference for gambling in order to engage in risky enterprises. Johnson noted that all that is necessary, according to the Friedman--Savage utility function, is that (1) the disutility of losses in assets or income increases at an increasing rate, and (2) the utility of gains in assets or income increase at an increasing rate.

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[1]In Chapter V only the first two stages are derived.

[2]L. A. Bradford, and G. L. Johnson, Farm Management Analysis (New York: John Wiley & Sons, 1953).

[3]G. L. Johnson and C. B. Haver, Decision Making Principles in Farm Management, Kentucky Bulletin 593 (Lexington: University of Kentucky, 1953), and G. L. Johnson, "Learning Processes: The Individual Approach," Proceedings of Research Conference on Risk and Uncertainity in Agriculture, Bozeman (Fargo, N. D.: North Dakota Agricultural Experiment Station, 1953).

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In reference to farm managers' behavior in gain situations he says:

> The action of a considerable number of farmers, everywhere, imply that they value gains in income--producing ability at an increasing marginal rate. In technical economic terms this is the same as saying that they have an increasing marginal utility for income and assets.

It is this type of belief that led Johnson to undertake a study of farmers' managerial processes including a test of the Friedman--Savage hypothesis. The Interstate Managerial Study, to be discussed in the next chapter, in cooperation with other researchers is the first large scale attempt at studying these processes. It is also the first time that quantifying of utility has been attempted in the field of farm management and used to describe farm managerial behavior. This latter phase of the Interstate Managerial Study will be the direct concern of the author in this thesis.

Statement of Hypotheses

The theoretical construct that man maximizes a measurable quantity called utility makes it possible to deduce the hypothesis that there is a means by which utility can be quantified. A second hypothesis can be deduced from the notion that managerial behavior can be predicted from the numerical utilities. This hypothesis states: There exists a correspondence between the numerical utilities derived from this technique and such characteristics of individuals as age, number of dependents, years of farming experience and place of residence. A further cause and effect association exists between the numerical

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utilities and certain managerial behavior such as income received, net worth position, debt position, and behavior in other situations requiring managerial action. By relating numerical utilities, common characteristics and managerial behavior of the past and present, future managerial behavior can be predicted.

Organization of Thesis

In the chapters which follow the original objectives and procedures of the Interstate Managerial Study will be discussed (Chapter II) and the mathematical model of von Neumann and Morgenstern will be related to the technique of quantifying utility used in the Interstate Managerial Survey (Chapter III). Then the effectiveness of the Interstate Managerial Survey technique in eliciting answers will be evaluated (Chapter IV). Next the relevant data for testing the hypothesis concerning the significance of the numerical utilities will be presented (Chapter V). Finally, a summary and an evaluation of the technique will reveal the significance of this method of measuring utility and suggest precautions to be taken in future research concerning the use of measurable utility in explaining managerial behavior.

The implications for farm management teaching and extension are not given in this thesis. To adequately accomplish this task would involve displaying various ethical propositions, and deducing from these and from the statements of fact presented in this thesis, recommendations useful to farm managers in solving their problems. These recommendations can and should

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CHAPTER II

SOURCE OF DATA

Origin of Interstate Managerial Study

The Interstate Managerial Study, henceforth referred to as I.M.S., is based upon the ideas and concepts stated in Johnson's and Haver's bulletin called Decision-Making Principles in Farm Management.[1]

The main contribution of this bulletin is the concept that farm management may be viewed in a functional-situational framework. The five functions that management is thought to perform are:[2] (1) observation, (2) analysis, (3) decision concerning the problem under consideration, (4) action taking, and (5) acceptance of economic responsibility. The situations in which these functions are carried out are characterized by changing conditions. The varying degrees of knowledge concerning (1) price structures and changes, (2) production methods and responses, (3) prospective technological developments, (4) the behavior and capacities of people associated with farm businesses, and (5) the economic, political, and social situations in which a farm business operates result in changing the conditions.[3] The five degrees

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[1]G. L. Johnson, and C. B. Haver, Decision Making Principles in Farm Management, Kentucky Bulletin 593 (Lexington: University of Kentucky, 1953).

[2]Ibid., p. 8 or cf. G. L. Johnson, "Needed Developments in Economic Theory," Journal of Farm Economics (Vol. 32, Nov. 1950) p. 1151-52.

[3]Johnson and Haver, op. cit., pp. 8 and 9.

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of knowledge that are delineated are:[1] (1) subjective uncertainty, (2) inactive situation, (3) the learning situation, (4) forced action situation, and (5) subjective certainty. These concepts which form the background to the study have been subject to discussion[2] and some empirical work.[3]

The most important discussion of these concepts from the standpoint of initiating empirical study occurred at the Risk and Uncertainty Conference at Bozeman, Montana, in 1953. Although Johnson presented in formal meetings some hypotheses that could be empirically tested,[4] various interested individuals at informal meetings did most of the conceptualizing for the I.M.S. After considerable discussion, an interstate survey was decided upon as a means of obtaining data to test the concepts set forth in Johnson's and Haver's bulletin. The sections that follow will be concerned with the operating details of the survey.

Interstate Managerial Survey

The Interstate Managerial Survey was conducted in seven states and obtained a total of 1075 interviews. The seven state institutions

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[1]*Ibid.*, pp. 11-14.

[2]*Proceedings of Research Conference on Risk and Uncertainty in Agriculture*, Great Plains Council Publication No. 11 (Fargo, N. D.: North Dakota Agricultural College, 1955).

[3]G. L. Johnson, *Managerial Concepts for Agriculturalists*, Bulletin 619 (Lexington: University of Kentucky, 1954).

[4]G. L. Johnson, "Relevant Theories, Concepts and Research Techniques; and Learning Processes, The Individual Approach." *Proceedings of Research Conference*, Publication No. 11 (Fargo, N. D.: North Dakota Agricultural College, 1955).

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which cooperated on setting up and running the survey are: (1) University of Kentucky, (2) University of Ohio, (3) Purdue University, (4) Michigan State University, (5) North Dakota State Agricultural College, (6) Iowa State College, and (7) Kansas State College. The services of the Farm Foundation and the Risk and Uncertainty Subcommittee of the North Central Farm Management Research Committee were utilized in establishing the cooperative relationships. Michigan State University, as originator and a primary sponsor of the survey, arranged for and contributed the services of a survey expert for use (a) in constructing and pre-testing survey schedules and (b) in training interviewers.

Schedule Construction and Pre-testing

The development of the schedule used in the Interstate Managerial Survey proceeded through four stages: (1) a proposed list of questions including the objectives and hypotheses to be tested, (2) a tentative schedule showing further design of the questions, (3) a schedule for pre-testing, and (4) the final field schedules.

The proposed list of questions, objectives and hypotheses was prepared by Glenn Johnson and the author and was presented to the Risk and Uncertainty Subcommittee of the North Central Farm Management Research Committee in November, 1953.[1] After considerable debate, the committee agreed that the subject area was well enough defined to proceed to the question design. For this purpose the services of Joel Smith of the Michigan State University Sociology department were

[1]Unpublished report, November 14-17, 1953, at the Farm Foundation Office, Chicago, Ill.

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contracted. With the aid of Joel Smith a tentative schedule was constructed. More emphasis was placed on design and wording of questions than in the previous proposed list. This schedule was presented to the subcommittee in March of 1954.[1] After careful scrutiny, and after the committee presented its revisions of the questionnaire, a third schedule to be used in a pretest was constructed.

Copies of the pretest schedule were sent to each of the cooperating states where the questions were subjected to field conditions in the respective states. The schedules complete with farmer responses and the interviewers' comments on the effectiveness of each question were returned to Michigan State for further analysis. From this valuable pretest material, a final schedule was designed.

The results of the pretest based upon a criterion of workability showed that the total list of questions which required an average of three hours to answer was too long. The belief that this length of interview would cause some of the respondents to become fatigued and disinterested resulted in a major change in schedule design. The pretest also revealed that certain questions were ineffective in eliciting responses consistent with the objectives and thus were either modified or eliminated. The total list of questions which appear in Appendix A was programmed into six shorter schedules requiring an hour to two hours to complete. Each smaller schedule was intended to comprise a unit in itself, that is, those questions which bore a close

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[1]Unpublished report, March 23-24, 1954, at the Farm Foundation Office, Chicago, Ill.

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relationship to each other in terms of the hypotheses to be tested appear on the same schedule. The distribution of the questions over the six schedules appears in Appendix B.

The order of the questions on the final schedule was also carefully considered. The sequence of questions attempted to follow this pattern: (1) a few easy, single response, attribute questions, (2) those open-ended questions which required a free response without prior information,[1] (3) some ranking questions with information aid cards, (4) some open-ended questions concerning specific decisions, (5) open-ended questions requiring short answers, (6) questions requiring a "yes" or "no" answer, and (7) further attribute data including gross income, net worth and debts. The order of questions on the final schedule is also shown in Appendix B.

Interviewer School

In June 1954, an interviewer school was held for one week at Purdue University. Joel Smith with the assistance of Glenn Johnson and the author instructed the interviewers of the seven participating states. Iowa and North Dakota had representatives at the school who later instructed their interviewers. The purpose of the school was to acquaint the interviewers with the study, the survey and the schedule, to instruct the interviewers in the proper techniques of interviewing, and to supervise some practice interviews under actual conditions.

A mimeographed review of the objectives of the study, the intent of the questions and sampling procedures helped acquaint the

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interviewers with the study and the survey. The schedule was fully discussed. A mimeographed set of instructions which included (1) general interviewing instructions, (2) general instructions for the schedule, and (3) instructions for specific questions aided in explaining interviewing procedures.

Following the formal instruction, each of the interviewers completed a schedule with a farmer in the vicinity of Lafayette, Indiana. Joel Smith discussed the responses and reactions obtained from the respondent with each interviewer. Further instructions were given to those interviewers who had difficulty on the first interview. In some cases a second interview was taken which was again reviewed by Joel Smith. One primary objective of these practice sessions was uniformity in interviewing.

Statistical Sample

Representatives of institutions cooperating with the North Central Risk and Uncertainty Subcommittee specified the area and units to be sampled. The area consisted of eight geographical regions containing contiguous groups of whole or part counties located within the seven states. The units to be interviewed consisted of rural commercial farms (census definition) with gross income of $2500 or more and which have single household managerial units. Farms characterized by livestock share leases, father-son arrangements where both have a separate family and household, and regular business partnerships between two unrelated individuals were ineligible for interview.

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The statistical laboratory at Iowa State College designed a stratified random sample of area sampling units. Each of the eight areas was a stratum and each stratum was subdivided into area sampling units. Each unit was expected to contain two eligible farms (in the case of Kentucky sampling units which contained an average of three eligible farms were used). The sample drawn was completed using the 1950 census of Agriculture and the 1947 Revised Master Sample Materials.

The following procedure was used in selecting the farms to be interviewed:

1) The number of eligible farms present in each whole or part county was determined. (Number of 1950 commercial farms with gross incomes of 2500 dollars or more, less the number of livestock share leases and 20 percent in order to adjust for partnerships, father-son arrangements and changes in the number of farms since 1950).

2) The total number of area sample units with two eligible farms within each county was determined.

3) Master Sample Materials were used in subdividing the county into area sampling units of the desired size.

4) A random sample of the desired number of area segments was drawn from each stratum and these segments were numbered and indicated on one-half inch scale county highway maps.

The sampling characteristics of the eight strata and the number of interviews taken are shown in Table 1.

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TABLE 1

CHARACTERISTICS OF THE SAMPLE OF EIGHT STRATA FOR THE INTERSTATE MANAGERIAL SURVEY

State	Estimated Number of Eligible Farms	Estimated Eligible Farms per Sampling Unit	Expected Number of Interviews	Actual Number of Interviews Taken
Kentucky	1,790	3	150	124
Ohio	23,599	2	200	137
Indiana	15,769	2	200	189
Michigan	37,545	2	224	199
Michigan	394	2	30	30
North Dakota	9,301	2	150	129
Iowa	23,649	2	140	120
Kansas	6,985	2	206	147

Interviewing

During the summer and fall of 1954, twenty-three interviewers in the seven states contacted the eligible farm managers. The interviewers were instructed to adopt the following procedure:

1) A segment map should be copied onto the applicability sheet and the locations of farms should be entered.

2) A drive through the segment before starting should allow making any necessary changes on the map. (Each prospective interviewing location should be given an identifying letter in sequence.)

3) All apparent farm residences in a segment should be visited to determine whether the occupant qualifies according to the criteria stated above.

4) All prospective respondents should be accounted for on the applicability sheet. (A total of three calls should be made, if necessary, to account for a potentially eligible farm.)

5) All interviews should be numbered in the sequence in which they are taken in addition to the segment number.

6) The six schedules should be rotated in sequence. (When a sample member is not at home on the first visit, reserve the questionnaire until the interview is finally made.)

7) When 10 to 20 interviews are completed, the schedules should be sent to Joel Smith for review.

Joel Smith examined the schedules as he received them and, if necessary, made suggestions to the interviewers on how they might improve the quality of their completed schedule. This type of control was intended to produce more uniform interviewing and to insure against unfinished schedules.

Coding Procedures

After most of the interviews were completed, the personnel at Michigan State University had the task of constructing a code which would make it possible to transfer the data from the schedules to IBM punch cards. This task advanced in four stages: (1) preliminary code construction, (2) revision and testing of the codes, (3) actual coding, and (4) cross tabulating.

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The first step in the preliminary code construction was to type a large number of the responses to the open-ended questions. With (1) many answers to one question before them, and (2) the general theoretical background of the study in mind, Joel Smith, Glenn Johnson, and the author proceeded with the second step of defining categories to which numbers were assigned. The answers could then be represented by a number. In the case of the attribute data code numbers were assigned to intervals of numbers or to the actual number given as an answer.

The preliminary code, constructed in this way, was presented to the Risk and Uncertainty Subcommittee. The code was revised according to their recommendations.

Later the sections concerning open-ended questions were subjected to reliability tests. To test the code a definite procedure was followed: (1) Two persons would code 15 or 20 actual questionnaires randomly selected from the seven states. (2) The code numbers assigned by the testers for each item were compared for agreement. (3) When the numbers did not agree, discussion of the reasoning followed in coding the item led to one of the members changing his mind to agree with the other or to both agreeing to change the code. This testing of the code provided the necessary background to instruct clerks in the coding procedure they were to follow.

The coding of all the schedules was carried out in three steps. First, Joel Smith and the author taught the clerks by acquainting them with the code and then instructing them on the proper procedure to follow in a

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The final stage in getting the responses from the schedules to IBM cards was cross tabulating. After all the lists of responses which did not fit the code were either (a) fitted into a broadened category of the existing code or (b) included in new code items, the number of items that would appear in a particular column of the IBM card was checked against the number of items that would appear in a related column.

When the coding procedures were completed, the tabulating department of Michigan State University punched the code numbers into IBM cards. The data on each schedule required a total of 480 columns on six IBM cards. The punched cards were again checked for interrelated punches between the columns for each question. After initial marginal tabulations were run these checks were repeated on punch and column totals.

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Reports and Criticism

In August 1955, a report of the progress of the I.M.S. was given to the American Farm Economics Association at their annual meeting. Harold Jensen discussed the nature of the study by pointing out the relation between the managerial concepts developed by Johnson and Haver and the survey questions.[1] Haver of the University of Chicago spoke about the universe of farms studied[2] and Joel Smith discussed some of the problems of methods in the I.M.S. survey.[3] These papers parallel and supplement the content of this chapter.

Glenn Johnson presented a paper of more direct concern to this thesis.[4] He pointed out how the Friedman-Savage utility hypothesis was used in constructing the technique dealing with gains and losses in the I.M.S. survey. Since there were no data available at the time of his report, no evaluation or conclusions could be drawn concerning the effectiveness of the technique.

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[1]Harold Jensen, "Progress and Problems in Decision Making Studies; The Nature of the Study," Journal of Farm Economics Proceedings No. 5, (December, 1955).

[2]C. B. Haver, "Progress and Problems in Decision Making Studies; The Universe of Farms Studied," Journal of Farm Economics Proceedings No. 5, (December, 1955).

[3]Joel Smith, "Progress and Problems in Decision Making Studies; Some Problems of Method in the Interstate Managerial Study," Journal of Farm Economics Proceedings No. 5, (December, 1955).

[4]G. L. Johnson, "Progress and Problems in Decision Making Studies; The Friedman-Savage Utility Hypothesis in the Interstate Managerial Study," Journal of Farm Economics Proceedings No. 5, (December, 1955).

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C. F. Sarle has criticized the total study in two published papers. In the first, he points out two conceptual difficulties that he envisions on the basis of the list of questions used in the survey. These are (1) the study assumes that the decision process is an individual process rather than a social one, and (2) the study imputes decision processes to the individual that are of a nature foreign to the best findings of psychology.[1] In reference to the questions on the schedule he believes them to be phrased in terms of an abstract managerial decision process lacking in empirical reference.

In his second paper, Sarle further criticizes the questionnaire for its use of abstract terms and concepts. He emphasizes how important communication between the researcher and the respondents is for sound socio-economic survey research.[2]

In reply to Sarle's criticisms, Johnson and Smith claim Sarle's evaluation was premature in that he was not well acquainted with many important aspects of the study, including the data.[3] In a second paper, Johnson states[4]

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[1]C. F. Sarle, "Research on the Dynamics of the Farm Managerial Decision Process," Journal of Farm Economics, Vol. 38 (February, 1956), pp. 159-160.

[2]C. F. Sarle, "Comment on the Rejoinder," Journal of Farm Economics, Vol. 38 (February, 1956), pp. 167-170.

[3]G. L. Johnson and Joel Smith, "A Rejoinder," Journal of Farm Economics, Vol. 38 (February, 1956), p. 163.

[4]G. L. Johnson, "More Ado About Sarles Suppositions Regarding the Interstate Managerial Study," Journal of Farm Economics, Vol. 38 (May, 1956), pp. 621-622.

> . . . (1) we have been aware of many of the dangers stressed by Sarle since early in the design of the study, (2) we have taken many positive steps to avoid these dangers, (3) we have succeeded in avoiding these dangers in some instances but not in others, the pattern of successes and failures bearing at best only a vague relationship to the degree to which we followed, ex ante, Sarle's suggested methodologies, and finally (4) we are trying to analyze the data so that no unjustifiable conclusions are reached as a result of failures in the questionnaire.

It is important to note that in none of the above criticism of the questionnaire were the specific questions to be analyzed in this thesis singled out. Thus it remains the task of this thesis to evaluate the specific questions, dealing with gains and losses directly or indirectly. A technique for quantifying utility which was made operational with the set of gain and loss questions will be evaluated in the chapters that follow.

CHAPTER III

MODEL AND TECHNIQUE FOR MEASURING UTILITY

This chapter deals with the mathematical model that is the basis for utility measurement and with the technique used in the I.M.S. to quantify utility.

The Model

It has already been assumed that the nature of the manager is such that his aim is to maximize utility. Utility was further supposed to be an undefined entity or an "intervening variable."[1] It is desired that this variable be mapped or correlated to numbers in order to make it possible to use the numbers as a basis for prediction. There may be many such mappings and the passage from one mapping to another is called a transformation, the totality of these mappings forming a system of transformations. The description of the variable by numbers is said to be unique up to that system of transformations.

The empirical relationships from which utility is supposed to be abstractable is (1) preference among events, and (2) indifference between combinations of events with stated probabilities.[2]

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[1]Intervening variables are those which intercede between empirical relationships, i.e., the concept contains only words which are reducible to empirical laws.

[2]This model was proposed by von Neumann and Morgenstern, Theory of Games and Economic Behavior. (Princeton: Princeton University Press, 1947).

Thus consider a system U of entities **u, v, w....** In U, a relation is given $u > v$, and for any number α, $(0 < \alpha < 1)$ an operation

$$\alpha u + (1 - \alpha) v = w$$

is defined.

This relation and this operation satisfy the following axioms.[1]

I. $u > v$ is a complete ordering of U, i.e., $u < v$ when $v > u$.

A. For any two u, v, one and only one of the following relations holds:

1) $u = v$

2) $u > v$

3) $u < v$

B. Transitivity: $u > v$, $v > w$, then $u > w$.

II. Ordering and combining

A. $u < v$, then $u < \alpha u + (1 - \alpha) v$

B. $u > v$, then $u > \alpha u + (1 - \alpha) v$

C. $u < w < v$, then there exists an α such that $\alpha u + (1 - \alpha) v < w$

D. $u > w > v$, then there exists an α such that $\alpha u + (1 - \alpha) v > w$

III. Algebra of combining

A. $\alpha u + (1 - \alpha) v = (1 - \alpha) v + \alpha u$

B. $\alpha (Bu + (1 - B) v) + (1 - \alpha) v = \gamma u + (1 - \gamma) v$ where $\gamma = \alpha B$

Two important theorems that von Neumann and Morgenstern deduced and proved[2] from this set of axioms are:

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[1]An axiomatic system is a linguistic structure in which no identification with empirical constructs is made.

[2]The proofs of the interceding lemmata and theorems as well as the proofs of the two theorems listed is given in the appendix of von Neumann and Morgenstern, op. cit., pages 617 - 632.

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Theorem 1) There exists a mapping of $w \longrightarrow q(w)$ of all w on a set of numbers possessing the two properties

a) Monotony (not decreasing)

b) For $0 < \alpha < 1$ and any u, v

$$q[(1-\alpha)u + \alpha v] = (1-\alpha)q(u) + \alpha q(v)$$

Theorem 2) For any two mappings of $q'(w)$ and $q(w)$ possessing the properties a) and b) of Theorem 1)

$q'(w) = w_0 \, q(w) + w_1$ with two suitable but fixed w_0 and w_1 where $w_0 > 0$.

The first theorem provides the correspondence between utilities and numbers whereas the second theorem says the numerical mapping is determined up to a linear transformation.[1]

Technique of Quantifying Utility

The set of axioms I, II, III and theorems 1 and 2 provides the formal structure for obtaining a numerical utility. If a technique that incorporates the concepts of the axioms can be developed for obtaining data, then the theorems provide the basis for deriving a numerical utility function. The technique used in I.M.S. has, as its objective, the collection of such data. The remainder of this chapter deals with the construction and use of this technique.

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[1]M. Friedman and L. J. Savage, "The Expected Utility Hypothesis and the Measurability of Utility," Journal of Political Economy, Vol. 60 (December, 1952), p. 468, present the alternative theorem: There are numbers $c_1, \ldots, c_n$ such that $u \leq v$, if and only if $\sum u_i c_i \leq \sum v_i c_i$. Moreover, any two such sequences of numbers c_i and c_i' are connected by an equation $c_i' = s + tc_i$ for some s, t, with $t > 0$.

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Consider this situation.

"If you knew that one person out of a group of 40 would get a piece of property worth \$1,000, at no further cost to him, would you be willing to pay 10 dollars out of your present income to become a member of that group?"

This situation could be considered as consisting of three entities, (1) the utility of the present income position, (2) the utility of the possible 1,000 dollar gain and (3) the utility of the possible position of having 10 dollars less than at present. It is assumed that a person could order these entities by the three relations (1) indifference, (2) more preferred, and (3) less preferred. The operation $\alpha u + (1 - \alpha) v = w$ is made meaningful by letting:

a) u = utility of 1,000 dollars gain

b) v = utility of the position of having 10 dollars less (payment to play)

c) w = utility of present income

d) α = probability of 1,000 dollar gain = 1/40

e) $1 - \alpha$ = probability of losing payment to play = 39/40

In this situation, the operation would read $1/40u + 39/40v > w$ or $1/40u + 39/40v < w$ depending upon the answer to the query. The transitivity axiom is given intuitive appeal by considering that if $u > w$ and $w > v$ in the above situation, then it seems plausible that $u > v$. Further, the ordering axiom seems clear when one considers $u > v$ in the above situations; then $u > 1/40\ u + 39/40\ v$ since the two alternatives are mutually exclusive there is no reason to expect complementarit

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complementarity between the utility of a 1,000 dollar gain and the utility of the position of having 10 dollars less. The ordering $u > w > v$ surely implies the existence of an α with $\alpha u + (1 - \alpha) v > w$; however, this technique does not attempt to find the exact α.

The algebra of combining axiom makes it possible to interchange the two entities u and v in the above situation and obtain the same answers. The technique does not take advantage of this axiom. Now suppose there were two situations, one exactly like the above and another analogous except that

a) size of gain = 5,000 dollars and

b) $\alpha = 1/200$

Suppose that someone answered "No" to the first situation and "Yes" to the second situation. Then the following operations would hold respectively:

1) $1/40\ u + 39/40\ v < w$

2) $1/200\ u' + 199/200\ v' > w'$

Where

a) u' = utility of 5,000 dollars gain

b) v' = utility of position of having 10 dollars less

c) $w = w'$ = utility of present income

Since the operation $\alpha u + (1 - \alpha) v = w$ is postulated, it must exist somewhere between these two situations. It seemed quite impractical to find the exact α for each interviewee and the utility entities which would satisfy this condition. This was particularly true as an alternative approximation to this condition produces the desired results.

Thus, it was assumed that an indifference point exists within the interval between the two quantities of gain. If the true points of indifference are uniformly distributed over the interval then they can be represented by a point located half-way between the two quantities of gain, then the operation is $1/200\ u'' + 119/120\ v'' = w''$, where

a) u'' = utility of 3,000 dollars gain

b) v'' = utility of position of having 10 dollars less

c) $w = w' = w''$ = utility of present income.

A belief that the large number of cases used would reduce the apparent inaccuracies of the mean values or of group data also justifies this procedure. The complete technique used in the I.M.S. consisted of two sets of similar situations, one set dealing with gain situations and the other with loss situations. A description of each of the situations for the gain set and the loss set is shown in Table 2.

The range of alternative gains from 500 dollars to 50,000 dollars, and the range of possible losses from 100 dollars to 50,000 dollars were intended to cover the range of gains and losses which would be meaningful to the respondents in the survey. A previous pilot study conducted by the author and Chris Beringer showed that married college students would accept smaller loss situations than gain situations. Thus the loss situations start at a smaller amount than the gain situations.

The range of probabilities from 1/2000 - 1/20 for the gains situations and from 1/2000 - 1/4 for the loss situations was kept to

TABLE 2

DESCRIPTION OF GAIN AND LOSS SITUATIONS USED ON THE INTERSTATE MANAGERIAL STUDY SCHEDULES

Amount of Gain (P_1) (dollars)	Probability of Gain (α)	Expected Gain (αP_1) (dollars)	Amount of Payment[a] (dollars)			Types of Odds[a]		
		Gains Situations						
500	1/20	25	10	25	40	MF	F	UF
1,000	1/40	25	10	25	40	MF	F	UF
5,000	1/200	25	10	25	40	MF	F	UF
10,000	1/400	25	10	25	40	MF	F	UF
25,000	1/1000	25	10	25	40	MF	F	UF
50,000	1/2000	25	10	25	40	MF	F	UF
		Loss Situations						
100	1/4	25	10	25	40	MF	F	UF
500	1/20	25	10	25	40	MF	F	UF
1,000	1/200	25	10	25	40	MF	F	UF
10,000	1/400	25	10	25	40	MF	F	UF
25,000	1/1000	25	10	25	40	MF	F	UF
50,000	1/2000	25	10	25	40	MF	F	UF

[a]The three sub-columns under these two headings correspond respectively to more than fair, just fair, and unfair odds. All 10 dollar payments are MF, 25 dollar payments F and 40 dollar payments UF.

a minimum, to try to avoid the possible confounding effect of the utility attached to probability distributions.[1]

The range of payments or stakes from 10 dollars to 40 dollars for both sets of situations was intended to avoid the possible disutility effect of this loss as well as to keep the expected gain or loss equal and small.[2]

The situations were arranged randomly on two sheets of legal sized paper with the loss situations on the first sheet and the gains situations on the second. The forms used are shown in Appendix A. The words used in communicating the probabilistic situation were intended to avoid the connotation of "roulette wheel gambling."[3]

The interviewers (1) read an example[4] of the loss situation to the respondent, (2) answered respondent's questions concerning this example, (3) asked the respondent to check Yes or No under each of the situations presented to him on the loss sheet and (4) if necessary, reframed the situations in more meaningful terms, i.e., using fire, windstorm or other possible farm losses. A similar procedure was then followed with

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[1] C. H. Combs, and O. Beardslee, On Decision-Making Under Uncertainty, formulate an extensive model that includes not only the utility of the gain (or loss) and the utility of the "payment to play" but also the utility of probability distributions. Experiments patterned after this model would include the entire range of probability from 0 to 1. This formulation can be found in R. W. Thrall, C. H. Coombs, and R. L. Davis, Decision Processes (New York: John Wiley & Sons, 1954) pp. 255-85.

[2] In a later chapter it is assumed that the marginal disutility of a dollar over the range of the three stakes is constant.

[3] Pretest results indicated that the gains questions were interpreted as gambling to which many respondents objected. The attempt at avoiding this connotation was not completely successful.

[4] The example was unlike any of the situations in Table 2 in respect to amount of loss or gain, probability or payment to play.

the sheet of gain situations by substituting gain for loss in the first three steps and meaningful terms in the fourth, e.g., a small investment in some farm enterprise.

Summary

This chapter has presented the mathematical structure for utility measurement. It has shown how this structure has been identified with certain aspects of the technique used in the I.M.S. to quantify utility. The next two chapters will be concerned with the results of using this technique with 529 farm managers.

CHAPTER IV

THE MODEL ELABORATED TO ESTABLISH CONSISTENCY CLASSIFICATIONS

This chapter elaborates the utility model and as a first step in the analysis of the data classifies responses as to degree of consistency with the elaborated model. This is only a preliminary to the main analysis of this thesis. This classification is used (1) to test the effectiveness of the schedule and the reliability of interviewing and (2) to not only test the technique of quantifying utility, but also in determining relationships between utility estimates and related variables. Testing of the schedule and the reliability of the interviewing will take place in the next chapter, while the second step is carried out in the sixth chapter.

Elaborated Model

In what follows the model is elaborated to include a utility function consistent with the formal structure set forth in the previous chapter. There, it was assumed that an individual would say 'Yes' to a situation if $\alpha u + (1 - \alpha) v > w$ where

u = the utility of the position of acquiring the gain

v = the utility of the position of having lost the payment to play

w = the utility of the present income, and

α = the probability of the gain.

This condition is illustrated by the function shown in Figure I.[1] Wealth is plotted along the horizontal axis and utility along the vertical axis. In Figure I, the following symbols represent the quantities of wealth represented by the property to be gained in the hypothetical situations--

P_0 = the present income

$P_0 - P_1$ = the value of the property to be gained, and

$P_0 - P_2$ = the payment to play.

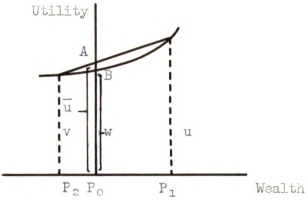

Figure I. Hypothesized utility function for an individual who accepts a fair bet.

Choosing α such that the expected gain of wealth is equal to zero, i.e., $\alpha P_1 + (1 - \alpha) P_2 = P_0$,[2] makes the situation a fair bet. The expected utility $\bar{u}$, is shown at A where $\alpha u + (1 - \alpha) v = \bar{u}$. The utility of the present income w is shown at B. The operation $\alpha u + (1 - \alpha) v > w$ is satisfied where $\bar{u} > w$. Only a function concave from

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[1]The shape of the hypothesized function is due to Friedman and Savage, op. cit., page 74.

[2]The equal sign means the monetary position of the individual is unchanged from his position at P_0. In Table 2 a fair bet was indicated when $\alpha P_1 = P_0 - P_2$.

above can describe the utility attached to the gain of wealth for a person who accepts this kind of a fair bet in maximizing his expected utility.

In the loss situations where

u = the disutility of the position of incurring the loss

w = the disutility of the position of having lost the payment of a premium (insured income)

v = the utility of the present income position, and

α = the probability of a loss,

a convex function from above shows the operation $\alpha u + (1 - \alpha) v < w$ to be satisfied.

In Figure II, the expected utility $\alpha u + (1 - \alpha) v = \bar{u}$ is shown at C, and the utility of the insured income, w, at D.

Let P_0 = the present income

$P_0 - P_1$ = the value of the property to be lost, and

$P_0 - P_2$ = the amount of the premium.

Assuming α is such that $\alpha P_1 + (1 - \alpha) P_2 = P_0$,[1] then the situation is a fair insurance scheme. For an individual to accept this situation means that $\bar{u} < w$.

Similarly for all the other odd situations, that is, more than fair, and unfair, the utility function for gains will be considered concave from above and for losses convex from above.

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[1]The equal sign means the monetary position of the individual is unchanged from his position at P_0, i.e., the expected loss is zero. In Table 2 a fair insurance scheme was indicated when $\alpha P_1 = P_0 - P_2$.

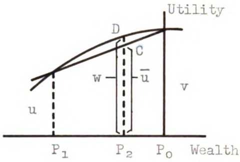

Figure II. Hypothesized utility function for an individual who accepts a fair insurance scheme.

The Patterns of Consistency

In this section all possible responses to the hypothetical questions are classified according to their consistency with the hypothesized utility function. It was shown in the previous chapter how the indifference point could be interpolated from the two operations $\alpha u + (1 - \alpha) v > w$ and $\alpha u' + (1 - \alpha) v' < w'$ given by a particular set of answers. From the indifference operation the utility of either gains or losses can be established. By using the concept of indifference points and assuming that these points fall on a numerical function, it is possible to determine types of answers which are consistent or inconsistent with the hypothesized utility function.

First those answers which either do indicate or could indicate an indifference point will be defined as being consistent with the axiomatic indifference operation. These consistencies will be called "within-odds consistent". Second, the location of the indifference points will be specified in order to define consistency with the hypothesized function. This kind of consistency will be called "between-odds consistent." Other types of answers will also be considered. In addition some statistical comparisons will be made of the observed and expected numbers of consistencies.

Within-Odds Consistency

These cases are consistent with the axiom of indifference. There are two kinds of within-odds consistency, (1) with the indifference point and (2) without the indifference point.

With Indifference Point

In this case the expression "within-odds consistent" refers to the series of answers in which an indifference point can be established. Such points can be established if an individual first said 'No' to one or more of the questions, starting at the smallest gain or loss and then said 'Yes' to the remainder of the questions within one set of odds. The intervals in which indifference points can be established occur along the horizontal axis for the gains and for the losses between two adjacent possible gains or losses, to one of which the respondent said 'No' and to the other of which he said 'Yes'. There are five intervals in which the indifference points can occur.

The location of the indifference points for each set of odds defines "between-odds consistency." This kind of consistency not only agrees with the indifference axiom but is also consistent with the hypothesized utility function. The degree of consistency is determined by the number of indifference points indicated by the answers to the gain or loss set. The three degrees of consistency to be defined contain three, two and one point(s) respectively.

Between-Odds Consistency with Three Indifference Points. - A pattern of answers for a respondent which displayed between-odds consistency with three indifference points (1) has one indifference point for each of the three odds which (2) can be joined by a line over the interval in which the indifference points occur that in the case of gains is concave from above and in the case of losses is convex from above. To be consistent with the hypothesized function, the indifference point for the fair odds has to occur at an amount equal to or greater than the amount at which the indifference point for the more than fair odds occurs. A similar relation has to exist between the unfair and fair odds, i.e., the indifference point for the unfair odds has to occur at an amount equal to or greater than the amount at which the indifference point occurs for the fair odds. By considering the five possible indifference points for each odd, the number of possible consistent cases of this type is 35 for either the gains or the losses. Actually, 24 and 29 cases for gains and losses respectively were manifest in the results.

Between-Odds Consistency with Two Indifference Points. - This type of between-odds consistency requires the following conditions: (1) one indifference point per odd for each of two adjacent odds, (2) either (a) the point for the least fair odd occurs between two amounts (of gain or loss) larger than the interval in which the other point occurs or (b) both points occur in the same interval, and (3) the odds for which there is no indifference point are (a) answered all Yes in the case of the more-than-fair odds and (b) answered all No in the case of the unfair odds. The number of possible consistent cases of this type is 30 for either the gains or losses. When all five possible indifference points are considered, the results showed 19 and 22 cases for the gains and losses respectively.

Between-Odds Consistency with One Indifference Point. - This type of consistency occurs when (1) there is only one indifference point and (2) the other odds are answered all Yes or all No according to the following patterns:

a) If the indifference point occurs in the more-than-fair odds then all the fair and unfair situations have to be answered No.

b) If the indifference point occurs in the fair odds, then all the more-than-fair situations have to be answered Yes and the unfair situations No.

c) If the indifference point occurs in the unfair odds, then all the fair and the more-than-fair have to be answered Yes.

When the five possible placements of the indifference points are counted for either the gains or losses, the number of consistent cases of this type is 15. For the gains 14 cases and for the losses 10 such cases were actually found in the results.

In total for either gains or losses there are 80 cases of the three types of between-odds consistency defined above. A chi-square test run on the sum of the squared differences between the observed and the expected number of types of consistency showed a significant difference (5 percent) for gains and a difference significant at 30 percent for losses.

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A smaller number of consistent answers were obtained for the gains than were obtained for the losses. This, no doubt, increased the probability of finding a greater number of consistent answers of the different types for the losses and explains the greater degree of significance for the gains. There were almost twice as many usable schedules from the standpoint of showing indifference points for the losses than for the gains. The apparent difficulties involved will be analyzed in the next chapter (see pages 59 to 95).

Without Indifference Points

A weaker definition of "within-odds consistent" is a series of answers in which there is no indifference point, as the respondent said either 'Yes' or 'No' to all the situations within one set of odds. This is a weaker definition of being consistent with the axiomatic indifference operation because there was no indifference point indicated by the answers. These answers can not be considered to be inconsistent with the axiom since a smaller or larger gain (loss) than was included in the questions would allow the respondent to indicate the location of his indifference point. They are consistent only in the sense that five chances to reveal inconsistency failed to do so.

Between-Odds Consistency with No Indifference Point. - This is the weakest type of between-odds consistency. It occurs when the respondent answered either all 'Yes' or all 'No' according to the following patterns:

1) No to all three odds,

2) No to unfair and fair, Yes to more than fair odds,

3) No to unfair, Yes to fair and more than fair,

4) Yes to all three odds.

Any one of these is called a weak form of consistency because (1) there is no indifference point, (2) the pattern 2) above is not inconsistent with a hypothesis of diminishing marginal utility for gains or diminishing marginal disutility for losses, and (3) pattern 3) above is not inconsistent with a hypothesis of constant marginal utility. None of the cases are inconsistent with a hypothesis of measurable utility. There are only these four possible cases of this type.

Within-Odds Inconsistency

The answers in this group are those which showed more than one indifference point per odd after adjusting the answers (see pp. 54-55). Also included in this group are cases which were inadequate for assessment, i.e.,one or more, but not all, situations were not answered.

Between-Odds Inconsistency

These cases of inconsistency, although containing one indifference point per odd which made them "within-odds consistent," had the indifference points located so that they were not consistent with the hypothesized utility function.

None of the Odds Answered

In some cases, the respondents refused to answer the questions; these cases are included in this group.

Statistical Comparisons of Observed and Expected Within-Odds Consistency

The number and percentage of observed and expected within-odds consistencies are shown in Table 3. The expected number assumes that the questions were answered at random. That is, by chance seven cases are expected to be consistent with the indifference axiom out of a total of 64 ways in which six Yes or No answers can be permuted for one odd.

TABLE 3

OBSERVED AND EXPECTED NUMBER AND PROPORTIONS OF WITHIN-ODDS CONSISTENCIES FOR GAINS AND LOSSES

Type of Answer	Odds	Observed Number	Observed Proportion	Expected Number	Expected Proportion
		Gains			
Consistent	More than Fair	363	68.6	57.8	10.9
Inconsistent	More than Fair	166	31.4	471.2	89.1
Consistent	Fair	370	69.9	57.8	10.9
Inconsistent	Fair	159	30.1	471.2	89.1
Consistent	Unfair	369	69.8	57.8	10.9
Inconsistent	Unfair	160	30.2	471.2	89.1
		Losses			
Consistent	More than Fair	390	73.7	57.8	10.9
Inconsistent	More than Fair	139	26.3	471.2	89.1
Consistent	Fair	356	67.3	57.8	10.9
Inconsistent	Fair	173	32.7	471.2	89.1
Consistent	Unfair	374	70.7	57.8	10.9
Inconsistent	Unfair	155	29.3	471.2	89.1

It is apparent that there are six times as many observed within-odds consistencies as there are expected by the random model. Obviously random answering as a null hypothesis must be rejected.

Statistical Comparisons of Observed and Expected Between-Odds Consistency

In total for either gains or losses there are 84 cases of the four types of between-odds consistency as defined above.[1] The number of individuals who revealed each of the four types is shown in Table 4. The total number of interviews was 529.

TABLE 4

NUMBER OF INDIVIDUALS IN EACH OF THE FOUR TYPES OF BETWEEN-ODDS CONSISTENCY

Number of Indifference Points		Observed Number	
		Gains	Losses
3		56	127
2		40	75
1		47	36
0		95[a]	105
	Total	238	343

[a]For reasons given in a later chapter this does not include all No answers.

It is apparent that a hypothesis that would state an equal probability of occurrence for each of the 84 cases would be rejected. A hypothesis of the probability of occurrence could be formulated from this study that could be tested by later studies. Subsequent chapters will consider some of the reasons for these differences in answers between the degrees of consistency and between the gains and losses questions.

[1]Considering the gains and losses together, there are 7,056 possible combinations of cases consistent with the axiom and the measurable utility hypothesis. No attempt has been made to formulate a probability model for the 84 or for the 7,056 cases.

CHAPTER V

EFFECTIVENESS OF THE SCHEDULES AND INTERVIEWERS

This chapter considers the responses to the schedule of questions concerning gains and losses in respect to its effectiveness in eliciting answers. In order to carry out this evaluation it is first necessary to review the procedure followed in getting the answers from the field schedules to IBM cards. This review indicates the adjustments that were made in the answers and the kind of information finally coded. Then the responses are cross classified between the types of answers and the state in which the schedule was taken. Finally, between states differences in types of answers are related to possible determining variables, including interviewing procedures.

This chapter is divided into subsections as follows: (1) coding procedure and adjustment, (2) the information coded, (3) answer groups defined, (4) between state differences by answer groups with special reference to interviewer bias.

Coding Procedure

The first step in the process of getting the responses onto IBM cards was to copy the answers from the field schedules onto the respective columns of work sheets. The work sheet is shown in Appendix C.

The next step was to make certain replacements and transpositions which provided some additional information for testing a methodological hypothesis. A replacement is the changing of a Yes to a No or vice versa in order that there will be one and only one indifference point per odd. If there were no indifference point, then no replacement was necessary; however, if two indifference points were indicated by the pattern of answers then the point at the greatest gain or loss was eliminated by a replacement. A common replacement, for example, would be to change the last No to a Yes in the following sequence.

No Yes Yes Yes Yes No

A transposition is the interchanging of a Yes and a No in order to make a pattern of answers show one and only one indifference point per odd. A common transposition would be to interchange the underlined Yes and No in the sequence of unfair odds.

Fair odds:	No	No	No	Yes	Yes	Yes
Unfair odds:	No	No	No	<u>Yes</u>	<u>No</u>	Yes

This will make the indifference point for the unfair odds occur at a larger amount than for the fair odds.

Either a replacement or a transposition was allowed in each set of odds but not both. Only one of either kind of adjustment was allowed because only one indifference point and hence only one area of indecision is implied by the model used in this thesis. Whenever a replacement or a transposition was made, a special code number was indicated. Whether or not this adjustment for consistency provides additional observations that would otherwise be lost is the methodological hypothesis to be tested by this procedure. The special code number furnishes the test data for this hypothesis.

The hypothesis is based upon the fact that the probability of a consistent answer occurring by chance without adjustment would be extremely small and the probability of making an unintentional error of the type adjusted is large. Thus, a superior criterion for testing the hypothesis is whether or not the adjusted cases are significantly different from the unadjusted cases in relevant respects. The hypothesis is tested in Chapter VI where further preliminary constructions are given.

The third step in coding was to summarize the placement of the indifference points on the left hand side of the work sheet. All the information necessary for further coding then appeared on the work sheet.

Coded Information

The following were coded and placed in 29 columns on IBM cards:

1) A summary of the placement of the indifference points for each of the 6 odds.
2) A special punch noted whether or not the odds were converted to consistency by replacement or transposition.
3) The exact answers for each gain and loss situation.
4) The numerical utility corresponding to each indifference point after adjustments were made. (These computations will be illustrated in the next chapter.)

5) The patterns or types of between-odds consistency.

6) A summary of combinations for both gains and losses of within and between-odds consistency.

Answer Groups Defined

The 529 schedules were divided into six groups based, in part, upon the consistency classes developed in the previous chapter. Further, some of these groups are distinctly different from each other in the mode of answers. However, considerable variability still exists within several of the groups. The schedules of the first group (Group I and A) are similar in that all more-than-fair situations were answered Yes, but differ in the manner in which the fair and unfair odds were answered. The last group (Group VI and F) contains schedules which showed within and between-odds consistency; however, no distinction is made concerning the location of indifference points until the next chapter. The six groups for gains and the six groups for losses are defined below:[1]

Group I.[2] Gains questions answered showing one of the following patterns:

a) Yes to all more-than-fair, No to all fair and unfair

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[1]For the remainder of this chapter groups formed from answers to the gains situations will be indicated by Roman numerals and the groups formed from answers to the loss situations will be indicated by capital letters.

[2]These cases are consistent with the indifference axiom and with the measurability of utility hypothesis; however, are the weakest type.

b) Yes to all more-than-fair and fair, No to all unfair

c) Yes to all more-than-fair, fair and unfair.

Group II. Gains questions answered No to all odds.

Group III. Gains questions answered but within-odds inconsistent or inadequate for assessment.

Group IV. Gains questions answered but between-odds inconsistent.

Group V. Gains questions not answered.

Group VI.[1] Gains questions answered and both within and between-odds consistent.

Similar groups for the loss situations were formed as follows:

Group A.[2] Loss questions answered but shows one of the following patterns:

a) Yes to all more-than-fair, No to all fair and unfair

b) Yes to all more-than-fair and fair, No to all unfair

c) Yes to all more-than-fair, fair and unfair.

Group B. Loss questions answered but No to all odds.

Group C. Loss questions answered but within-odds inconsistent or inadequate for assessment.

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[1]These schedules are consistent with the axiom and with the hypothesized utility function. This group is considered again in Chapter VI.

[2]These cases are consistent with the indifference axiom and with the measurability of utility hypothesis; however, are the weakest type.

Group D. Loss questions answered but between-odds inconsistent.

Group E. Loss questions not answered.

Group F.[1] Loss questions answered and both within and between-odds consistent.

These groups will be studied for differences with respect to certain attributes and behaviors. The revealed differences will, in turn, be used to explain differences between the groups.

The attribute data are:

1) State in which the schedule was taken
2) Respondent's years of farming experience
3) Respondent's age
4) Number of respondent's dependents
5) Type of farming engaged in by the respondent
6) Number of years respondent attended school.

The behavior items are:

1) Net worth of respondent
2) Respondent's average gross income for a three-year period
3) Debt position of respondent (amount of debt in dollars)
4) Proportion of total land managed that is rented by the respondent
5) Proportion of total gross income that respondent earned from the farm
6) The respondent's ratio of total debts to total assets

---

[1]These schedules are consistent with the axiom and with the hypothesized utility function. This group is considered again in Chapter VI.

7) The respondent's concern for taking action when he should not, or for not taking action when he should.

Comparisons were made on the basis of the Student's "t" test on the mean values of the groups and by the chi-square test of independence for the attribute data. Only those results are reported which showed differences significant at the 30 per cent level by the "t" test between groups and indicated independence between variables at chi-square values significant at the 40 per cent level. For each characteristic the level of significance will be reported.

Between State Differences by Answer Groups with Special Reference to Interviewer Bias

For Gains

The distribution of the 529 schedule over the six answer groups for gains is shown in Table 5 in numbers and by percentages.

TABLE 5

DISTRIBUTION OF THE 529 SCHEDULES OVER THE SIX ANSWER GROUPS, FOR GAINS

Answer Group	(Mode of Answer)	Number of Schedules	Per cent of Total
I	(Weak Consistency)	95	18.0
II	(All No)	123	23.2
III	(Within-odds Inconsistent)	83	15.7
IV	(Between-odds Inconsistent)	21	4.0
V	(Not Answered)	65	12.3
VI	(Consistent)	142	26.8
Total		529	100.0

In Table 6 the distribution of the schedules for the seven states over the six answer groups is shown by percentages.

TABLE 6

DISTRIBUTION OF THE SCHEDULES FOR EACH OF THE SEVEN STATES OVER THE SIX ANSWER GROUPS, BY PER CENT, FOR GAINS[a]

	I (Weak)	II (All No)	III (W - O Incon.)	IV (B - O Incon.)	V (Not Answered)	VI (Consist.)	Total	Number of Schedules
Kentucky	26.2	13.1	16.4	3.3	8.2	32.8	100.0	61
Ohio	14.7	4.4	7.4	4.4	27.9	41.2	100.0	68
Indiana	6.45	58.1	14.0	2.1	6.45	12.9	100.0	93
Michigan	23.2	14.3	11.6	3.6	12.5	34.8	100.0	112
No. Dakota	15.4	20.0	20.0	4.6	12.3	27.7	100.0	65
Iowa	22.0	27.1	22.0	5.1	3.4	20.4	100.0	59
Kansas	19.7	18.3	22.6	5.6	15.5	18.3	100.0	71

[a]Chi-square is significant at less than 1 per cent.

The important point to observe in Table 6 is that Kentucky, Ohio, Michigan, and North Dakota have higher percentages in group VI than any other group. Group I is second in per cent of schedules taken in Kentucky, Michigan, Iowa, and Kansas. Indiana and Iowa had the highest percentage of schedules in Group II; however, Indiana had over 50 per cent of its schedules in this group while Iowa had slightly over 25 per cent. Kansas had the highest percentage of schedules in Group III. All the states were low in respect to Group IV. The low percentages in Group IV probably result from coding. Schedules were probably disqualified from Groups I, II and VI on the basis of within-odds inconsistency before the between-odds factor was considered, i.e., if an individual was inconsistent within one odd, his between-odds consistency was not considered.

In Table 7 the distribution of each group over the seven states is shown by percentages.

TABLE 7

DISTRIBUTION OF EACH GROUP OVER THE SEVEN STATES, BY PER CENT, FOR GAINS[a]

	I (Weak)	II (All No)	III (W - O Incon.)	IV (B - O Incon.)	V (Not Answered)	VI (Consistent)
Kentucky	16.9	6.5	12.1	9.5	7.7	14.1
Ohio	10.5	2.4	6.0	14.3	29.2	19.7
Indiana	6.3	43.9	15.65	9.5	9.2	8.45
Michigan	27.4	13.0	15.65	19.05	21.6	27.45
No. Dakota	10.5	10.6	15.65	14.3	12.3	12.7
Iowa	13.7	13.0	15.65	14.3	3.1	8.45
Kansas	14.7	10.6	19.3	19.05	16.9	9.15
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Chi-square is significant at less than 1 per cent.

The first table in this sequence (Table 6) showed how the schedules were distributed within each state. Table 7 shows the contribution of the particular state to each of the six groups. Thus, Michigan contributed the largest percentage of schedules to Group I, Indiana to

Group II, and Kansas to Group III. Indiana, Michigan, North Dakota and Iowa were tied for a close second in Group III. Michigan and Kansas contributed the largest percentage to Group IV but Michigan made the greatest contribution to Group VI. Ohio contributed the largest percentage to Group V.

These two sets of comparisons for gains show the wide diversity in answering the gains questions both between and within states. If the questions had been answered similarly in each state, the distributions by states would be approximately the same and the distribution between states would correspond to the proportion of the total schedules taken in each state. This latter proposition is not true for the gains questions. The same two comparisons for the loss questions follow in the next sub-section.

For Losses

The distribution of the 529 schedules for the loss questions over the six groups is shown in Table 8 in numbers and by percentages.

TABLE 8

DISTRIBUTION OF THE 529 SCHEDULES OVER THE SIX ANSWER GROUPS, FOR LOSSES

Answer Group	(Mode of Answer)	Number of Schedules	Per cent of Total
A	(Weak consistency)	89	16.8
B	(All No)	18	3.4
C	(Within-odds Inconsistent)	105	19.8
D	(Between-odds Inconsistent)	27	5.1
E	(Not Answered)	51	9.7
F	(Consistent)	239	45.2
Total		529	100.0

Table 9 gives the distribution of the schedules for losses within the seven states.

TABLE 9

DISTRIBUTION OF THE SCHEDULES FOR EACH OF THE SEVEN STATES OVER THE SIX ANSWER GROUPS, BY PER CENT, FOR LOSSES[a]

	A (Weak)	B (All No)	C (W - O Incon.)	D (B - O Incon.)	E (Not Answered)	F (Consistent)	Total	Number of Schedules
Kentucky	31.1	4.9	16.3	4.9	8.2	34.4	100.0	61
Ohio	8.8	0	10.3	1.5	16.2	63.2	100.0	68
Indiana	20.4	5.3	25.8	6.5	6.5	35.5	100.0	93
Michigan	14.3	1.8	15.2	5.3	10.7	52.6	100.0	112
No. Dakota	9.5	6.3	9.5	6.3	7.9	60.3	100.0	63
Iowa	16.9	3.4	28.8	8.5	3.4	39.0	100.0	59
Kansas	18.3	2.8	33.8	2.8	14.1	28.2	100.0	71

[a]Chi-square significant at less than 1 per cent.

The outstanding feature of Table 9 is that the highest percentage of schedules for all the states except Kansas is in Group F. Kansas has the second highest percentage in Group F which includes those schedules consistent within and between-odds and corresponds to Group VI for gains. This distribution is in contrast with Table 6 on gains where the proportion in Group VI for all states is less than in Group F.

It is also noteworthy (seen in Table 9) that Indiana, Michigan, North Dakota and Iowa have the second highest per cent in Group C whereas Kansas has its highest per cent in Group C. This is the group in which either the within-odds were inconsistent or inadequate for assessment. In all states except Kentucky at least 60 per cent of the schedules fell either in Group C or Group F. Group F dominates in all states except Kansas and Kentucky. Thus, it appears that a high percentage of all the respondents was either totally consistent or inconsistent in answering the loss questions. This is in contrast to the results on the gains questions, where several other modes of answers, e.g., I, II and IV were also prominent. This may mean that the loss questions were easier for the interviewers to communicate to the respondent than were the gains questions. At least this could have resulted in the respondent attempting to answer the questions, regardless of whether or not he answered them consistent with the hypothesis; whereas, in the case of the gains questions, other types of answers may have appeared as the respondents attempted to avoid the "gambling type" situations.

In Table 10 the between states distribution by groups is shown. In contrast to Table 7 on gains, where several states contributed a large percentage to a particular group, Table 10 shows Indiana consistently contributing the highest or at least a high percentage to Groups A, B, and C; whereas, Michigan contributes the highest or a high percentage to Groups D, E, and F. This between-states distribution for losses corresponds more closely to the proportion of the total schedules taken in each state than the same distribution for the gains questions.

TABLE 10

DISTRIBUTION OF EACH GROUP OVER THE SEVEN STATES, BY PER CENT, FOR LOSSES[a]

State	A (Weak)	B (All No)	C (W - O Incon.)	D (B - O Incon.)	E (Not Answered)	F (Consistent)
Kentucky	21.3	16.7	9.5	11.1	9.8	8.8
Ohio	6.7	0	6.7	3.7	21.6	18.1
Indiana	21.3	27.8	22.8	22.2	11.8	13.9
Michigan	18.0	11.1	16.2	22.2	23.5	24.8
No. Dakota	6.9	22.2	5.7	14.8	9.8	16.0
Iowa	11.2	11.1	16.2	18.5	3.9	9.7
Kansas	14.6	11.1	22.8	7.4	19.6	8.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Chi-square significant at less than 1 per cent.

The above two sections on gains and losses are presented together to emphasize two important facts: (1) there are important differences in the way in which the questions were answered within each set (gains or losses) of questions and (2) there are important differences between states in the way in which the two sets of questions were answered.

The first of these, that is, the differences in answer groups for the gains and losses questions, will be the main concern of the remainder of this chapter. In the case of gains certain answer groups were generally associated with a particular state and in the case of losses two states contributed large percentages to the six groups. It is highly probable that the attributes of the individuals in a particular answer group will be similar to the average respondent in the state making up the majority of the group. However, if meaningful characteristics can not be found to explain the differences between the groups then the one respect in which states could differ, interviewer bias, will be used to explain the differences.

In order to determine whether or not the characteristics of an answer group differ from the average of a state it is necessary to compare the characteristics of individuals in the seven states. The next section carries out this comparison for the characteristics listed on pages 58 and 59.

Characteristics by States

This sub-section presents the relevant characteristics of the respondents in each state. No attempt is made to explain the revealed differences. The objective, instead, is to provide background and handy reference tables for the analysis that follows. The average net worth, gross income, and debt position of respondents in the seven states is given in Table 11.

No significant differences were found among Kentucky, Indiana, and Iowa in net worth; Kansas has the highest net worth of any of the states and Michigan, the lowest. Likewise, there are no significant differences among Kentucky, Ohio, Michigan, North Dakota, and Kansas in gross income. Only Iowa and Indiana are significantly different from the other five states and from each other. Comparisons on debt position

TABLE 11

AVERAGE NET WORTH, GROSS INCOME, AND DEBT POSITION OF RESPONDENTS, BY STATES

State	Dollars		
	Net Worth	Gross Income	Debt
Kentucky	44,101.64	7,142	2,710
Ohio	38,591.67	7,563	2,695
Indiana	48,670.59	9,430	3,159
Michigan	30,725.49	7,179	2,770
No. Dakota	36,020.00	7,619	3,117
Iowa	47,539.66	11,200	3,572
Kansas	64,632.84	7,204	2,687

show Iowa and Ohio to be different at a 30 per cent level of significance. All other comparisons on debts are not significant.

The age, farming experience, and number of dependents for respondents in each state is shown in Table 12.

Kansas respondents who had the largest number of years of farming experience showed a significant difference from other respondents except those from Kentucky who ranked second in number of years of farming experience. There is no apparent difference between the other six states in this respect.

There is about a four-year difference in average age between Kentucky, Indiana and Kansas respondents compared to Ohio, Michigan, North Dakota and Iowa as groups. The average number of dependents per respondent did not vary significantly between the states.

TABLE 12

AVERAGE YEARS OF RESPONDENTS' FARMING EXPERIENCE, AGE OF RESPONDENTS, NUMBER OF RESPONDENTS' DEPENDENTS, BY STATES

State	Years of Farming Experience	Age	Number of Dependents
Kentucky	21.9	50.3	2.8
Ohio	19.1	46.7	2.6
Indiana	21.0	50.8	2.5
Michigan	19.9	48.1	2.9
North Dakota	19.8	46.1	3.1
Iowa	17.9	44.0	3.0
Kansas	23.1	49.2	2.7

The following six reference tables show highly significant differences between states for (1) the ratio of debts to assets (Table 13), (2) the proportion of total acres rented (Table 14), (3) the proportion of income from farming (Table 15), (4) the type of farm (Table 16), (5) the concern for the two types of errors (Table 17), and (6) the number of years of school attendence (Table 18). Each table shows the per cent of the total number of respondents in that state with the particular attribute.

TABLE 13

RATIO OF DEBTS TO ASSETS, PROPORTIONS, BY STATES[a]

State	Ratio				Total
	0	< .1	.11 - .2	> .2	
Kentucky	62.3	9.8	11.5	16.4	100.0
Ohio	55.0	8.3	21.7	15.0	100.0
Indiana	46.5	19.7	25.4	8.5	100.0
Michigan	57.3	17.1	14.6	11.0	100.0
North Dakota	30.3	24.2	25.8	19.7	100.0
Iowa	32.8	31.0	19.0	17.2	100.0
Kansas	60.3	19.1	11.8	8.8	100.0

[a]Chi-square significant at 2 per cent.

TABLE 14

PROPORTION OF TOTAL ACRES RENTED, BY STATES[a]

State	Proportion Rented				Total
	0	< .5	.5 - .7	> .7	
Kentucky	50.8	24.6	8.2	16.4	• 100.0
Ohio	50.0	22.0	11.8	16.2	100.0
Indiana	62.4	11.8	11.8	14.0	100.0
Michigan	62.5	25.9	8.0	3.6	100.0
North Dakota	29.2	21.5	15.4	33.8	100.0
Iowa	35.6	10.2	6.8	47.4	100.0
Kansas	28.2	18.3	16.9	36.6	100.0

[a]Chi square significant at less than 1 per cent.

TABLE 15

PROPORTION OF INCOME FROM FARMING, BY STATES[a]

State	Proportion from Farming				Total
	0 - < .5	.5 - .75	≥ .75 < 1	All	
Kentucky	3.3	8.3	13.3	75.0	100.0
Ohio	8.8	2.9	26.5	61.8	100.0
Indiana	7.5	11.8	10.3	69.9	100.0
Michigan	4.5	6.3	11.6	77.7	100.0
North Dakota	4.6	1.5	10.8	83.1	100.0
Iowa	0	1.7	6.8	91.5	100.0
Kansas	5.6	7.0	15.5	71.8	100.0

[a]Chi square significant at 2 per cent.

TABLE 16

TYPE OF FARM, PROPORTIONS, BY STATES[a]

State	Dairy[b]	Fat Stock[c]	Cash Crop[d]	General[e]	Fat Stock-Cash Crop[f]	Tobacco[g]	Other[h]	Total
Kentucky	3.3	39.3	14.7	3.5	9.8	29.5	0	100.0
Ohio	14.7	41.2	22.1	8.8	7.3	4.4	1.5	100.0
Indiana	3.3	53.3	21.1	7.8	8.9	0	5.6	100.0
Michigan	42.3	9.6	21.1	11.5	2.9	0	12.5	100.0
No. Dakota	3.1	14.1	73.4	1.6	7.8	0	0	100.0
Iowa	0	63.8	25.9	1.7	6.9	0	1.7	100.0
Kansas	1.5	13.4	71.6	1.5	11.9	0	0	100.0
Total Number of Schedules	62	165	175	30	29	21	20	100.0

[a]Chi square significant at less than 1 per cent.
[b]More than 40% of income from dairying.
[c]More than 40% of income from fat stock, i.e., hogs, beef, and sheep.
[d]More than 40% of income from cash crops.
[e]Between 15 and 40% of income from each of fat stock, dairy and other or between 15 and 40% of income from each of dairy and two other.
[f]Either 50% cash crop and 50% fat stock; or between 30 and 40% cash crop and between 30 and 40% fat stock.
[g]More than 35% tobacco, usually in combination with other cash crops or fat stock.
[h]Includes those with more than 40% of income from fruits and vegetables, poultry or truck farming.

TABLE 17

CONCERN FOR THE TWO TYPES OF ERROR, BY STATES[a]

State	Proportion Concerned				Total
	1st[b]	2nd[c]	Both[d]	Don't Know	
Kentucky	27.1	32.2	33.9	6.8	100.0
Ohio	20.6	16.2	52.9	10.3	100.0
Indiana	22.6	30.1	44.1	3.2	100.0
Michigan	31.5	32.4	35.2	.9	100.0
No. Dakota	29.2	44.6	20.0	6.2	100.0
Iowa	18.6	40.7	35.6	5.1	100.0
Kansas	18.6	24.3	47.1	10.0	100.0

[a]Chi square significant at 2 per cent.
[b]More concerned about their taking action when should not.
[c]More concerned about not taking action when should.
[d]Are equally concerned about both types of error.

TABLE 18

NUMBER OF YEARS OF SCHOOL ATTENDANCE, BY STATES[a]

State	Years Attended				
	< 8	8	> 8 and < 12	12	> 12
Kentucky	24.6	37.7	14.7	14.8	8.2
Ohio	8.8	25.0	14.7	39.7	11.8
Indiana	4.3	26.9	21.5	33.3	14.0
Michigan	10.7	43.8	20.5	17.0	8.0
North Dakota	16.9	32.3	21.5	23.1	6.2
Iowa	6.8	27.1	23.7	35.6	6.8
Kansas	12.9	44.3	10.0	21.4	11.4

[a]Chi-square significant at less than 1 per cent.

Characteristics of Farmers in Each Answer Group on Gain Questions

This section considers the characteristics of the respondents in the six answer groups for gains. It will be recalled that the purpose of this section is to explain the differences between the modes of answers on the basis of attribute and behavior data. The following table (Table 19) indicates the average net worth, gross income, and debt position of these respondents.

Group II (all No answers) has the highest average net worth and is significantly different from all the other groups. It also has the highest income and the second highest debt position. Indiana contributed the largest percentage to this group and has the second highest net worth, gross income, and debt positions.

TABLE 19

AVERAGE NET WORTH, GROSS INCOME, AND DEBT POSITION, BY ANSWER GROUPS, ON GAINS

Answer Group		Dollars		
		Net Worth	Income	Debt
I	(Weak)	45,148	7,648	4,593
II	(All No)	53,031	8,865	3,246
III	(W-O Inconsistent)	38,597	8,456	2,124
IV	(B-O Inconsistent)	28,760	6,611	1,853
V	(Not Answered)	46,062	7,472	1,144
VI	(Consistent)	38,922	7,746	2,972

Group IV (between-odds inconsistent) has the lowest net worth and income and the second lowest debt position. However, in contrast to Group II, all states contributed about equally to this group.

Although Group I (weak consistency) and Group V (not answered) do not differ significantly on net worth, there is a significant difference in debt position. This may indicate that individuals in Group V are financially more stable than those in Group I.

Notice that there is no significant difference between Group III (within-odds inconsistent) and Group VI (completely consistent) on any of the three variables in Table 19. All states contributed about equally to Group III, but Michigan contributed more than one-fourth of the schedules in Group VI. However, average net worth for Michigan is substantially less than the average net worth of Group VI.

Table 20 gives the average number of years of farming experience, age, and number of dependents for respondents by answer groups.

TABLE 20

AVERAGE YEARS OF FARMING EXPERIENCE, AGE, AND NUMBER OF DEPENDENTS, BY ANSWER GROUPS, ON GAINS

Answer Group		Years of Farming Experience	Age	Number of Dependents
I	(Weak)	20.0	47.4	2.9
II	(All No)	23.0	50.7	2.8
III	(W-O Inconsistent)	19.2	44.1	2.9
IV	(B-O Inconsistent)	20.4	49.9	3.2
V	(Not Answered)	25.7	55.7	2.0
VI	(Consistent)	16.8	44.8	2.9

Group II respondents again are very much like the average Indiana respondent as shown in Table 12. Group IV respondents have the lowest net worth and income, a very low debt position, relatively short farming experiences and the largest number of dependents.

Previous comparisons between Groups I and V indicated that individuals in V may be financially more stable; this fact is compatible with the data indicating that Group V individuals are relatively older, have more farming experience and fewer dependents than those in Group I. This contrast is also true when Group V is compared to all the others on the three variables of age, experience and number of dependents. Again notice that there is no significant difference between Group III and VI.

Michigan and Ohio schedules form approximately 50 per cent of Group VI; however, the average length of farming experience of individuals of these two states is considerably greater than the average for the whole group. The average age and number of dependents for this group are about the same as for Michigan and Ohio.

The following series of tables (Table 21 to 24) present attribute data about the six answer groups which were found to be significant by the chi-square test of independence. Two attributes--years of school attendance and the ratio of debts to assets--were found to be independent of the answer groups.

TABLE 21

PROPORTION OF TOTAL ACRES RENTED, BY ANSWER GROUPS, ON GAINS[a]

Answer Group	Proportion Rented				Total
	0	< .5	.5 - .7	> .7	
I (Weak)	44.2	25.3	8.4	22.1	100.0
II (All No)	52.8	17.1	13.0	17.1	100.0
III (W-O Inconsistent)	43.4	14.4	16.9	25.3	100.0
IV (B-O Inconsistent)	42.9	19.0	9.5	28.5	100.0
V (Not Answered)	66.2	10.75	12.3	10.75	100.0
VI (Consistent)	40.8	24.7	7.7	26.8	100.0

[a]Chi-square significant at 5 per cent.

TABLE 22

PROPORTION OF INCOME FROM FARMING, BY ANSWER GROUPS, ON GAINS[a]

Answer Group	Proportion from Farming				Total
	< .5	.5-.75	≥.75<1	All	
I (Weak)	3.2	8.4	11.6	76.8	100.0
II (All No)	4.1	8.1	8.9	78.9	100.0
III (W-O Inconsistent)	7.2	1.2	8.5	83.1	100.0
IV (B-O Inconsistent)	0	9.5	19.1	71.4	100.0
V (Not Answered)	9.2	1.5	18.5	70.8	100.0
VI (Consistent)	5.0	7.1	18.6	69.3	100.0

[a]Chi square is significant at 10 per cent.

TABLE 23

CONCERN ABOUT THE TWO TYPES OF ERROR FOR SIX ANSWER GROUPS, ON GAINS[a]

Answer Group	Proportion Concerned				Total
	1st[b]	2nd[c]	Both[d]	Don't Know	
I (Weak)	23.9	34.8	35.9	5.4	100.0
II (All No)	21.0	31.4	41.9	5.7	100.0
III (W-O Inconsistent)	32.9	30.5	31.7	4.9	100.0
IV (B-O Inconsistent)	9.5	66.7	23.8	0	100.0
V (Not Answered)	20.6	14.3	52.4	12.7	100.0
VI (Consistent)	27.7	31.2	37.6	3.5	100.0

[a]Chi square is significant at less than 1 per cent.
[b]More concerned about their taking action when should not.
[c]More concerned about not taking action when should.
[d]Are equally concerned about both types of error.

TABLE 24

TYPE OF FARM,[a] PROPORTION BY ANSWER GROUPS, ON GAINS[b]

Answer Group	Dairy	Fat Stock	Cash Crop	General	Fat Stock-Cash Crop	Tobacco	Other	Total
I (Weak)	11.8	29.0	28.0	7.5	10.3	7.5	5.4	100.0
II (All No)	6.7	43.7	31.9	5.9	6.7	.9	4.2	100.0
III (W-O Inconsistent)	9.0	33.3	41.0	1.3	6.4	6.4	2.6	100.0
IV (B-O Inconsistent)	15.0	45.0	25.0	0	5.0	5.0	5.0	100.0
V (Not Answered)	15.4	30.8	41.5	4.6	6.2	0	1.5	100.0
VI (Consistent)	16.9	22.8	34.6	8.8	8.1	5.1	3.7	100.0

[a]See Table 16 for type of farm definitions.
[b]Chi square significant at 5 per cent.

The characteristics of Group II correspond rather closely to those of Indiana in the following ways:

Characteristic	Indiana	Group II
(1) Proportion rented	Second highest in owners and second lowest in renters	Second highest in owners and second lowest in renters
(2) Income from farming	High proportion from farming	High proportion from farming
(3) Concern about errors	High proportion concerned about both	High proportion concerned about both
(4) Type of farm	High proportion in fat stock, and cash crops	High proportion in fat stock, and cash crops

Tables 21 and 23 show two definite characteristics of Group IV: (1) the second highest proportion of renters, (i.e. equal to or greater than .5) and (2) two-thirds (the highest proportion) of individuals who are concerned about not taking action when they should do so.

In contrasting Group I and V, the high proportion of owners in Group V as well as their concern for both types of errors (over 50 per cent of Group V) is consistent with the previous comparisons.

It is difficult to find marked differences between Groups III and VI in the series of tables presented. It is, however, significant that though almost 50 per cent of the schedules of Group VI came from Michigan and Ohio, Group VI averages differ noticeably from these two states in (a) proportion of total acres rented (Table 14 and 21), (b) concern for two types of error, particularly in Ohio, and (c) type of farm (Table 16 and 24). In respect to type of farm, the data show a high proportion of dairy farms in Michigan in contrast to a low proportion in Group VI. Moreover, Michigan and Ohio have a relatively low proportion of cash crop farms whereas Group VI has a relatively high proportion.

This section can be summarized as follows:

Group I (weak consistency) -- This group has a high debt position suggestive of cautious individuals in risky situations. This group will be compared further with Group VI (totally consistent) in the next chapter.

Group II (all No answers) -- This group is comprised of a high proportion of Indiana schedules and appears to be very similar in character to the average of all the Indiana respondents.

Group III (within-odds inconsistent or inadequate for assessment) -- This group was found not to be significantly different from Group VI.

Group IV (between-odds inconsistent) -- This group has the lowest net worth, a low debt position, the largest number of dependents, and a high proportion of renters. Respondents are more concerned about not taking action when they should than any other group. However, the small number of schedules in this group makes it difficult to draw conclusions.

Group V (not answered) -- This group has a relatively high net worth, the lowest debt position, and has older individuals with a longer period of farming experience and with fewer dependents than any other group. It has the highest proportion of owners and its individuals are equally concerned about the two errors. These characteristics are indicative of individuals who would have no need to take risks for relatively large gains. This may explain their refusal to answer these questions.

Group VI (totally consistent) -- This group is relatively young and thus has the shortest period of farming experience of any of the groups. This group, which will be analyzed further in the next chapter, does not differ significantly from Group III in any of the characteristics discussed above. In spite of the fact that Michigan and Ohio contributed almost 50 per cent of the schedules, this group seems to be comprised of individuals substantially different from the average of the individuals interviewed on these questions in those states.

Characteristics of Farmers in Each Answer Group on Loss Questions

This section will consider the characteristics of the respondents in the six answer groups on the loss questions. Table 25 shows the average net worth, gross income, and debt position of the respondents in the six answer groups for losses defined on pages 57 and 58.

TABLE 25

AVERAGE NET WORTH, GROSS INCOME, AND DEBT POSITION OF SIX ANSWER GROUPS, FOR LOSSES

Answer Group	Dollars		
	Net Worth	Income	Debt
A (Weak)	55,305	7,931	2,129
B (All No)	36,306	9,069	3,567
C (W-O Inconsistent)	45,343	7,960	3,581
D (B-O Inconsistent)	37,854	9,479	3,329
E (Not Answered)	47,270	7,526	1,251
F (Consistent)	39,298	7,924	3,183

Group A (weak consistency) has a significantly higher net worth than all the other groups with a large percentage of schedules from Indiana and Kentucky. However, Group A respondents have an average net worth considerably higher than for those two states.

Group B (all No answers) has the lowest net worth but is not significantly different from Group D and F. Only 18 schedules of the total of 529 fall into this group.

Group C (within-odds inconsistency) and E (not answered) are similar on both net worth and income and differ significantly only on debt position. On debt position, Group C ranks the highest but is not significantly different from Groups B, D, and F.

Group D (between-odds inconsistency) has the highest income whereas Group E has the lowest. Group E, however, does not differ significantly from Groups A, C, and F. Group E has the lowest debt position.

Table 26 gives the average number of years of farming experience, age, and number of dependents for respondents in the six answer groups.

Group E contains the oldest individuals with the most farming experience and the fewest dependents. This also is true for Group V on gains (see Table 20).

TABLE 26

AVERAGE YEARS OF FARMING EXPERIENCE, AGE AND NUMBER OF DEPENDENTS OF SIX ANSWER GROUPS ON LOSSES

Answer Group	Years of Farming Experience	Age	Number of Dependents
A (Weak)	24.6	51.6	2.7
B (All No)	20.5	46.7	3.0
C (W-O Inconsistent)	18.6	46.6	2.7
D (B-O Inconsistent)	14.7	42.7	3.4
E (Not Answered)	26.6	56.3	2.1
F (Consistent)	19.1	46.5	2.9

The between-odds inconsistent individuals in Group D are the youngest of all the groups and have the least farming experience and the most dependents.

Tables 27 through Table 30 present data on attributes which proved to be significantly related to the answer groups by the chi-square test of independence. Proportion of income from farming and the number of years of school attendance were found to be independent of the six answer groups.

TABLE 27

PROPORTION OF THE TOTAL ACRES RENTED FOR SIX ANSWER GROUPS, ON LOSSES[a]

Answer Group	Proportion Rented				Total
	0	< .5	.5 - .7	> .7	
A (Weak)	59.5	19.1	6.7	14.6	100.0
B (All No)	38.9	27.8	22.2	11.1	100.0
C (W-O Inconsistent)	36.2	21.9	10.5	31.4	100.0
D (B-O Inconsistent)	29.6	33.3	14.8	22.2	100.0
E (Not Answered)	60.8	15.7	11.8	11.8	100.0
F (Consistent)	48.5	17.1	11.7	22.6	100.0

[a]Chi-square significant at almost 2 per cent.

TABLE 28

CONCERN FOR TWO TYPES OF ERROR BY ANSWER GROUPS, ON LOSSES[a]

Answer Group	Proportion Concerned				Total
	1st[b]	2nd[c]	Both[d]	Don't Know	
A (Weak)	32.1	21.4	41.7	4.8	100.0
B (All No)	26.3	15.8	36.8	21.1	100.0
C (W-O Inconsistent)	22.3	36.9	36.9	3.9	100.0
D (B-O Inconsistent)	30.8	38.5	26.9	3.8	100.0
E (Not Answered)	16.7	18.7	50.0	14.6	100.0
F (Consistent)	23.5	36.1	37.8	2.6	100.0

[a]Chi-square significant at 1 per cent.
[b]More concerned about their taking action when should not.
[c]More concerned about not taking action when should.
[d]Are equally concerned about both types of error.

TABLE 29

TYPE OF FARM,[a] PROPORTION BY ANSWER GROUPS, ON LOSSES[b]

Answer Group	Dairy	Fat Stock	Cash Crop	General	Fat Cash	Stock-Cash Crop	Tobacco	Other	Total
A (Weak)	10.6	45.9	16.5	3.5	10.6	7.1	5.9	100.0
B (All No)	11.1	27.8	44.4	16.7	0	0	0	100.0
C (W-O Inconsistent)	8.0	38.0	37.0	2.0	10.0	3.0	2.0	100.0
D (B-O Inconsistent)	14.8	25.9	40.7	7.4	3.7	3.7	3.7	100.0
E (Not Answered)	10.0	26.0	46.0	6.0	6.0	0	6.0	100.0
F (Consistent)	14.7	27.2	35.4	7.3	6.9	4.8	3.5	100.0

[a]See Table 16 for type of farm definitions.
[b]Chi-square significant at 5 per cent.

TABLE 30

RATIO OF DEBTS TO ASSETS, PROPORTION BY ANSWER GROUPS, ON LOSSES[a]

Answer Group	Ratio				Total
	0	.01-.1	.11-.2	> .2	
A (Weak)	51.3	21.8	16.7	10.3	100.0
B (All No)	40.0	26.6	6.7	26.7	100.0
C (W-O Inconsistent)	53.1	19.8	13.5	13.5	100.0
D (B-O Inconsistent)	40.0	4.0	44.0	12.0	100.0
E (Not Answered)	75.0	5.6	11.1	8.3	100.0
F (Consistent)	45.1	20.0	20.5	14.4	100.0

[a]Chi-square significant at 2 per cent.

Group E has the highest proportion of owners, the largest per cent of individuals who have no debts and who are equally concerned about both types of errors.

Groups C, D, and F have high proportions of renters, but Group C has the highest proportion of individuals who have a debt-asset ratio of .1 or less. Group D has the largest proportion who have a debt-asset ratio of .2 or more.

Each group has a pattern of answers with respect to types of errors which seems to be meaningfully related to the answer groups for losses. Group A, where the respondent said either Yes or No to an entire set of odds, has the highest proportion of individuals equally concerned about the two types of error. The fact that a higher proportion were more concerned about the first than about the second error is also consistent with the fact that the group largely consists of individuals who accepted all unfair insurance schemes. The consistency between their attitude and their answers is evident in the following interpretation. In a situation involving a high probability of loss, taking action when they should not is a successful evasion of the loss. However, in the hypothetical questions action had to be taken in a loss situation and the respondents accepted all the unfair insurance schemes to afford himself protection.

Group B has the highest proportion of "Don't know" answers to the types of errors question, of any of the groups. Twice as many of the respondents who answered No to the loss questions were more concerned about taking action when they should not than about the second type of error.

Group C has as many individuals who are equally concerned about both errors as it has individuals who are more concerned about not taking action when they should. Group F has almost identical percentages in each of the categories, yet Group C was inconsistent and Group F was consistent in answering the loss questions. However, individuals in Group F are considerably different from individuals in Groups A and B in respect to their concern for the second type of error.

Group E is not much different from Group C in the proportion of individuals concerned about the second type of error; however, it is different in the proportion concerned about taking action when they should not and in the proportion who are equally concerned about both errors.

The type of farming in each respective group correlates markedly with the type of farming in the states making up the majority of the group. However, in the case of Group F, the distribution of type of farms rather closely conforms with the distribution for the total number of farms for all the states as shown in Table 16.

In summarizing the results of this section, the following characteristics of each group will aid in understanding the differences between the six answer groups on losses.

Group A (weak consistency) -- This group, which is made up of a high proportion of individuals who took all unfair insurance schemes, has a high net worth and a relatively low debt position.

Individuals in this group are slightly older and have more farming experience than individuals in Groups C, D and F. There are as many individuals who have no debts as there are who have some debts. In addition, a high proportion of individuals in this group are equally concerned with both types of errors. These characteristics, plus the fact that a high proportion of individuals in this group took all the unfair insurance schemes, could mean that they were extremely desirous of maintaining their relatively strong financial position.

Group B (all No answers) -- No significant conclusions can be drawn about this group because of the small number of respondents falling into this category. (It is noteworthy that the corresponding group for gains had 123 schedules with all No answers).

Group C (within-odds inconsistency) -- This group is very similar to Group F except for (a) higher net worth, (b) higher proportion of renters, and (c) higher proportion with no debts. However, these characteristics do not appear to explain the difference in the modes of answers.

Group D (between-odds inconsistency) -- This group consists of individuals who are relatively younger and have fewer years of farming experience than any other group. There is also a high proportion of individuals in the owner-renter stage of farming. In general, they are concerned about not taking action when they should. These characteristics might fit an individual who, due to his youth and inexperience, would be prone to make mistakes in his attempt to maintain consistency.

Group E (not answered) -- This group is characterized by individuals who have relatively high net worth and low debt positions. They are the oldest individuals with the longest period of farming experience and have a high proportion of owners among them and a high proportion with no debts. They are equally concerned about the two types of errors. Notice the striking similarity of this group with Group V on gains. A similar conclusion can be drawn in this case; perhaps these individuals have less necessity for participating in insurance schemes than do others.

Group F (totally consistent) -- The outstanding feature of this group is the close resemblance of its characteristics to those of the 529 respondents as a group. The only noticeable exception is that individuals in Group F were relatively more concerned about not taking action when they should, than individuals in the total group. This group will be examined further in the next chapter.

The Problem of Interviewer Bias

There are three facts from the analysis in the above two sections which remain without adequate explanation. They are:

1) The high proportion of Indiana schedules in Group II on gains.

2) The similarity of characteristics between Groups III and VI on gains.

3) The similarity of characteristics between Groups C and F on losses.

There are, no doubt, several reasons that would explain these facts; however, one of the most obvious reasons is the differences between interviewers. Whether it be because of approach, personality traits or rapport with the farmer, differences between the interviews may account in some degree for the data that cannot be explained in any other way.

In an attempt to explain the high proportion of Indiana schedules in Group II on gains, comparisons are made between interviewers from Indiana and Michigan in Table 31.

TABLE 31

COMPARISON OF INDIANA AND MICHIGAN INTERVIEWERS ON PER CENT OF SCHEDULES FALLING INTO EACH ANSWER GROUP, ON GAINS[a]

Interviewer	Answer Group[b]					Number of Schedules Taken
	I (Weak)	II (All No Answers)	III (W-O Inconsistent)	V (B-O Inconsistent)	VI (Consistent)	
Indiana						
1	6.25	37.5	12.5	31.25	16.7	16
2	4.8	66.7	16.6	0	11.9	42
3	8.6	57.1	17.1	2.9	14.3	35
Michigan						
1	25.8	16.1	9.7	0	48.4	31
2	20.4	20.4	22.2	11.1	25.9	54
3	25.9	0	3.7	33.4	37.0	27

[a]Chi-square tests were significant at less than 30 per cent.
[b]Group IV is not included because of the small number of schedules in this group.

It is apparent that Indiana interviewers, in contrast to Michigan interviewers, had a high proportion of schedules fall into Group II. From comments written on the schedules by the Indiana interviewers, the following conclusions might be drawn.[1] The interviewers often accepted a respondent's first impression that the questions dealt with gambling (which they felt was immoral) and did not attempt to rephrase the questions to include the risks of farming.

The second fact or the striking similarity between Groups III and VI on gains may be, at least partly, explained by the significantly different results obtained by interviewers in the following states: Kentucky, Michigan, North Dakota, and Iowa. This comparison is given in Table 32.

Examination of the distribution of schedules within and between states shows extreme differences among interviewers between Groups III and VI. Some interviewers were prone to get Group III answers whereas others were prone to get Group VI answers. One would expect in a random sample that approximately similar proportions of schedules of the two groups would be taken by the different interviewers. If these interviews were random from the total sample, comparisons between the groups would probably show similarities in the characteristics previously discussed.

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[1]The following are direct quotations from Indiana schedules. Interviewer 1, "Doesn't take chances like these." Interviewer 2, "Wouldn't gamble except for worthy purpose." "Not much of a gambler, anything on this line not favorable considered." "This is lottery, too much against one." Interviewer 3, "Do not believe in gambling and this is interpreted in this way." "Doesn't believe in this kind of gambling, is not constructive."

TABLE 32

PROPORTION OF EACH ANSWER GROUP ON GAINS TAKEN BY INTERVIEWERS IN THEIR RESPECTIVE STATES[a]

Interviewer	Answer Group[b]					Number of Schedules Taken
	I (Weak)	II (All No Answers)	III (W-O Inconsistent)	V (Not Answered)	VI (Consistent)	
Kentucky						
1	11.1	0	22.2	11.1	55.6	18
2	31.25	18.75	12.5	0	37.5	16
3	25.0	12.5	25.0	12.5	25.0	16
4	45.4	27.3	18.2	0	0	11
Michigan						
1	25.8	16.1	9.7	0	48.4	31
2	20.4	20.4	22.2	11.1	25.9	54
3	25.9	0	3.7	33.4	37.0	27
North Dakota						
1	27.8	55.5	11.1	0	5.6	18
2	7.5	5.0	35.0	15.0	37.5	40
3	28.6	14.2	0	28.6	28.6	7
Iowa						
1	20.0	30.0	20.0	5.0	25.0	20
2	27.3	27.3	9.0	9.1	27.3	11
3	5.6	27.8	50.0	0	16.6	18
4	50.0	20.0	10.0	0	20.0	10

[a]All chi-square tests were significant at no less than 30 per cent. Ohio, Kansas and Indiana interviewers did not show the above patterns for Groups III and VI.

[b]Group IV is not included because of the small number of schedules in this group.

Likewise, the similarity between Groups C and F for losses may be explained by different results obtained by the respective interviewers. The comparison between interviewers is presented in Table 33.

The fluctuation in percentages of Groups C and F between interviewers is particularly noticeable in Kentucky, Indiana, Iowa, and Kansas. The range from no group F schedules to 77.8 per cent of this group is the striking feature of this table. The range of proportions of schedules in Group C is from none to 45.5 per cent when all the interviewers are considered. It is quite likely that if the interviews that include the loss questions appear at random from the total sample, comparisons between the two groups will show similarities in their other characteristics.

Summary

This chapter has shown how the answer groups are constructed and has attempted to explain the differences between the answer groups on the basis of attribute and other data from the total schedule.

Since there is no model for predicting the expected numbers of schedules in each of the answer groups, only a qualitative evaluation can be made of this schedule and interviewers with respect to their effectiveness in eliciting responses. The following conclusions are apparent: (1) in using this technique to measure utility, it is easier to get answers to the loss questions than to the gain questions, (2) the technique is difficult if not impossible to use with individuals who display little evidence of need to participate in insurance or in gambles for large gains, i.e., individuals who are relatively older,

TABLE 33

PROPORTION OF EACH ANSWER GROUP ON LOSSES TAKEN BY INTERVIEWERS IN THEIR RESPECTIVE STATES[a]

Interviewer	Answer Group A	B	C	D	E	F	Number of Schedules Taken
Kentucky							
1	11.1	0	11.1	11.1	11.1	55.6	18
2	43.8	6.2	25.0	0	0	25.0	16
3	25.0	12.5	0	6.2	12.5	43.8	16
4	54.5	0	36.4	0	9.1	0	11
Ohio							
1	2.2	0	4.4	0	15.6	77.8	45
2	21.7	0	21.7	4.3	17.4	34.8	23
Indiana							
1	12.5	6.3	43.8	0	18.7	18.7	16
2	14.3	4.8	23.8	7.1	4.8	45.2	42
3	28.6	5.7	25.7	5.7	2.9	31.4	35
Michigan							
1	22.6	3.2	3.2	3.2	3.2	64.5	31
2	13.0	1.8	20.4	7.4	11.1	46.3	54
3	7.4	0	18.5	3.7	18.5	51.8	27
North Dakota							
1	11.1	11.1	0	0	0	77.8	18
2	5.0	2.5	17.5	12.5	10.0	52.5	40
3	14.3	14.3	0	0	14.3	57.1	7
Iowa							
1	15.0	0	15.0	0	5.0	65.0	20
2	18.2	0	45.5	0	9.1	27.2	11
3	27.8	5.6	27.8	16.7	0	22.2	18
4	0	10.0	50.0	10.0	0	30.0	10
Kansas							
1	0	0	28.5	0	14.3	57.2	7
2	28.6	14.3	21.4	7.1	21.4	7.1	14
3	0	0	0	100.0	0	0	1
4	16.3	2.0	38.8	0	12.3	30.6	49

[a]All chi-square tests were significant at less than 30 per cent.

have more farming experience, fewer dependents, high net worths, low debt positions and own their own farms, and (3) the effectiveness of the technique in eliciting answers is closely related to the interviewers' ability to make clear to respondents the meaning of the various hypothetical situations.

This latter conclusion is substantiated by two illustrations. That is, first, it is easier for an interviewer to accept an answer of "I don't gamble" and deduce from this that the respondent's answer to the gain questions would be all No, than it is for an interviewer to interpret the questions in a meaningful context and then to press the respondent for answers other than all No. The second illustration of possible interviewer bias is the apparent similarity between individuals who were consistent with the hypothesis and those who were inconsistent. Whether or not some interviewers helped the respondents acquire consistency is not known. In future studies the hypothesis of whether or not helping the respondent maintain consistency affects the usefulness of responses beneficially or adversely could be tested. Such help could bias responses or produce more usuable unbiased responses.

The next chapter will consider further the two types of consistencies for gains and losses. As a consequence of interviewer bias there is a high probability that many Indiana farmers are misrepresented by inclusion in Group II; thus, these schedules will be eliminated from the analysis presented. Group B, on losses, is similar to Group II in that both are consistent with a diminishing marginal utility hypothesis; however, Group B will not be used in the next chapter because of the small number of schedules. Groups I, VI, A and F remain to be analyzed more extensively in the next chapter than was possible here.

The conclusion concerning the interviewer bias between Groups III and VI and C and F is believed not to affect the usability of the data in the next chapter. The similarity of characteristics between the groups indicated that either some data were lost in Groups III and C or some were gained in Groups VI and F. If it is true that some data were lost, then this means that valuable observations in testing the hypotheses are not available. However, if it is true that some data were gained, then two situations may exist. The observations gained may or may not be random. If they are not random, they may be unbiased depending upon whether or not the lack of randomness reflects true relationships among the variables involved or interviewer bias. If they are random then the additional observations create variance which may obscure but not bias estimates of the true relationships. As Groups VI and F and Groups III and C are made up of demonstrably similar individuals there are grounds for supposing that true relationships will be reflected when Groups VI and F are analyzed.

CHAPTER VI

DERIVATION AND EVALUATION OF EMPIRICAL UTILITY FUNCTIONS

This chapter contains the main analysis of this thesis. Numerical utility functions are estimated for those respondents showing consistency in their responses. Marginal utility estimates are derived from these total utility functions and used to classify the individuals into derived types. These types are then related to attribute and behavioral variables. This analysis contributes substantially to the general evaluation of the utility measuring technique employed in this thesis. Further, the utility estimates are used to predict other kinds of behavior.

More specifically, only individual responses displaying the types of consistencies defined in the previous chapter under I and VI for gains and under A and F for losses will be analyzed. The weak types of consistencies defined under I and A are not inconsistent with the indifference axiom or with the hypothesized utility function, but were considered a weak form of consistency. The much stronger types of consistency defined under VI and F are those which are consistent with the indifference axiom and with the hypothesized utility function in that they permit computation of one or more indifference points. The location of the indifference points for the latter consistent types will be the basis of the analysis, i.e., an estimated utility function will be fitted to these points and related to attribute, behavioral items, and predicted behavior. First the utility functions will be related to the following attributes:

1) State in which the schedule was taken

2) Respondent's years of farming experience

3) Respondent's age

4) Number of respondent's dependent

5) Type of farming engaged in by the respondent

6) Number of years respondent attended school.

On a prior basis, these characteristics should be associated with the marginal utility an individual attaches to different quantities of wealth. If a complete and meaningful representation of an individual can be given by combinations of these characteristics, then predictions of the marginal utility attached to wealth by other individuals with the same characteristics as those in the sample could be made.

Second the utility functions will be related to the following characteristics, here denoted behavioral items, which are interpreted as the indirect or direct consequences of the respondent's managerial action:

1) Net worth of respondent

2) Average gross income for a three-year period

3) Debt position (amount of debt in dollars)

4) Proportion of total acres rented

5) Proportion of income from farming

6) Ratio of debts to assets

7) Concern for two types of error

8) Attitude toward informal insurance schemes.

In agreement with the theoretical nature of man offered in Chapter I, a cause and effect relationship is hypothesized between these behavioral items and utility. This means that the same stable and consistent utility function manifested in an individual's answers to the hypothetical situations, motivated the behavior implied in the above list.

Third and lastly the utility functions will be used to predict the amount of gain necessary to induce the respondent to accept an unfair risk (gamble) and the amount of loss necessary to motivate him to accept an unfair insurance scheme.

In the first section of this chapter a method will be developed for regrouping the individuals in consistency classes of Chapter V into "derived types." In the second section the relevant data for comparing these types will be presented while in the third predictions from the utility function are made. The last section will present a concise evaluation in regard to the technique's effectiveness in providing numerical estimates of cardinal utility.

Development of Derived Types

The method used in reclassifying the individuals of answer groups I, A, VI and F was, first, to derive a utility function for each respondent; second, to make an estimate of the marginal utility per dollar by taking the derivative of the estimated utility function; and third, to classify on the basis of the estimate of marginal utility.

Derivation of Utility Function

From the indifference relation $\alpha u + (1 - \alpha) v = w$ and from Theorem 1, it is possible to compute $q(u)$ given a unit of measure and an arbitrary origin.

Let $q(u)$ = the numerical utility at a specified gain or loss

$q(v)$ = the numerical utility at the other alternative

$q(w)$ = the numerical utility at a certainty position

α = the probability of obtaining the gain or of incurring the loss

Let the unit of measure, say one util, be equal to[1]

$$q(w) - q(v) = \frac{P_0 - P_2}{5}$$

Then

$$q(v) = q(w) - \frac{P_0 - P_2}{5}$$

Substituting into

$$\alpha q(u) + (1 - \alpha) q(v) = q(w)$$

gives

$$\alpha (q)u + \left[(1 - \alpha) \left[q(w) - \frac{P_0 - P_2}{5} \right] \right] = q(w)$$

Multiplying out the brackets and dividing thru by α gives

$$q(u) - \left[\frac{P_0 - P_2}{5 \alpha} \right] + \left[\frac{P_0 - P_2}{5} \right] = q(w)$$

Factoring and transposing gives

$$q(u) = q(w) + \left[\frac{1 - \alpha}{\alpha} \right] \left[\frac{P_0 - P_2}{5} \right]$$

Let the origin be where $q(w) = 0$ and $P_0 = 0$

then

$$q(u) = \left[\frac{1 - \alpha}{\alpha} \right] \left[\frac{P_2}{5} \right]$$

since P_2 is a negative quantity.

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[1]Thus the total utility function is assumed to be a straight line between 0 and -8 utils. P_0, P_1 and P_2 are specified in Chapter IV.

With the equation $q(u) = \left[\frac{1-\alpha}{\alpha}\right] \cdot \left[\frac{P_2}{5}\right]$, it is easy to compute the utility attached to a specified gain or loss. Thus, for example, suppose a respondent said No to the 1,000 dollar gain situation and Yes to the 5,000 dollar gain situation on the fair series, then the indifference point where $\alpha = \frac{1}{120}$ is, by linear interpolation, near an amount equal to 3,000 dollars. Substituting into the above equation gives $q(u) = \left[\frac{\frac{119}{120}}{\frac{1}{120}}\right] \cdot \left[\frac{25}{5}\right] = 595.$

This computation was made for all the possible indifference points. Thus, for each respondent depending upon the number of indifference points present in his answers, a point was or a number of points were obtained indicating the nature of his utility function for gains or for losses.[1]

Using the method of least squares or Lagrange's interpolation formula, the equation $\hat{u} = ax + bx^2$ where $\hat{u}$ is the estimated utility and x is the amount of gain or loss, was fitted to each case in which there was at least one indifference point after replacements and transpositions.[2] The methods of fitting and the assumptions made about the

[1]For those cases like Group I and A where there is no indifference points the utility curve is bounded from below by the utility or disutility of the odd which was answered Yes and above by the utility or disutility of the odd situation which was answered No.

[2]For the fitted curves on gains the most meaningful difference found between the adjusted cases and those which were consistent with the hypothesized utility function without adjustment was the number of years of school attendance. Almost 80 per cent of the respondents who had attended 8 or more years of school were consistent without adjustment, while almost 40 per cent of those who had attended school for less than

location of the indifference points and other identification points are shown in Appendix D.

It should be stressed that the reader can not fully understand the derivation of the utility functions without careful study of that outline. However, the continuity of the chapter is enhanced by not interrupting the sequence of analysis with the outline at this point.

From the fitted equation $\hat{u} = ax + bx^2$ the derivative or estimated marginal utility $\frac{dy}{dx} = a + 2bx$ was found for the following points: (1) 3,000 dollar gain and loss (approximate cost of a new car), (2) 7,500 dollar gain and loss (approximately average annual gross income of respondents), and (3) 30,000 dollar gain or loss (approximate value of a small farm).

Derived Types Defined

This marginal utility represents the amount of utility attached to one additional unit of wealth <u>relative</u> to the utility attached to one unit of wealth at the present income position. As a relative marginal

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8 years required adjustment to be consistent with the hypothesis. The chi-square test was significant at 5 per cent. A similar test for the fitted curves on losses was not significant. The chi-square test of independence between the state in which the schedule was taken and the adjusted and unadjusted cases for losses was significant at 1 per cent. Although six of the states had a high proportion of unadjusted cases, Kansas had to have 50 per cent of its cases adjusted to be consistent with the hypothesis.

For the cases with no indifference points there were 13 out of 105 schedules on the losses question that were changed to consistency. On the gains questions that were answered all No, one out of the 123 cases required adjustment. Out of the other 95 cases of weak consistency for gains 29 were adjusted in order to show consistency with the indifference axiom. No meaningful variable could be found in the rest of the schedule to explain the difference in answers.

utility this quantity is interpersonally comparjable, but it is not interpersonally comparable as an absolute marginal utility. It is this relative quantity which is crucial in the decision making theory of the marginal analyst. It is this interpersonal comparability which makes it possible to group individuals into the derived types. The estimates provided by this thesis can in no way be useful to welfare economics.

This procedure of grouping is intended to provide data for testing the second hypothesis presented in Chapter I. The procedure is based upon the belief that the mean and variance of a group in respect to the relative marginal utilities attached to different amounts of wealth correspond to (fits) the distributions of the attribute and behavior data. That is, individuals who attach relatively small marginal utilities to additional wealth will behave similarly; whereas groups of individuals who attach relatively large marginal utilities to additional wealth will behave similarly, but differently than the former group.

In total, 30 derived types were formed on the basis of marginal utility, 15 for gains and 15 for losses. The 15 groups consist of three sets of five groups defined by the derivative at the 3,000, 7,500 and 30,000 dollar gain or loss.

For the gains each of the five types contain two groups for which the marginal utility is hypothesized and three for which it is estimated from the utility function. These latter three groups were formed on the basis of the number of individuals in each, i.e., one large middle group with two smaller extreme groups.

Each of the five types for losses contain one group for which the marginal utility is hypothesized and four for which it is estimated from the utility function. These four groups contain two large middle groups and two smaller extreme groups.

Analysis of Relationships Between Empirical Utility Functions and Relevant Variables

This analysis is based upon rather loosely formed hypotheses concerning the character of individuals who have relatively high marginal (dis) utilities for gains (losses) compared to those who have relatively low marginal (dis) utilities. The characterization is necessarily empirical and loose because no general model has been constructed that correlates the shape of the utility curve with the character, disposition, and behavior of individuals.

Derived Types for Gains Questions

A statistical comparison between the groups formed upon the basis of the derivatives of the total utility curve at three different gains ($3,000, $7,500, and $30,000) showed that the 30,000 dollar derivative produced types not only related to more of the other variables but related more significantly to meaningful variables than the other two derivatives. Therefore, the analysis reported in this section is confined to the 30,000 dollar derivative.

The five types compared are defined and shown with the estimate of the relative marginal utility per dollar in Table 34. Those types which are defined by a derivative (called derivative types) are the cases with indifference points and differ from each other by the relative marginal utility per dollar attached to gains in wealth. The types without difference points are defined by the answers on the schedule; however, the relative marginal utility per dollar for these types is hypothesized in relation to the derivative types. The respective number of individuals in each group is also shown. The convention of denoting types for the gain questions by Roman numerals will continue to be followed.

TABLE 34

RELATIVE MARGINAL UTILITIES FOR DERIVED TYPES AND NUMBER OF RESPONDENTS AT 30,000 DOLLAR GAIN

Type	Defining Conditions	Relative Marginal Utility Per Dollar	Number of Respondents
I	All No to Fair or to Unfair Odds	0.14 or 0.26	62
II	Derivative	0.0 or 0.30	41
III	Derivative	0.31 or 1.00	63
IV	Yes to All Odds	1.56	33
V	Derivative	1.01 and over	35

In the subsequent discussion the following procedure is used. First, since Type II differs from Type I by the presence of indifference

points in its answers and not by marginal utility, they are paired for comparison. Second, since Type V differs from Type IV by the presence of indifference points in its answers and not by marginal utility, they are also paired. Third, the three with indifference points or the derivative types are compared with each other.

In Table 35 the average net worth, income and debt position of each type are shown.

TABLE 35

AVERAGE NET WORTH, GROSS INCOME AND DEBT POSITIONS FOR THE DERIVED TYPES ON 30,000 DOLLARS GAIN

Type	Dollars		
	Net Worth	Gross Income	Debt
I (M.U., .14 or .26)	48,395	7,917	5,632
II (M.U., 0- .30)	33,864	7,579	1,997
III (M.U., .31-1.00)	42,857	8,064	2,609
IV (M.U., 1.56)	38,959	7,159	2,716
V (M.U., > 1.01)	36,720	7,357	3,256

In Table 35, Type I differs significantly from Type II on both net worth and amount of debt. Type V does not differ significantly from Type IV on any of the variables. Type III has the highest net worth of the three groups with indifference points, but Type II has the lowest net worth and debt position. None of the types differ significantly with respect to average gross income.

The average number of years of farming experience, age of respondents, and number of respondents' dependents are given in Table 36.

TABLE 36

AVERAGE LENGTH OF FARMING EXPERIENCE, AGE AND NUMBER OF RESPONDENTS' DEPENDENTS FOR FIVE DERIVED TYPES ON 30,000 DOLLAR GAIN

Type	Years of Farming Experience	Age	Number of Dependents
I (M.U., .14 or .26)	19.7	46.5	3.2
II (M.U., 0- .30)	15.6	43.4	3.2
III (M.U., .31 - 1.00)	17.2	46.6	2.6
IV (M.U., 1.56)	20.7	49.2	2.4
V (M.U., > 1.01)	17.7	43.4	3.1

Type I individuals have significantly more farming experience than Type II individuals. However, they do not differ significantly as to age and number of dependents. Type V are significantly younger, have fewer years of farming experience and have more dependents than Type IV.

Types II, III, and V do not differ significantly on any of the three variables; however, Type II individuals are relatively younger with fewer years of farming experience and with more dependents than the other two groups.

Only two other variables showed significance by the chi-square test. These are the state in which the schedule was taken and the respondents' type of farm (shown in Table 37 and 38 respectively).

Type I is made up of about 25 per cent Michigan schedules while the other 75 per cent was distributed rather evenly over the other six states. Type II contains a high proportion of Michigan schedules with Ohio making up the second highest proportion. Type III is almost evenly divided with Kentucky, Ohio, and Michigan each contributing about 20 per cent and the other four states about 10 per cent each. Michigan contributed one-third of the schedules in Type IV with Kentucky and Kansas contributing the second and third highest respectively. Type V is about evenly distributed over five of the states; only Iowa and Kansas contributed a smaller proportion than the other five.

The proportion of schedules from a particular state is important when considering the next table on type of farming. The test of independence between the five derived types and the type of farming was significant (10 per cent) at a higher level than the same test between the derived types and the state of origin (30 per cent). This fact should be kept in mind when examining Tables 37 and 38.

Although Type II is made up of a high proportion of Michigan schedules, Table 38 shows over sixty per cent are fat stock, or cash crop farmers. Type II is similar to Type I in having a high proportion of fat stock and cash crop farms; however, it has a higher proportion of dairy farms than Type I.

Type IV has a high proportion of cash crop farmers whereas, dairy, fat stock, fat stock - cash crop, and tobacco farmers are evenly

TABLE 37

COMPOSITION OF EACH DERIVED TYPE FOR 30,000 DOLLAR GAIN BY STATES[a]

Type		Kentucky	Ohio	Indiana	Michigan	North Dakota	Iowa	Kansas	Total
I	(M.U., .14 or .26)	11.3	14.5	4.8	24.2	12.9	17.7	14.5	100.0
II	(M.U., 0- .30)	9.8	19.5	4.9	43.9	7.3	4.9	9.8	100.0
III	(M.U., .31 - 1.00)	16.9	20.0	9.2	21.5	12.3	10.8	9.2	100.0
IV	(M.U., 1.56)	27.3	3.0	9.1	33.3	6.1	6.1	15.2	100.0
V	(M.U., > 1.01)	13.9	19.4	11.1	19.4	19.4	8.3	8.3	100.0

[a]Chi-square significant at 30 per cent.

TABLE 38

TYPES OF FARMING, PROPORTION IN DERIVED TYPES FOR THE 30,000 DOLLAR GAIN[a]

Type	Dairy	Fat Stock	Cash Crops	General	Fat Stock -Cash Crops	Tobacco	Other	Total
I (M.U., .14 or .26)	9.8	36.1	27.9	9.8	8.2	3.3	4.9	100.0
II (M.U., 0- .30)	15.8	23.7	28.9	18.4	2.6	5.3	5.3	100.0
III (M.U., .31 - 1.00)	24.2	17.8	35.5	1.6	9.7	6.5	4.8	100.0
IV (M.U., 1.56)	15.6	15.6	28.1	3.1	15.6	15.6	6.3	100.0
V (M.U., > 1.01)	5.9	32.4	41.2	11.8	5.9	2.9	0	100.0

[a]Chi-square significant at 10 per cent.

distributed. Fifty per cent of Type IV schedules come from Michigan and Kentucky. Contrariwise, in Type V where an almost equal proportion of schedules come from five different states, over 40 per cent were cash crop farmers. The second highest proportion of farms was fat stock farms.

The nature of the five derived types for the 30,000 dollar gain may be summarized as follows.

Type I (all No to fair or unfair odds) -- Individuals in this group have the highest net worth and debt position of any of the groups. They are older in comparison to the other groups but have a relatively large number of dependents. They are mainly cash crop and fat stock farmers. Although 63.4 per cent of the all schedules taken came from east of the Mississippi, about 50 per cent of this group live east and 50 per cent west of the Mississippi.

Type II (MU of 0 to .30 utils per dollar) -- Individuals in this group have the lowest net worth and debt position of any of the groups. They are the youngest of the groups and have a relatively large number of dependents. They are mainly cash crop and fat stock farmers; however, a higher proportion of them are general farmers than any other group and about 15 per cent are dairy farmers. Over 75 per cent of the individuals in this group live east of the Mississippi, 10 per cent more than for the survey as a whole.

Type III (MU of .31 to 1.00 utils per dollar) -- Individuals in this group have the highest net worth of the three derivative types and are about in the middle of the three on debt position. They are somewhat older with more farming experience and with fewer dependents than Type II individuals. Their types of farming are mainly cash crop and dairy. Over 65 per cent of them live east of the Mississippi which is similar to the portion of schedules taken in these geographic regions.

Type IV (Yes to all odds) -- These individuals have about the average net worth and a below average debt position. They are the oldest, have the most farming experience and have the fewest dependents of any of the groups. They are engaged in almost all types of farming with a higher proportion of the fat stock-cash crop and tobacco farms than in any other group. A high proportion of these individuals live in Michigan and Kentucky.

Type V (MU of 1.01 utils per dollar and over) -- Individuals in this group do not differ significantly from Type II on net worth; however, they have a higher debt position than either of the other two derivative types. They are younger than the average of the groups but have about the same farming experience and number of dependents. Over 73 per cent of the farmers are engaged in cash crop or fat stock farming. About 60 per cent live in the three states of Ohio, Michigan and North Dakota.

The following conclusions appear to be warranted:

1) On the average, Type I individuals are significantly different from individuals in other groups. Their action can be rationalized in either of two ways. They may have diminishing marginal utility for

wealth or near constant marginal utility with some risk aversion. A possible cause of their risk aversion could be their high debt position which might prevent them from taking anything but a fair or a more-than-fair chance.

2) Type IV is more like Type III than it is like Type V. Though this would seem to indicate that the estimate of marginal utility for this group was high or that the estimate for V is low, an alternative explanation might be the presence of a positive preference for risk.

3) Two factors seem to distinguish the three derivative types. One is the debt position of the respondent. As the amount of debt increases, the marginal utility per dollar of wealth increases. The other factor is the type of farming engaged in by the respondent. Traditionally, cash crop and fat stock farming are considered more risky than the other types. This study substantiates this contention for, as the proportion of these two types of farms increase, the marginal utility per dollar increases. It can be inferred, therefore, that these individuals are more willing to engage in farming with risky enterprises. Dairying, fat stock-cash crop, and tobacco farming are intermediate in the amount of risk involved; a high proportion of individuals in the middle group in respect to marginal utility are also dairy, fat stock-cash crop, or tobacco farmers. The general farm is usually associated with a low level of risk; it was also associated with a low marginal utility for wealth in the above discussion.

Derived Types on Loss Questions

The statistical comparisons between groups formed upon the basis of the slope of the total utility curve at three different sizes of loss show that (1) the 7,500 and 30,000 dollar derivatives each produced types that were significantly different from each other on several of the other variables, and (2) the types formed at the 7,500 dollar derivative were consistently related to the same variables and in a fashion similar to the types formed at the 30,000 dollar derivative. Therefore, in the subsequent analysis, the comparisons are limited to the types formed upon the basis of the 7,500 and 30,000 dollar derivatives.

Types formed at the 7,500 dollar derivative and at the 30,000 dollar derivative will be denoted by capital letters with a subscript-$_{7.5}$ and -$_{30}$ respectively. The defining conditions, the estimate of marginal disutility and the number of individuals for each of the derived types on losses are shown in Table 39. The types are arranged approximately by the amount of marginal disutility per dollar, i.e., Type $A_{7.5}$ and A_{30} have the smallest whereas Type $F_{7.5}$ and F_{30} have the largest marginal disutility per dollar.

In the subsequent analysis Type $B_{7.5}$ or A_{30} will not be included. Because of the small number of observations, no statistically significant conclusions can be drawn concerning this group. Table 39 includes these types so that it would parallel Table 34 on gains. Type $E_{7.5}$ will be compared with $D_{7.5}$ and D_{30} with E_{30} in the following discussion. The four derivative groups will be discussed as a group.

TABLE 39

RELATIVE MARGINAL UTILITIES FOR DERIVED TYPES AND NUMBER OF RESPONDENTS AT 7,500 AND 30,000 DOLLAR LOSSES

Type	Defining Conditions	Relative Marginal Disutility Per Dollar	Number of Respondents
$A_{7.5}$	Derivative	0 to .20	37
$B_{7.5}$	No to fair or unfair odds	.14 or .26	16
$C_{7.5}$	Derivative	.21 to .40	79
$D_{7.5}$	Derivative	.41 to 1.00	72
$E_{7.5}$	Yes to all odds	1.56	70
$F_{7.5}$	Derivative	1.01 to 7.00	51
A_{30}	No to fair or unfair odds	.14 or .26	16
B_{30}	Derivative	0 to .40	44
C_{30}	Derivative	.41 to 1.00	69
D_{30}	Derivative	1.00 to 2.00	60
E_{30}	Yes to all odds	1.56	70
F_{30}	Derivative	2.01 to 20.00+	58

The average net worth, gross income, and debt position for each set of derivative types are shown in Table 40.

Type $E_{7.5}$ has the highest net worth and income[1] and the lowest debt position of any of the groups. It is more like $F_{7.5}$ than like

[1]Average incomes are not significantly different between any pair of the types.

TABLE 40

AVERAGE NET WORTH, GROSS INCOME AND DEBT POSITION OF RESPONDENTS IN DERIVED TYPES ON LOSSES

Type		Dollars		
		Net Worth	Income	Debt
$A_{7.5}$	(M.U., 0 - .20)	38,954	8,757	4,027
$C_{7.5}$	(M.U., .21 - .40)	43,863	7,947	2,696
$D_{7.5}$	(M.U., .41 - 1.00)	39,130	7,812	4,105
$E_{7.5}$	(M.U., 1.56)	54,078	8,011	2,063
$F_{7.5}$	(M.U., 1.01 - 7.00)	32,800	7,434	2,102
B_{30}	(M.U., 0 - .40)	39,583	8,308	2,548
C_{30}	(M.U., .41 - 1.00)	45,094	7,921	4,002
D_{30}	(M.U., 1.00 - 2.00)	36,499	7,819	3,602
E_{30}	(M.U., 1.56)	54,078	8,011	2,063
F_{30}	(M.U., 2.01 - 20.00+)	33,644	7,447	2,247

$D_{7.5}$ in debt position. Of the four derivative types, $A_{7.5}$ is most similar to $D_{7.5}$ on net worth and debt position, but $C_{7.5}$ has a higher net worth and a lower debt position than either $A_{7.5}$ or $D_{7.5}$. Type $F_{7.5}$ has the lowest net worth and debt position of the four.

In the lower half of Table 40, E_{30} again has the highest net worth and the lowest debt position of any of the groups. It is similar to F_{30} on debt position. Of the four remaining types, C_{30} has the highest net worth and debt position. Type B_{30} and D_{30} do not differ significantly on net worth but D_{30} has more debt. Type D_{30} does not differ significantly on net worth from F_{30} but they are different on debt position.

In general, after excluding $E_{7.5}$ or E_{30}, it appears that those individuals who have a low marginal disutility for losses have relatively high net worths and high debt positions. This conclusion is completely distorted if those individuals who took all unfair insurance odds are included. These individuals seem to be unlike any of the other groups. A hypothesis that these individuals have a positive preference for security may explain their answers to the loss questions.

Table 41 shows farming experience, age, and number of dependents for each derived type for losses.

For the three variables shown in Table 41 there is no significant difference between the four groups based upon the derivative of the total utility function; however, type $E_{7.5}$ or E_{30} is significantly different from them. Individuals in type $E_{7.5}$ are older, have more farming experience, and have fewer dependents than any group. The same is true for the comparison between the four groups and E_{30} except on the number of dependents where C_{30} has the largest number.

The derived types on losses were also found to be significantly dependent on three other variables. These are: (1) the state in which the schedule was taken, (2) the type of farm, and (3) the concern for the two types of errors. These comparisons are shown in Tables 42, 43 and 44 respectively.

TABLE 41

FARMING EXPERIENCE, AGE, AND NUMBER OF DEPENDENTS OF INDIVIDUALS IN DERIVED TYPES ON 7,500 AND 30,000 DOLLAR LOSSES

Type	Years of Farming Experience	Age	Number of Dependents
$A_{7.5}$ (M.U., 0 - .20)	19.7	46.5	3.0
$C_{7.5}$ (M.U., .21 - .40)	18.6	44.8	3.0
$D_{7.5}$ (M.U., .41 - 1.00)	18.7	47.2	2.9
$E_{7.5}$ (M.U., 1.56)	25.1	52.8	2.6
$F_{7.5}$ (M.U., 1.01 - 7.00)	20.1	47.9	2.7
B_{30} (M.U., 0 - .40)	20.0	46.9	2.4
C_{30} (M.U., .41 - 1.00)	18.9	45.5	3.2
D_{30} (M.U., 1.01 - 2.00)	18.6	46.3	3.0
E_{30} (M.U., 1.56)	25.1	52.8	2.6
F_{30} (M.U., 2.01 - 20.00+)	19.2	47.5	2.8

TABLE 42

COMPOSITION OF EACH DERIVED TYPE ON 7,500 AND 30,000 DOLLAR LOSSES BY STATES[a]

Type	Kentucky	Ohio	Indiana	Michigan	North Dakota	Iowa	Kansas	Total
$A_{7.5}$ (M.U., 0 - .20)	13.5	18.9	2.7	16.2	18.9	21.6	8.1	100.0
$C_{7.5}$ (M.U., .21 - .40)	10.1	29.1	11.4	13.9	19.0	5.1	11.4	100.0
$D_{7.5}$ (M.U., .41 - 1.00)	5.6	12.5	13.9	38.9	9.7	12.5	6.9	100.0
$E_{7.5}$ (M.U., 1.56)	25.7	0	24.3	20.0	7.1	12.9	10.0	100.0
$F_{7.5}$ (M.U., 1.01 - 7.00)	7.8	7.8	25.5	27.5	21.6	3.9	5.9	100.0
B_{30} (M.U., 0 - .40)	11.4	31.8	6.8	15.9	13.6	15.9	4.5	100.0
C_{30} (M.U., .41 - 1.00)	8.7	20.3	10.1	15.9	21.7	7.2	15.9	100.0
D_{30} (M.U., 1.01 - 2.00)	8.8	14.7	10.3	36.8	11.8	10.3	7.4	100.0
E_{30} (M.U., 1.56)	25.7	0	24.3	20.0	7.1	12.9	10.0	100.0
F_{30} (M.U., 2.01 - 20.00+)	6.9	8.6	27.6	27.6	19.0	6.9	3.4	100.0

[a]Chi-square for both sections is significant at 1 per cent.

TABLE 43

TYPE OF FARMING, PROPORTION IN DERIVED TYPES ON 7,500 AND 30,000 DOLLAR LOSSES[a]

Type	Dairy	Fat Stock	Cash Crops	General	Fat Stock-Cash Crop	Tobacco	Other	Total
$A_{7.5}$ (M.U., 0 - .20)	2.7	35.1	37.8	2.7	8.1	10.8	2.7	100.0
$C_{7.5}$ (M.U., .21 - .40)	13.2	28.9	40.8	3.9	5.3	5.3	2.6	100.0
$D_{7.5}$ (M.U., .41 - 1.00)	27.9	29.4	25.0	8.8	2.9	2.9	2.9	100.0
$E_{7.5}$ (M.U., 1.56)	10.3	45.6	13.2	4.4	11.8	8.8	5.9	100.0
$F_{7.5}$ (M.U., 1.01-7.00)	8.0	16.0	40.0	14.0	14.0	2.0	6.0	100.0
B_{30} (M.U., 0 - .40)	9.3	39.5	32.5	4.6	4.6	7.0	2.3	100.0
C_{30} (M.U., .41 - 1.00)	10.4	26.9	44.8	3.0	4.5	7.5	3.0	100.0
D_{30} (M.U., 1.01 - 200)	26.6	26.6	26.6	9.4	6.3	3.1	1.6	100.0
E_{30} (M.U., 1.56)	10.3	45.6	13.2	4.4	11.8	8.8	5.9	100.0
F_{30} (M.U., 2.01-20.00+)	10.5	19.3	36.8	12.3	12.3	1.8	7.0	100.0

[a]Chi-square is significant at less than 1 per cent for both sections.

Five of the seven states contribute almost an equal proportion to Type $A_{7.5}$; only Indiana and Kansas do not. Ohio contributes over 25 per cent to Type $C_{7.5}$ along with a smaller but equal contribution from the other states with the exception of Iowa which contributes only five per cent. Type $D_{7.5}$ is made up of a large proportion of Michigan schedules with Ohio, Indiana and Iowa contributing over 35 per cent. Seventy per cent of Type $E_{7.5}$ schedules came from Kentucky, Indiana, and Michigan. Ohio did not have any schedules in this group.

For the derived types at 30,000 dollar loss, Ohio contributed over 30 per cent to Type B_{30}, whereas Kentucky, Michigan, North Dakota and Iowa contributed equal proportions. Ohio, Michigan, North Dakota, and Kansas contributed over 70 per cent to Type C_{30}. Over one-third of Type D_{30} schedules came from Michigan with the other six states contributing a small but approximately equal proportion. Type E_{30} is similar to $F_{7.5}$ in that Indiana, Michigan, and North Dakota contribute about 70 per cent of these schedules.

Over 70 per cent of the individuals in $A_{7.5}$ and B_{30} are fat stock or cash crop farmers, although both groups are well distributed over at least five states. Type $C_{7.5}$ and C_{30} have over 60 per cent cash crop and fat stock farmers; however, the proportion of dairy farms is larger than in Types $A_{7.5}$ and B_{30}. The proportion of dairy farmers in Types $D_{7.5}$ and D_{30} is considerably greater than in the first two types, but the proportion of cash crop and fat stock, although still high, is much less. A high proportion of Type $D_{7.5}$ and D_{30} schedules came from Michigan.

Types $E_{7.5}$ and E_{30} have proportionally more fat stock farmers than the other groups. The high proportion of Kentucky schedules which is in these types accounts for the presence of a high proportion of tobacco farms.

Although Types $E_{7.5}$ and E_{30} have higher proportions of general and fat stock-cash crop farms than any other type, they also have a high proportion of cash crop farms. Over fifty per cent of the schedules in the two types come from Indiana and Michigan where a cash crop farm could have a wide diversity of crops without being considered specialized like a North Dakota or Kansas cash crop farm.

It is apparent in Table 44 that neither Type $E_{7.5}$ or E_{30} fit into the pattern shown by the other four groups; Type $E_{7.5}$ or E_{30} has the highest proportion of individuals who are more concerned about taking action when they should not and the lowest proportion of individuals who are more concerned about not taking action when they should. This result is also consistent with the previous observation that these individuals may have a positive preference for security. The pattern shown in the four derivative groups is most prominent in the upper section of Table 44. It is obvious that as the marginal disutility for losses increases, the concern for both types of errors increases while the proportion of individuals who are equally concerned decreases.

The following characterization of each type summarizes the results of this section.

TABLE 44

CONCERN FOR THE TWO TYPES OF ERRORS BY DERIVED TYPES ON 7,500 AND 30,000 DOLLAR LOSSES[a]

Type	Proportion Concerned 1st[b]	2nd[c]	Both[d]	Total
$A_{7.5}$ (M.U., 0 - .20)	19.4	33.3	47.2	100.0
$C_{7.5}$ (M.U., .21 - .40)	23.0	32.4	44.6	100.0
$D_{7.5}$ (M.U., .41 - 1.00)	26.9	38.8	34.3	100.0
$E_{7.5}$ (M.U., 1.56)	35.9	23.4	40.6	100.0
$F_{7.5}$ (M.U., 1.01 - 7.00)	28.0	44.0	28.0	100.0
B_{30} (M.U., 0 - .40)	27.9	27.9	44.2	100.0
C_{30} (M.U., .41 - 1.00)	16.9	38.5	44.6	100.0
D_{30} (M.U., 1.01 - 2.00)	27.0	39.7	33.3	100.0
E_{30} (M.U., 1.56)	35.9	23.4	40.6	100.0
F_{30} (M.U., 2.01 - 20.00+)	28.6	39.3	32.1	100.0

[a]Chi square for both sections significant at 30%.
[b]More concerned about their taking action when should not.
[c]More concerned about not taking action when should.
[d]Are equally concerned about both types of error.

Type $A_{7.5}$ (MU of 0 to .20 utils per dollar) -- The average net worth of individuals in this group is about the same as for the entire sample. They have a relatively high average gross income[1] and relatively high debt position. A high proportion of them are cash crop and fat stock farmers. They are least concerned about taking action when they should not, though a higher proportion are

[1]Gross income is significantly different from Group $F_{7.5}$ at the 30 per cent level.

concerned about both types of errors than any other group. In contrast to the proportions for all respondents, there are about as many who live east as live west of the Mississippi in this group.

Type $C_{7.5}$ (MU of .21 to .40 utils per dollar) -- Individuals in this group have the highest net worth of the four derivative types but have a relatively low debt position. They are the youngest of any of the groups and have the fewest years of farming experience. They have as many dependents as Type $A_{7.5}$ respondents. A higher proportion of them are cash crop farmers than any other group; however, there are proportionally more dairy farmers than in Type $A_{7.5}$. Over 60 per cent of Type $C_{7.5}$ individuals live east of the Mississippi.

Type $D_{7.5}$ (MU of .41 to 1.00 utils per dollar) -- The average net worth of individuals is about the same as for other respondents though they have the highest average debt position of any of the groups. They are mainly concerned about not taking action when they should; however, an almost equal proportion are equally concerned about the two types of errors. The proportion of dairy farmers is approximately equal to the proportion of cash crop and fat stock farmers. Over one-third live in Michigan where there is a high proportion of dairy farms.

Type $E_{7.5}$ (Yes to all odds) -- This group of individuals is not similar to any other group. They have the highest net worth and the lowest debt position of any of the groups. They are the oldest, have the most years of farming experience and the fewest dependents of any of the groups. Although they are equally concerned about the two types of errors, a larger proportion are more concerned about taking action when they should not than are concerned about the second type of error. A higher proportion of them are fat stock farmers than for any other group. As almost fifty per cent of the schedules came from Kentucky and Indiana where the largest per cent of the farmers are of this type, this is not surprising.

Type $F_{7.5}$ (MU of 1.01 to 7.00 per dollar) -- Individuals with the lowest average net worth, gross income and debt position of the four derivative types are found in this group. They are the oldest, have the most farming experience and the fewest dependents of the four derivative types. They are primarily cash crop farmers of the type found mainly in Indiana and Michigan. There is also a high proportion of general farmers and fat stock-cash crop farmers in this group. A higher proportion of these individuals are more concerned about not taking action when they should than about taking action when they should not; however, a higher proportion of them are more concerned about the latter type of error than any other group.

The characterization is essentially the same for the derivative groups at the 30,000 dollar loss. One important exception is that Type B_{30} has a lower debt position than Types $A_{7.5}$ and C_{30}.

Type C_{30} has a higher debt position than $C_{7.5}$. Another exception is that the difference in income between Types B_{30} and F_{30} is significant at 20 per cent rather than at 30 per cent as for $A_{7.5}$ and $F_{7.5}$.

The above discussion of the derived types on losses warrants the following conclusions:

1) The individuals who took all the unfair loss situations are different on the average from any of the other groups with respect to net worth, amount of debt, age, farming experience and number of dependents. This indicates that the estimate of marginal disutility may be low when compared to Type $F_{7.5}$ or F_{30}. It could be hypothesized that it would take a more unfair loss situation than was included on the schedule in order to determine an indifference point for these individuals. There is no apparent reason for Kentucky, Indiana, and Michigan to have a high proportion and North Dakota, Iowa, and Kansas to have a low proportion of these individuals while Ohio does not have any.

A possible rationalization is that these individuals, because of their advanced age, desire to protect their high net worth position and are willing to do this at high cost. Their security seeking is emphasized by the fact that a higher proportion said that they were more concerned about taking action when they should not than any other group. In a situation involving a high probability of loss, their concern would insure their avoiding the loss.

2) There are extreme differences between states on the four derivative types[1] from which the following parallels may be drawn. Associated with the increasing marginal disutility per dollar is, (a) the decreasing proportion of Kentucky and Ohio schedules, and (b) the increasing proportion of Indiana and Michigan schedules. Answers from North Dakota, Iowa, and Kansas respondents do not parallel the change in relative marginal disutility per dollar as do the other states. There appears to be no obvious reason for this situation.

3) The patterns for the type of farming seem to correspond to the pattern already established by states. These patterns are: (a) associated with the increasing marginal disutility per dollar is the increasing proportion of general, and fat stock-cash crop farms and the decreasing proportion of fat stock and tobacco farms; (b) dairy farmers seem to be intermediate in relative marginal disutility for losses but this is also true for the Michigan schedules in general; and (c) the pattern in cash crop farms corresponds to the irregular pattern of marginal disutility already established in Iowa, Kansas, and North Dakota.

4) Although the relationship is not prominent, in general, there is an indication that as net worth and gross income decrease the relative marginal disutility for losses increases. A possible interpretation is that although engaged in enterprises with a high probability of loss, individuals who have a low marginal disutility for losses have accepted those situations which also have a low probability of large monetary gains and have been successful.

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[1]The remaining conclusions will refer to the four derivative types only.

A possible factor, aside from the effectiveness of the technique in distinguishing the relationship, is the inaccuracy of the respondents' estimates of net worth and gross income. Random inaccuracies would average out in the mean values, but consistent bias on the part of certain respondents in estimating gross income and net worth would distort the relationship. This hypothesis could be tested by repeated interviewing.

5) The pattern established in relation to individual's concern for the two types of errors indicates that the basis for forming the derivative groups is probably quite sound. The fact that individuals who have a high marginal disutility for losses are also more concerned about not taking action when they should is quite compatible in light of the fact that they also participate in unfair insurance schemes. As the amount of marginal disutility of losses increases the proportion of individuals who are more concerned about taking action when they should not increases.

Derived Types for Both Gains and Losses

This sub-section will concern the differences between groups formed upon the basis of whether or not consistency was present on (a) both gains and losses, (b) losses only, and (c) gains only. It will consider three sets of analyses. These are analyses concerning (1) all forms of consistencies, i.e. the weak type and the type using indifference points, (2) only the weak type, and (3) only the type using indifference points. Involving both weak and strong the first table (Table 45) in this series shows consistency on both gains and losses versus losses only and gains only by states.

TABLE 45

WEAK AND STRONG CONSISTENCY ON BOTH GAINS AND LOSSES, LOSSES ONLY, AND GAINS ONLY, BY STATES

State	Percent			
	Both	Losses Only	Gains Only	Total
Kentucky	61.1	18.5	20.4	100.0
Ohio	69.8	22.6	7.6	100.0
Indiana	60.0	10.0	30.0	100.0
Michigan	64.6	15.6	19.8	100.0
North Dakota	66.7	24.1	9.2	100.0
Iowa	49.0	19.6	31.4	100.0
Kansas	56.2	16.7	27.1	100.0

Sixty per cent or more of the respondents who were consistent with the indifference axiom or the hypothesized utility function in all states except Iowa and Kansas were consistent on both gains and losses and in those two states almost fifty per cent were consistent. Ohio and North Dakota had the highest percentage of individuals who were consistent on the losses only, whereas Indiana and Iowa had the highest percentage of respondents who were consistent on the gains only.

The average net worth, income, and debt position for the three forms of consistency are shown in Table 46.

Those individuals who were consistent on gains only have the highest net worth, income, and debt position of any of the groups. Those

TABLE 46

AVERAGE NET WORTH, INCOME, AND DEBT POSITION OF WEAK AND STRONG CONSISTENCIES IN BOTH GAINS AND LOSSES, LOSSES ONLY, AND GAINS ONLY

Consistency Form	Dollars		
	Net Worth	Income	Debt
Both	42,598	7,955	3,234
Losses only	38,570	8,160	1,851
Gains only	46,947	8,512	4,219

who were consistent on losses only have the lowest net worth and debt position. Several hypotheses explaining this result are given at the end of this section.

Only two other variables were found dependent of the form of consistency: (1) the number of years the respondent attended school, and (2) the respondent's concern for the two types of errors. The first of these is shown in Table 47.

One of the interesting facts in Table 47 is that at least 49 per cent of the individuals who completed any grade were consistent on both gains and losses except those with more than 12 years of education. A high proportion of the individuals who attended school for more than 12 years were consistent on gains only.

Respondents' concern for the two types of errors in relation to the form of consistency is shown in Table 48.

Individuals who were consistent on both the gains and the losses were usually equally concerned about both types of errors. However,

TABLE 47

FORMS OF WEAK AND STRONG CONSISTENCY, BY YEARS OF SCHOOL[a]

Years	Consistency Form			
	Both	Losses Only	Gains Only	Total
< 8	49.0	25.5	25.5	100.0
8	69.2	16.4	14.2	100.0
8 to 12	56.1	14.6	29.3	100.0
12	67.9	15.2	16.9	100.0
> 12	45.5	22.7	31.8	100.0

[a]Chi-square significant at 2 per cent.

TABLE 48

CONCERN FOR TWO TYPES OF ERROR BY RESPONDENTS WHO WERE WEAK AND STRONG CONSISTENT ON BOTH GAINS AND LOSSES, LOSSES ONLY, AND GAINS ONLY

Consistency Form	Proportion Concerned			
	1st[b]	2nd[c]	Equally[d]	Total
Both	26.8	30.4	42.8	100.0
Losses only	30.1	38.4	31.5	100.0
Gains only	21.4	43.8	34.8	100.0

[a]Chi-square significant at 20 per cent.
[b]More concerned about their taking action when should not.
[c]More concerned about their not taking action when should.
[d]Are equally concerned about both types of error.

individuals who were consistent on either the losses only or the gains only were more concerned about not taking action when they should than about the other two possibilities.

Aside from school attendance, several hypotheses explaining the relation between the form of consistency, the respondents financial position and his concern for the two types of errors can be given. One possible hypothesis is that those individuals who were consistent on gains only, have gone into debt to make supposedly profitable investments. Their desire to get out of debt is evidenced by their being consistent on gains only and by their concern for not taking action when they should. An alternative hypothesis is that these individuals have a positive preference for risk taking, evidenced by their being consistent on gains only and their concern for not taking action when they should. Their relatively high financial position and debt position may be explained by profitable investment with borrowed funds. Still a third alternative is that they are "newly rich." Their consistency on gains or their inconsistency on losses may be rationalized by their state of confusion after becoming rich. Neither this hypothesis nor the others can be tested by this thesis, as unfortunately data on changes in financial positions were not obtained by the I.M.S. survey.

The individuals who were consistent on losses only can be explained by several hypotheses also. These would be quite similar to the ones stated for gains but would be interpreted to be consistent with the loss situation. For example, these individuals may be inconsistent toward gains because of a recent change in their financial positions. This change may be manifested in their greater concern for the first error in contrast to the individuals who were consistent on gains only.

Involving Weak Types of Consistency Only

Of the 135 cases which were only consistent with the indifference axiom, 13 were consistent on losses only which is not enough cases for analysis. Of the individuals who were consistent on both gains and losses, 70 percent answered Yes to all the odds. It appears that these individuals have an extremely high marginal (dis)utility for both gains (losses). However, with situations of more unfair odds and a greater range of gains and losses than were included in the I.M.S. schedule, this hypothesis could be tested. The other 30 per cent had combinations of all Yes or all No answers to the different odds. A more extensive schedule could also explore these cases.

Comparisons by states showed no significant dependence between the consistencies on both and on gains only, on one hand, and the state in which the schedule was taken, on the other.

The average net worth, gross income, and debt positions of individuals who were consistent on both gains and losses and on gains only are shown in Table 49.

Individuals who were consistent on gains only have the highest net worth, income, and debt position. They perhaps thought they could get themselves out of debt more easily by taking small chances of large gains than by insuring their present position and continuing in their present endeavor.

TABLE 49

AVERAGE NET WORTH, GROSS INCOME, AND DEBT FOR WEAK CONSISTENCY ON BOTH GAINS AND LOSSES AND GAINS ONLY

Consistency Form	Dollars		
	Net Worth	Gross Income	Debt
Both	48,700	7,694	2,283
Gains only	54,237	9,168	5,286

The only other two significant variables were again the number of years of school attendance and their concern for the two types of error. The first of these is presented in Table 50.

TABLE 50

FORMS OF WEAK CONSISTENCY BY THE NUMBER OF YEARS OF SCHOOL ATTENDANCE[a]

Years of School Attendance	Consistency Form	
	Both	Gains Only
< 8	57.1	42.9
8	76.1	23.9
8 to 12	46.7	53.3
12	59.2	40.8
> 12	29.4	70.6

[a]Chi-square significant at one per cent.

The individuals who attended school for eight years had the highest proportion of consistency on both gains and losses, while those who attended for more than 12 years had the lowest proportion. Those who attended more than 12 years had the highest per cent consistent on gains only.

The two groups' concern for the two types of error is shown in Table 51. Individuals who were consistent on both gains and losses are equally concerned about the two types of error.

TABLE 51

CONCERN FOR THE TWO TYPES OF ERROR BY INDIVIDUALS WHO WERE WEAK CONSISTENT ON BOTH THE GAINS AND THE LOSSES, AND GAINS ONLY[a]

Consistency Form	Proportion Concerned			
	1st[b]	2nd[c]	Equally[d]	Total
Both	30.4	17.4	52.2	100.0
Gains only	25.5	41.8	32.7	100.0

[a]Chi-square is significant at one per cent.
[b]More concerned about taking action when should not.
[c]More concerned about not taking action when should.
[d]Are equally concerned about both types of error.

Individuals who were consistent on gains only are more concerned about not taking action when they should. These results are similar to those found for all types of consistencies above.

Involving Strong Types of Consistency Only

The number of individuals who were consistent on losses only outnumber those consistent on gains and losses by about 50 per cent and those consistent on gains only by

300 per cent. The average net worth, income, and debt position for the three groups are presented in Table 52.

TABLE 52

AVERAGE NET WORTH, GROSS INCOME, AND DEBT FOR STRONG CONSISTENCIES ON GAINS AND LOSSES, LOSSES ONLY AND GAINS ONLY

Consistency Form	Dollars		
	Net Worth	Gross Income	Debt
Both	35,159	7,636	2,978
Losses only	39,512	8,169	3,283
Gains only	40,734	8,120	2,815

No significant differences were found among the three groups on these variables.

The by-states comparison is shown in Table 53.

Except for Kentucky and Ohio, the greatest proportion of the schedules were consistent on losses only. These two states had a higher proportion that were consistent on both. Iowa had the lowest proportion of schedules in the consistent category for both gains and losses.

The two other significant variables (1) school attendance and (2) concern for the two types of errors are presented in Table 54 and 55 respectively.

There is an indication in Table 54 that those individuals who were consistent on both gains and losses had attended school more years than those who were consistent on either losses only or on gains only.

TABLE 53

PER CENT STRONG CONSISTENCY ON BOTH GAINS AND LOSSES, LOSSES ONLY AND GAINS ONLY WITHIN STATES[a]

Consistency Form	Both	Losses Only	Gains Only	Total
Kentucky	41.4	31.0	27.6	100.0
Ohio	54.4	39.1	6.5	100.0
Indiana	21.6	67.6	10.8	100.0
Michigan	32.4	47.3	20.3	100.0
North Dakota	31.8	59.1	9.1	100.0
Iowa	12.9	61.3	25.8	100.0
Kansas	22.2	51.9	25.9	100.0

[a]Chi-square is significant at one per cent.

The proportion consistent on gains only seems to be skewed more toward fewer years of school attendance than the other two groups.

The respondents' concern for the two types of error is represented in Table 55.

The pattern that has been present in the two previous tables on concern for the two types of errors is again shown in Table 55; those individuals who were consistent on both gains and losses are equally concerned while those who were consistent on losses only and gains only are more concerned about not taking action when they should.

It appears, regardless of the type of consistency, that individuals who were consistent on gains only have the highest net worth, a high

TABLE 54

PER CENT OF INDIVIDUALS WHO ATTENDED THE SPECIFIED NUMBER OF YEARS OF SCHOOL FOR THE STRONG CONSISTENCY[a]

Consistency Form	Both	Losses Only	Gains Only
< 8	7.5	11.6	22.5
8	32.3	37.0	26.5
8 to 12	20.4	14.4	20.4
12	33.3	26.0	24.5
> 12	6.5	11.0	6.1
Total	100.0	100.0	100.0

TABLE 55

CONCERN FOR THE TWO TYPES OF ERROR BY INDIVIDUALS WHO WERE STRONG CONSISTENT ON BOTH GAINS AND LOSSES, LOSSES ONLY, AND GAINS ONLY[a]

Consistency Form	Proportion Concerned			Total
	1st[b]	2nd[c]	Equally[d]	
Both	30.7	27.3	42.0	100.0
Losses only	21.4	42.9	35.7	100.0
Gains only	25.0	41.7	33.3	100.0

[a]Chi-square significant at 20 per cent.

[b]More concerned about their taking action when should not.

[c]More concerned about not taking action when should.

[d]Are equally concerned about both types of error.

debt position and are concerned about not taking action when they should. In general, individuals who were consistent on losses only are not much different than those who were consistent on both gains and losses except that the first group is more concerned about not taking action when they should while the latter groups are equally concerned about the two errors.

Summary -- Several hypotheses could be formulated that would rationalize the action of individuals in the various groups. One is that individuals who were consistent on gains only are prone to take risks and have thus gotten themselves into debt but have found that their "gambling" has paid off in a high net worth and income. Another possible hypothesis is that these individuals, in spite of their high net worth, are heavily in debt and will take a "gamble" in their attempt to get out of debt rather than insure against losses.

Individuals who were consistent on losses only may be extremely conservative, infrequent users of credit facilities, and frequent visitors of insurance salesmen. Or perhaps these individuals believe their relatively lower net worth position can be protected from loss more easily than it can be increased by taking chances on gains. Still another explanation for these individuals' action is that they have just experienced a change in their income or net worth position.

The fact that respondents were in some cases consistent with the hypothesized utility function for gains only or for losses only must reflect upon two aspects of this study. One of these concerns the

hypothesis itself and the other concerns the technique of utility measurement.

The hypothesis is intended to rationalize individuals behavior who simultaneously gamble and insure. The results may mean that some individuals do not in fact do both. Whether or not the hypothesized utility function applies to these individuals is a matter for further speculation.

The reflection upon the technique of utility measurement could be from many sources. One is that by the time the respondent got to the gains questions after doing the loss questions, he possessed sufficient understanding to proceed without difficulty. Another is that a person who answered the questions concerning losses was too fatigued to answer the gains.

Although many difficulties remain as far as the technique is concerned, significant differences were discovered between the three forms of consistency. This could mean that the difficulty with the hypothesis outweighs the shortcomings of the technique.

Predictions From the Utility Equations

When the fitted utility functions are equated to a straight line function from the origin, the intersection points shows the (dis) utility attached to a specified gain (loss) situation. Thus if:

$$ax + bx^2 = cx \qquad \text{where}$$

$$\hat{U} = ax + bx^2$$

$$c = \frac{U}{P_1}$$

$$U = \left(\frac{1 - \alpha}{\alpha}\right)\left(\frac{P_2}{5}\right) \text{ and}$$

is such that $P_1 < P_0 - P_2$, i.e., leaves the individual with less than P_0, then solving for x produces the minimum amount of gain (loss) necessary to induce the individual to accept the unfair bet (insurance). For any degree of fairness of odds this procedure can be followed to predict the size of gain or loss necessary to induce an individual with a specified utility function to accept the risk or insurance. For the derivative types on gains and losses, the prediction was made for unfair odds similar to the ones in the schedule. The predicted amount of gain and loss necessary to induce acceptance for the gains type and for the loss types is shown in Table 56.

TABLE 56

AMOUNT OF GAIN OR LOSS NECESSARY TO INDUCE ACCEPTANCE OF AN UNFAIR ODD

Type[a]	Amount of Gain (dollars)
II	135,780
III	31,880
V	7,410
	Amount of Loss (dollars)
$A_{7.5}$	92,340
$C_{7.5}$	48,910
$D_{7.5}$	10,530
$F_{7.5}$	1,750
B_{30}	137,350
C_{30}	18,150
D_{30}	9,400
F_{30}	2,320

[a]These are the groups defined in a previous section of this chapter.

It is apparent from Table 36 that those individuals who have a low slope or marginal (dis)utility for gains (losses) also require a larger amount of gain (loss) to induce them to take an unfair risk (insurance scheme). For individuals with a steep slope or high marginal (dis) utility, the size of gain (loss) necessary to induce them to accept an unfair situation is relatively small.

By using these estimates of the size of gains and losses necessary to induce acceptance of unfair odds for those individuals who were consistent on both gains and losses, the correlation between the size of gain and the size of the loss was determined. Finding that the correlation was significant at the 10 per cent level, an equation was fitted to show the size of gain as a function of the size of the loss. The equation is

$$X_1 = 26.35809 + .28205\, X_2 \qquad \text{where}$$

X_1 = size of gain necessary to induce acceptance of an unfair risk

X_2 = size of loss necessary to induce acceptance of an unfair insurance scheme.[1]

The equation shows that the size of gain necessary to induce acceptance of an unfair risk is at most 26 times as large as the size of loss necessary to induce acceptance of an unfair insurance scheme.

Reliability of Predictions

The reliability of the predictions from the fitted utility curve could be tested by correlating it with actual behavior. The type of

[1]The coefficient on X_2 is significant at the 5 per cent level.

behavior most useful in this regard would be behavior in actual situations in which the odds and the expected return were known. Unfortunately the total schedule on which these questions concerning gains and losses appeared did not contain questions on this kind of managerial behavior. Furthermore, in agricultural sciences, little is known about the expected returns and the odds involved in various farm enterprises.

However, an indication of the reliability of the prediction from the fitted curves is available for the loss questions. There were 13 questions concerning informal insurance schemes on the total schedule of which seven appear to be useful for this purpose.[1] These are:

1) Was there any time in the last year when you kept on hand a reserve of cash or things easily converted to cash, like wheat, bonds, and livestock, in case of unfavorable developments?

2) Was there any time in the last year when you paid more for an item from a person you could trust, than you would have had to pay for the same item from a less reliable person?

3) Do you keep more tractor or horsepower on hand than is necessary for average weather in order to handle the crop in case of poor weather?

4) Was there any time in the last year when you added crops and livestock enterprises for the main purpose of getting your eggs in more baskets?

5) Did you refrain from borrowing so as to have property to mortgage in case of trouble?

6) Was there any time in the last year when you refused to use your money for an apparently profitable purpose in order to 'play it safe'?

7) Was there any time in the last year when you didn't close what appeared to be a profitable deal because the person you were dealing with might not be reliable?

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[1]Six of the questions were eliminated because they either did not apply to all respondents or they were more formal insurance schemes that could be argued depended as much upon salesmanship as on marginal disutility of losses for acceptance.

There is no estimate of the amounts of money or the odds that might be involved in these insurance schemes which would make it possible to show an exact correlation. However, if the seven items are ranked using the proportions of individuals who said 'Yes' to the questions in each derivative group as an indication of the groups ranking of the specified act, then the ranks can be compared between groups. The ranking of the seven items by the four derivative types on losses is shown in Table 57.

TABLE 57

RANKING OF SEVEN INSURANCE SCHEMES BY FOUR DERIVATIVE GROUPS ON LOSSES

Type	Rank						
B_{30}	1	2	3	4	5	6	7
C_{30}	1	6	5	4	2	3	7
D_{30}	2	4	3	6	1	5	7
F_{30}	1	5	6	4	3	2	7

The numbers in the first row of the table correspond to the numbers on the items in the list above and represent the ranking of these items by individuals in Group B_{30}. Three of the groups agree on the ranking of items, 1, 4, and 7; however, for the other items as the marginal disutility of losses increase the ranking changes according to a certain pattern. This pattern can be represented by the permutation on the four numbers (2635). The permutation is read: 2 goes into 6, 6 goes into 3, 3 goes into 5, and 5 goes into 2. With some variation in Groups C_{30} and D_{30}, this permutation describes the change in the ranking of the seven items from Groups B_{30} to F_{30}. Notice that items 2 and 3 differ from items 5 and 6 in that the latter two items have a direct reference to the possibility of a loss of money. The group that would accept an unfair insurance scheme against relatively small loss ranks items 5 and 6 higher than items 2 and 3; while the opposite is true for the group that requires a large loss before accepting an unfair insurance scheme.

Perhaps the most that this comparison indicates is that the technique used in this study to quantify utility distinguished groups of individuals who act differently in other loss situations. But even this much of an indication as to the reliability of the technique is sufficient to warrant further research with it.

Evaluation

This chapter has presented some data which were intended to ascertain whether or not the utility measuring technique employed provides meaningful estimates of cardinal utility. The following statements of its effectiveness seem justified.

1) The technique provides some estimates of cardinal utility capable of distinguishing individuals on the basis of meaningful managerial behavior. This behavior in respect to gains and/or losses is: (1) amount of debt, (2) type of farm, (3) net worth, (4) income and (5) concern for two types of error.

2) The technique does not provide estimates of cardinal utility for individuals who display no indifference points in their answers.

3) The technique and computational methods used allow individuals to be consistent with only one hypothesized utility function.

4) The technique allows individuals to be consistent with only the gain, only the loss, or both portions of the hypothesized utility function.

5) The technique did not provide its own reliability test, in that, additional gain and loss situations similar to those on the schedule were not used to test the predictions of the set of questions used in this study.

CHAPTER VII

SUMMARY AND CONCLUSIONS

This chapter will review the hypotheses tested, the procedures followed and those results pertinent to the testing of the hypotheses. It will then present some conclusions which would be useful to subsequent research in this area.

In the first chapter of this thesis, man was conceived of as an animal possessing a free will and motivated by his desire for utility and naturally constituted so as to maximize this quantity. If utility is a measurable quantity there must be some means for its measurement. The first hypothesis of the thesis is that such a technique exists. The second hypothesis is that a correspondence can be discovered relating past and present characteristics of individuals to future managerial behavior via estimates of numerical utility.

The procedure followed was to derive utility functions, i.e., a relationship between numerical utilities and monetary gains and losses which provided the data for testing the hypotheses. This latter information was produced by asking individuals whether or not they would accept at varying costs certain odds for gains or against losses. This schedule of questions and additional questions necessary to provide related data were asked of 529 farm managers in seven midwestern states. Only single family managerial units for farms producing over 2500 dollars gross income were interviewed. The stratified random sample was designed by the Iowa State College Statistical Laboratory.

A two week school provided uniform training for the 23 interviewers. The actual numerical utility computations are based upon two operational prerequisites, (1) preference among alternative utilities and (2) indifference between a certain and an uncertain alternative (objects with probability distributions).

The first phase in analyzing the data was conducted to determine the effectiveness of the schedule and interviewers in eliciting answers. The analysis had two steps. The first and most important step was to specify which responses were and which were not consistent with the hypothesis of measurable utility and the hypothesized utility function.

The next step was to consider certain attributes and types of behavior in order to ascertain possible reasons for the different answers and degrees of consistency. It was found that relatively older people with more years of farming experience, fewer dependents, relatively high net worths, and small amounts of debts were less likely to answer the questions concerning gains or losses. Further, it was found that certain Indiana farm managers were probably misrepresented by answers on the schedules. This misrepresentation was traced to interviewer bias. In this case it was concluded that these data should be eliminated from the subsequent analysis.

One of the most outstanding reasons for the different proportions of consistent and inconsistent answers was that different interviewers had conducted the interview. It was concluded that some useful observations were lost in the case of the inconsistent answers. Data added to

the consistent group of answers by interviewer bias were concluded to be useful for the fitting of utility functions. The relationships which were discovered between estimates of numerical utility and behavior substantiate this conclusion.

As more individuals answered the loss questions than the gain questions it can be concluded that the gain questions were more difficult to handle. Several reasons could be offered to explain this difficulty. One might be that the gain questions which followed the loss questions sounded similar to the loss questions and that respondents refused to answer on the ground that they "had already answered those." Another explanation is that the gain questions were worded on the schedule in such a manner that the respondents did not understand the situations as well as they did in the loss situations. A somewhat more likely explanation is that more individuals are familiar with insurance taking than they are with chance taking for property gains. Still another reason which reflects upon some of the theoretical bases of the study is that although the theory denies neither risk aversion nor ethical objections to gambling, these two factors may help explain some of the apparent difficulties encountered by the interviewers. An additional motivating factor in contrast to the utility of wealth assumed by this study is the utility attached to non-monetary gains and losses.

The second phase of analysis was directed toward finding empirical relationships between the estimates of numerical utility and the character, disposition, and behavior of farm managers. This analysis

not only contributes evidence for the existence of a technique for quantifying utility, but also to the hypothesis concerning the actual correspondence between numerical utilities and predictable managerial behavior. The predictability of managerial behavior is based upon the premise, "that men act as they have acted."[1] This phase, the second one in the analysis has three steps.

The first step was to divide the total group of consistent answers into types based upon the estimates of relative marginal utility differentiated off the individual's total utility curve for wealth. This classification was based on the belief that individuals who attach the same or approximately the same relative marginal utility to a dollar of wealth at different gain or loss levels will have similar characteristics and behavior. The technique does not provide a basis for making comparisons of an absolute numerical utility. It does provide a basis for making comparisons of relative utility, i.e., relative to the unit of measure and position of origin. Thus, the second step was to compare the attributes and behavior of the individuals in each type.

The type of individual who answered all Yes to the losses and the gains made up a sizable group with rather distinguishing characteristics. They are the oldest individuals of those interviewed and have the most farming experience and the fewest dependents. On the average they have a high net worth and low debt positions relative to the other types. Their other behavior is commensurate with this type of

[1]This is contrary to the premise "men act as they should act" which would have lead to a study of ethics rather than one of behavior.

individual; however, the fact that they accepted all the unfair insurance schemes and the unfair risk situations is surprising. This fact may reflect more heavily upon the technique than upon the disposition of the individual. Contrary to the conclusion that they attach an extremely high marginal utility to wealth may be their feeling that it made no difference to them what they answered. Thus, the technique and interviewing procedures may be ineffective with this type of individual.

The second type of individual, which did not appear in significant numbers on the losses questions, was one who would not accept a fair bet on gains. Like the type just described, these individuals have a high net worth but, by way of contrast, have the highest debt position of any of the consistent groups. This result suggests that these individuals may have a positive preference for certain odds aside from either the probabilities involved or the utility of the gain. A hypothesis to this effect could be tested by a more extensive schedule of more-than-fair odds and fair odds than was included in the I.M.S. technique. The fact that for the individuals who were consistent on both gain and losses the size of gain necessary to induce acceptance of an unfair risk was at most 26 times as large as the size of loss necessary to induce acceptance of an insurance scheme substantiates the contention that the range of gains needs to be more extensive.

In those cases where an estimate of utility was derived from a fitted equation, two of the most meaningful variables found related to marginal utility for gains was the amount of debt and the type of

farming engaged in by the respondent. These results indicate that the technique and the procedures followed does provide, for at least some individuals, numerical utility estimates useful in predicting managerial behavior. It could be hypothesized that the reason a significant relationship was not found between net worth, income, and marginal utility was that the respondents' estimate of these two items was less accurate than their estimate of debts. This hypothesis suggests a more extensive interviewing procedure to obtain more accurate measures of these factors than was used for the I.M.S. Another factor, which may be related to answers on the gains and loss questions, is recent changes in individuals income, net worth and debt position. Unfortunately the I.M.S. schedule did not include this information. The need for such information is emphasized here as a necessity for future research in this area.

For the fitted utility functions on losses, the four most meaningful variables (from the standpoint of establishing a relationship between marginal utility and behavior) were (1) net worth, (2) income, (3) type of farming, and (4) concern for the two types of error. These results indicate that the technique does provide meaningful estimates of marginal disutility for losses. Previous comparisons showed that more individuals answered and were consistent on the loss questions than on the gain questions.

A third step in the analysis attempted to establish the reliability of the technique in predicting behavior. Although the technique did not include its own reliability check, one part of the total I.M.S. schedule involved informal insurance schemes. A ranking of these schemes showed that the various types formed on the basis of answers to the loss questions ranked the items differently. The pattern manifested between the types warrants a hopeful conclusion that the technique, at least for the loss questions, possessed some reliability.

A reliability test on the predictions would consist of a second set of gain and loss situations involving different amounts of money and different probabilities than appear on the schedule from which the utility function is estimated. The predicted answers to this second set could be statistically compared with the observed answers to ascertain the confidence to be attached to the predictions. A stronger way of testing the reliability of the technique would be to predict what an individual would do in specific uncertain circumstances in his particular setting. Of course, to make this feasible the researcher would have to have the returns and the probabilities of the outcomes involved in the enterprise. This would be a more expensive procedure than the first suggested, however, it would probably be more meaningful than the hypothetical approach.

The following suggestions grow out of general experience with this study and specific analysis presented herein.

1) Further research in utility measurement is warranted on the same basis that research with other measurement techniques (I.Q. tests, and personality tests) are warranted.

2) Supplemental theoretical work is needed in decisions making theory of farm management similar in character to that of mathematical statistics, i.e., greater emphasis needs to be placed upon quantitative measurements and more precise definitions of the relevant variables.

3) Examination of some of the basic assumptions of utility theory in respect to their compatibility with the fundamental suppositions of science needs to be performed, e.g., the teleological nature of the theory may be in conflict with the mechanistic approach of science.

4) Further effort should be given to technique construction and interviewing procedures, particularly with respect to situations involving gains. The technique should be extensified to include not only other situations for the various odds, but additional reliability tests.

5) When utility measurement techniques are employed they should not be a small part of a larger schedule. Information which is supplemental to the utility schedule should be orientated to testing specific hypotheses and obtained in the most accurate manner available.

6) The results of this study indicate that a sample stratified on other than a geographical variable could exclude individuals from whom it is difficult to get answers on the particular questions used in the study and from whom answers would be meaningless. Another variable is the utility attached to objects other than wealth; such a variable was implied in this study by certain individuals who were distinguished by age, net worth, type of farm and debt position. Perhaps a different type of utility measuring technique could be designed to include the individuals with whom the questions were unsuccessful in this study.

7) Further consideration should be given to methods of analyzing the data. Such as:

a) Other criterion for specifying consistent and inconsistent answers, e.g., classifying on the basis of risk aversion as indicated by answers to certain odds.

b) Determine the effect of changing the assumption of constant utility over the range of the payment (stakes).

c) Consider the cases which were inconsistent with the indifference axiom for consistency with a subjective probability hypothesis.

8) The implications of the present study for farm management teaching and extension need to be considered and made available in relevant publications.

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APPENDICES

APPENDIX A

The schedule used in the I.M.S. survey is presented here in toto. The particular questions which have been the main concern of this thesis appear on pages 159, 160, and 182.

Interview Number________

CHECK OFF LIST FOR QUESTION 57

Here is a group of similar situations. Please fill in your answers to show whether or not you'd be willing to pay these costs to get out of groups in which one person has to bear a loss.

No. of people in group 1,000
Amount of loss $25,000
Cost of getting out of group $25
Yes____ No____

No. of people in group 2,000
Amount of loss $50,000
Cost of getting out of group $25
Yes____ No____

No. of people in group 400
Amount of loss $10,000
Cost of getting out of group 40
Yes____ No____

No. of people in group 20
Amount of loss $500
Cost of getting out of group 10
Yes____ No____

No. of people in group 40
Amount of loss $1,000
Cost of getting out of group $10
Yes____ No____

No. of people in group 400
Amount of loss $10,000
Cost of getting out of group $25
Yes____ No____

No. of people in group 20
Amount of loss $500
Cost of getting out of group $40
Yes____ No____

No. of people in group 400
Amount of loss $10,000
Cost of getting out of group $10
Yes____ No____

No. of people in group 2,000
Amount of loss $50,000
Cost of getting out of group $10
Yes____ No____

No. of people in group 4
Amount of loss $100
Cost of getting out of group $40
Yes____ No____

No. of people in group 20
Amount of loss $500
Cost of getting out of group $25
Yes____ No____

No. of people in group 40
Amount of loss $1,000
Cost of getting out of group $25
Yes____ No____

No. of people in group 2,000
Amount of loss $50,000
Cost of getting out of group $40
Yes____ No____

No. of people in group 1,000
Amount of loss $25,000
Cost of getting out of group $10
Yes____ No____

No. of people in group 4
Amount of loss $100
Cost of getting out of group $10
Yes____ No____

No. of people in group 1,000
Amount of loss $25,000
Cost of getting out of group $40
Yes____ No____

No. of people in group 40
Amount of loss $1,000
Cost of getting out of group $40
Yes____ No____

No. of people in group 4
Amount of loss $100
Cost of getting out of group $25
Yes____ No____

Interview Number__________

CHECK OFF LIST FOR QUESTION 58

Here is another group of situations that are similar to this one. Please fill in your answer to show whether or not you'd be willing to pay these costs to get into a group in which one person would get the gain.

No. of people in group 40
Value of property gained $1,000
Amount you pay to get in $25
Yes____ No____

No. of people in group 1,000
Value of property gained $25,000
Amount you pay to get in $40
Yes____ No____

No. of people in group 2,000
Value of property gained $50,000
Amount you pay to get in $10
Yes____ No____

No. of people in group 20
Value of property gained $500
Amount you pay to get in $25
Yes____ No____

No. of people in group 40
Value of property gained $1,000
Amount you pay to get in $40
Yes____ No____

No. of people in group 1,000
Value of property gained $25,000
Amount you pay to get in $25
Yes____ No____

No. of people in group 2,000
Value of property gained $50,000
Amount you pay to get in $40
Yes____ No____

No. of people in group 400
Value of property gained $10,000
Amount you pay to get in $10
Yes____ No____

No. of people in group 400
Value of property gained $10,000
Amount you pay to get in 40
Yes____ No____

No. of people in group 200
Value of property gained $5,000
Amount you pay to get in $25
Yes____ No____

No. of people in group 20
Value of property gained $500
Amount you pay to get in $10
Yes____ No____

No. of people in group 2,000
Value of property gained $50,000
Amount you pay to get in $25
Yes____ No____

No. of people in group 20
Value of property gained $500
Amount you pay to get in $40
Yes____ No____

No. of people in group 40
Value of property gained $1,000
Amount you pay to get in $10
Yes____ No____

No. of people in group 1,000
Value of property gained $25,000
Amount you pay to get in 10
Yes____ No____

No. of people in group 400
Value of property gained $10,000
Amount you pay to get in $25
Yes____ No____

No. of people in group 200
Value of property gained $5,000
Amount you pay to get in $10
Yes____ No____

No. of people in group 200
Value of property gained $5,000
Amount you pay to get in $40
Yes____ No____

Interview Number________

Date____________________
Income Qualifications Checked_________
Managerial Qualifications Checked_____

INTERSTATE FARM MANAGERIAL SURVEY

1. Now first of all, how many acres, all together:

_________ do your own?

(IF "ANY") This year how many of these are you actually using as:

_____ crop land and rotation pasture
_____ permanent pasture
_____ rent out or put out on shares
_____ remainder

_____ are you renting this year?

(IF "ANY") How many of these are you actually using as:

_____ crop land and rotation pasture
_____ permanent pasture
_____ remainder

2. What do you consider to be the main crop or livestock product on your farm?____________________

What did you do with it last year?______________________________________

What other crops or products did you market last year?______________

____

____

(IF MORE THAN ONE CROP AND/OR PRODUCT WAS MARKETED IN THE PRECEDING YEAR.) What proportion of your last year's total farm income did each of these account for? (LIST UNTIL 70% OF INCOME IS ACCOUNTED FOR.)

Main product ____________________________ ______%

2nd product ____________________________ ______%

3rd product ____________________________ ______%

4th product ____________________________ ______%

5th product ____________________________ ______%

6th product ____________________________ ______%

7th product ____________________________ ______%

8th product ____________________________ ______%

9th product ______________________ ______%

10th product ______________________ ______%

3. Now I'd like to ask you some questions about the kinds of information that a farmer needs. What should a farmer find out before setting up a farm in a strange area for a strange family?

____

____

____

____

4. In general what kinds of information do you think a farmer ought to keep up with in order to operate a going farm business.

   a. In order to get the greatest profit?

   ____

   ____

   ____

   ____

   ____

   b. In order to get the greatest satisfaction for his entire family?

   ____

   ____

   ____

   ____

   ____

5. Here is a list of five types of information which at one time or other you may have had to obtain in order to make decisions about things that have come up in the course of your farming career. Each type is explained on this list and if the explanation is not completely clear, I'll try to help you with it.

(PRESENT LIST. PAUSE FOR RESPONDENT TO READ AND EXPLAIN IF NECESSARY.)

1. PRICES: Information on prices received for farm products and prices paid for items used in farm production this includes past, present, and future prices.

   EXAMPLES:

Current market prices	Feed and supply prices
Market outlook	Machinery prices
Corn-hog ratio	Wage rates
Dairy-feed ratio	Interest rates

2. PRODUCTION FACTORS: Information on the effects of all accepted farm practices and items used in production on rates of crop and livestock production--also information on how soils, disease, and weather affect yields.

   EXAMPLES:

Fertilizers	Storage methods
Sprays and insects	Work methods
Crop varieties	Tillage practices
Feeding rates	Building layout

3. NEW DEVELOPMENTS: Information on new developments or changes in farm practices and items used in production.

   EXAMPLES:

Supplemental irrigation	Meat-type hogs
Antibiotics	New feed supplements
Anhydrous ammonia	Self feeding silos
Chemical weed killers	Krilium

4. HUMAN FACTORS: Information about individuals you may have to deal with or consider in making decisions about a farm.

   EXAMPLES:

Family members	Dealers and buyers
Relatives	Salesmen
Neighbors or friends	County agents
Other people	Hired workers

5. POLITICAL, SOCIAL, RELIGIOUS FACTORS: Information on local, national and international governments and formal and informal groups whose actions affect a farm.

EXAMPLES:

Acreage controls	Church practices
Tax rates	Conservation programs
Draft	Drainage districts
School districts	Co-op policies

a. In the light of your own experience in getting information to set-up and run your farm to get the most out of life, which of these five types of information have you found to be most important to you? (IOWA INTERVIEWERS WILL SUBSTITUTE "FOR PROFIT" IN PLACE OF "TO GET THE MOST OUT OF LIFE.")

Rank 1 ____________________

Which of the remaining four do you think has been most important to you?

Rank 2 ____________________

Which of the five has been least important?

Rank 5 ____________________

Now of the remaining two-(INSERT NAMES OF REMAINING TWO TYPES) which do you think you've found more important in solving your farm problems?

Rank 3 ____________________

Rank 4 ____________________ (REMAINING CATEGORY)

_____ All equally important

_____ Can't rank: Why do you feel that you can't rank them?

____

____

b. The kinds of information you find important may not be equally difficult to get hold of. In the light of your own experience in getting information, then, which of these types has been the most difficult to get?

Rank 1 ____________________

Which of the remaining four has been most difficult to get?

Rank 2 ______________________________

Which of the five would you say that you've found least difficult?

Rank 5 ______________________________

Now of the remaining two-(INSERT NAMES OF REMAINING TWO TYPES) which do you think that you've found most difficult to get?

RANK 3 ______________________________

RANK 4 ______________________________ (REMAINING CATEGORY)

_______ All equally difficult

_______ Can't rank; Why do you feel that you can't rank them?

____

____

9. We've been talking about information needs that you may have had in making decisions about specific problems. However, there are a number of other difficulties involved in making decisions and acquiring information that you may also find to be problems. Here is a list of some of them. (HAND CARD TO RESPONDENT) I'd like you to tell me which of these or any other not on this list have been problems in your own experience.

_____1. Knowing when to change your production plans.

_____2. Recognizing the existence of problems.

_____3. Defining the objectives of your family.

_____4. Knowing when you are on the "wrong track" in your attempt to reach a desired goal.

_____5. "Putting your finger" on the difficulty when you know there is something wrong or when you know a problem exists.

_____6. Just keeping up with all of the new information relating to farming that constantly comes along.

_____7. Getting information organized in your own mind so that you can see what it means for you.

_____8. Knowing how and when to arrive at decisions (once you've organized the information) when some of it leads you to one conclusion and some to another.

_____9. Any others not on this list.______________________________

____

____

____

10. In figuring out what action to take on the basis of the information you have about a problem, do you sometimes look at what it will cost you and compare this, both financially and otherwise, with the results you can expect?

_____No: Why is it that you don't do this?______________________

____

____

_____Yes: Do you ever try to work out the answers in writing?

_____ No

_____ Yes Can you tell me some of the things you've done this for?

____

____

____

Do you sometimes do this figuring in your head?

_____ No

_____ Yes Can you tell me some of the things you've done this for?

____

____

____

11. Here is a way for a farmer to figure out the costs and returns of expanding a 15 litter hog enterprise to 25 litters.

a. The farmer figures that his costs per litter will increase from $210 to $222. With the price of hogs remaining as at present, he will gross $270 per litter. On this basis, if he expands his hog enterprise to 25 litters, his net profit per litter will be $48, or the difference between the $270 and $222.

Would these figures tell you how many litters this farmer should raise?

_____ Yes: How many litters should he raise?

____

_____ No

_____ Don't know

b. Here is another way to figure out the same problem.

He figures his costs and returns on each additional litter and finds that each one will add or lose the following amounts after costs are subtracted.

	Profit	Loss		Profit	Loss
16th litter	$80	-	21st litter	$14	-
17th litter	$72	-	22nd litter	$ 7	-
18th litter	$59	-	23rd litter	-	$11
19th litter	$45	-	24th litter	-	$15
20th litter	$30	-	25th litter	-	$20

Would these figures tell you how many litters this farmer should raise?

_____ Yes: How many litters should he raise?

____

_____ No

_____ Don't know

c. Which way do you figure out costs and returns in similar situations?

_____ Uses a.
_____ Uses b.
_____ Uses both
_____ Uses another method: How would you figure it out?__________

____

____

12. a. Here is the information that a farmer has for deciding whether of not to put another $250 into machinery. (INTERVIEWER PRESENT CARD) His records indicate that his average gross income per $250 invested in machinery is $450. The average returns above fuel and labor costs per $250 invested in machinery are $275. Is this enough information to decide whether or not a farmer should invest another $250 in machinery?

_____ Yes: For what reasons? ______________________________

____

____

_____ No: Why not? ______________________________

____

____

_____ Don't know: What difficulties are you having in figuring this out?

____

____

____

b. Here is another way for him to figure it out. (INTERVIEWER PRESENT CARD) An analysis of records from his farm and other similar farms indicates that additional investments in machinery can be expected to return 25% on the dollar after the earnings of all other expenitures and investments are accounted for. This 25% includes profits, interest on the machinery investment figured at 5%, and depreciation figured at 10%. Is this enough information to decide whether or not a farmer should invest another $250 in machinery?

_____ Yes: For what reasons? ______________________________

____

____

_____ No: Why not? ______________________________

____

____

____ Don't know: What difficulties are you having in figuring this out?

____

____

____

13. Two methods of arriving at conclusions are illustrated by the examples on this card (INTERVIEWER PRESENT CARD)

1. In some cases we draw conclusions from experience. Thus, we may notice that in certain situations certain results always seem to follow. On the basis of this, we conclude that these results always occur in this situation. An example might occur in fertilizing a field. Thus, if a farmer sees that the poor thin spots in a field respond to fertilizers more than the rich spots, he may conclude that poor thin spots <u>always</u> respond more than rich spots.

2. In other cases, we "reason out" conclusions about new situations facing us from facts and principles we know or assume to be true. For instance, a farmer may know or assume that a certain barn arrangement will save labor and then "figure out" how the use of this arrangement would affect the amount of labor which would be left over from use elsewhere in his business.

a. Do you use both, mainly one, only one, or neither of these methods in arriving at conclusions?

___ Both
___ Mainly one: Which?______
___ Only one: Which?______
___ Neither
___ Don't know

b. Which of these thinking methods is most natural for you to use?

___ Both
___ One: Which?______
___ Neither
___ Don't know

c. Can you use one of these methods without using the other?

___ Yes
___ No
___ Don't know

d. What proportion of your thinking is like the first method? (PRESENT CHECKLIST)

___None	___About 1/2	___All
___Less than 1/4	___Between 1/2 and 3/4	___Don't know how much, but not all
___About 1/4	___About 3/4	___No answer
___Between 1/2 and 1/2	___More than 3/4	

e. What proportion of your thinking is like the second method? (PRESENT CHECKLIST)

___None	___About 1/2	___All
___Less than 1/4	___Between 1/2 and 3/4	___Don't know how much, but not all
___About 1/4	___About 3/4	___No answer
___Between 1/2 and 1/2	___More than 3/4	

f. Could you give me another example of the first method of arriving at conclusions?

____

____

____

____

g. Could you give me another example of the second method?

____

____

____

15. In deciding whether or not to buy a piece of land, a farmer can make either of two kinds of mistakes. He can buy land when he should not have. This mistake was made by many farmers after World War I. On the other hand, he can make the mistake of not buying land when he should have. This mistake was made by many farmers who did not buy land between 1935 and 1945. In making farm decisions, are you more concerned about taking action when it would have been better not to than you are about not taking actions when you should have, or are you equally concerned about both of these?

___ More concerned about taking actions when shouldn't
___ More concerned about not taking actions when should
___ Equally concerned
___ Don't know

17. Could you please tell me how you made up your mind about what or how much of each product to produce this year?

____

____

____

____

____

18. a. What important thing that you buy and use in production has had a fairly big change in price recently?________________(X)

 b. What do you use it for?________________________(Y)

 c. How did you make up your mind about how much of__________to use in producing_____Y______, when the price of_____X____changed?

____

____

____

____

19. a. What important thing that you produce for sale has had a rather drastic change in price recently?_______________(X)

 b. Did the price go up or down?____________________

 c. How did you make up your mind about what to do about your production of _____X________as a result?

____

____

____

____

 d. What reasons did you have for coming to this conclusion?_________

____

____

____

20. What was the last major piece of machinery that you bought? ________

How did you go about making up your mind to buy it? ____________

____

____

____

____

21. In the last two years have you attended two or more:

County agent's or extension specialists meetings ___Yes ___No.

Meetings of farm organizations like the Farm Bureau, the Grange, and the Farmers' Union ___Yes ___No

22. There are ways of getting some information without using any of the sources we've been talking about. Would you please take this chart and check the appropriate spaces for ways you usually use to get these same kinds of information? (INTERVIEWER EXPLAIN HEADINGS)

23-24. Would you please take this chart and check the appropriate spaces for the sources you usually use to get these different kinds of information? (INTERVIEWER EXPLAIN HEADINGS)

25. a. What do you expect the price of (INSERT NAME OF MOST IMPORTANT COMMODITY, EXCLUDING DAIRY PRODUCTS) to be at your next marketing time?

____

When would that be? ____________

b. Do you expect the price of (NAME PRODUCT MENTIONED IN a.) at marketing time to be higher than, lower than, or the same as they were at the same time last year?

_____Higher
_____Lower
_____Same

How have you arrived at this estimate?

____

____

____

___Don't know
Still, if you had to make a prediction now, how would you figure it out?

____

____

____

____

_____ _____

c. (IF NO GENERAL MODEL IS GIVEN IN b., ASK THE FOLLOWING THREE QUESTIONS IN c.)
In general, what circumstances lead you to expect that the prices you receive will be higher than they were in previous years?

In general, what circumstances lead you to expect that the prices you receive will be the same as they were in previous years?

In general, what circumstances lead you to expect that the prices you receive will be lower than they were in previous years?

d. Is there any special year or group of years that you think of as typical for purposes of comparison in trying to figure out what prices to expect?

What reasons do you have for thinking of that period as typical?

26. a. We buy many things to operate our farms. Feed, fertilizer, and seed are just some examples. In deciding when to buy things, how do you usually judge what prices are going to be?

b. What are some of the things that you buy from time to time that get used up in production?

____

Under what conditions do you assume that the prices you will be paying for (INSERT NAME OF FIRST INPUT MENTIONED ABOVE) will be higher than they were?

____

____

____

Under what conditions do you assume that the prices you will be paying for (INSERT NAME OF FIRST INPUT MENTIONED ABOVE) will be the same as they were?

____

____

____

Under what conditions do you assume that the prices you will be paying for (INSERT NAME OF FIRST INPUT MENTIONED ABOVE) will be lower than they were?

____

____

____

27. No farmer operates his farm without having some contact with other people. He comes into contact with such people as farm laborers, men who do custom work, dealers, landlords, bankers, and so on. Do you usually have some idea as to what to expect from a person you're about to meet? (INTERVIEWER CODE)

___Has some idea: How can you tell what to expect from a person you've just met?

____

____

____

(IF ANSWER INDICATES THAT HE DEPENDS ON INFORMATION FROM OTHERS) If you didn't know anyone who could give you some information about the person, then how could you tell what to expect?

____

____

____

___Waits and sees: Are people so different that a man has to know new acquaintances for a while before he has some idea of what he can expect from them?

___Yes: Are there any things you can look for in a person to give clues as to what to expect?

___No
___Yes: What are some of these things?

____

____

What can we figure out from them?

____

____

___No: Well, then, what can you expect from people you've just met?

____

____

____

What are some of the things that make it possible to know what to expect from strangers?

____

____

____

___It's hard to say of depends: What does it depend on?________________

____

____

(IF ANSWER UNCLEAR, ASK FOLLOW-UP TO "DON'T KNOW")

___Don't know In selecting a regular hired man, how would you forecast whether he will make a good employee?

____

____

(IF "HIRED MAN" QUESTION NOT ANSWERED ADEQUATELY AND RESPONDENT IS A LAND LORD.
In selecting a man to operate some of your land, how would you decide whether a man would make a good tenant?

____

____

____

(IF "HIRED MAN" QUESTION NOT ANSWERED ADEQUATELY AND RESPONDENT IS A TENANT.)
In looking for a man to rent from, how would you decide whether a land-owner would make a good landlord?

____

____

____

28. Do you think there will be any changes in national, state, or local government programs and policies for farmers in the next two years?

___No: What are your reasons for feeling this way?________________

____

____

___Yes: What are your reasons for feeling this way?________________

____

____

___Change and no change equally likely: What are your reasons for feeling this way?________________

____

___Don't know: Well, then, do you try to take these things into account in your planning?

___No
___Yes: How?___

29. a. Do you think there will be any changes in farming methods and things used in farming during the next two years?

___No: What reasons do you have for feeling this way?___

___Yes: What reasons do you have for feeling this way?___

For what kinds of things do you anticipate these changes?

___

___Don't know: Well, then do you try to take these possible changes into account in your planning?

___No
___Yes: How? ___

b. Assuming, for a moment, that there will be changes in farming methods and equipment, would you be willing to be the first one in your area to try out some of these changes, or would you prefer to have some other farmer try them out before you adopt them?

___Willing to be first
___Would prefer to wait for others
___Depends or don't know: What would it depend on?___

30. Could you have used more credit profitably last year?

___No
___Yes: Did you refrain from borrowing so as to have property to mortgage in case of trouble?

___Yes
___No

31. Was there any time in the last year when you didn't close what appeared to be a profitable deal because the person you were dealing with might not be reliable?

___Yes
___No

32. Was there any time in the last year when you added crops and livestock enterprises for the main purpose of getting your eggs in more baskets?

___Yes
___No

33. Was there any time in the last year when you refused to use your money for an apparently profitable purpose in order to "play it safe?"

___Yes
___No

34. Do you keep more tractor or horse power on hand than is necessary for average weather in order to handle the crop in case of poor weather?

___Yes
___No

35. Was there any time in the last year when you paid more for an item from a person you could trust, than you would have had to pay for the same item from a less reliable person?

___Yes
___No

36. Do you carry life insurance?

___No
___Yes: Do you carry additional life insurance to cover a debt for your family?

___Yes
___No

37. How about fire insurance? Do you carry any?

___Yes
___No

38. Was there any time in the last year when you kept on hand a reserve of cash or things easily converted to cash, like wheat, bonds and livestock, in case of unfavorable developments?

___Yes
___No

39. Do you ordinarily keep larger feed supplies than necessary to be able to change your mind on livestock numbers?

___Yes
___No

40. Do you ordinarily keep larger feed reserves than necessary to protect yourself against loss due to bad weather?

___Yes
___No

41. Do you make a practice of having available more hay or pasture ground than necessary in order to protect yourself against drought?

___Yes
___No

43. Do you carry collision insurance to cover damages to your car or truck?

___Yes
___No

44. Could you please give me some examples of things which you or your family did last year, when you were not completely sure of the outcome, but willing to take the consequences of acting and being wrong?

____

____

45. Now we'd like examples of things which you or your family decided <u>not</u> to do last year even though you ran a risk of being wrong in not acting. We want cases in which you were willing to take the consequences of being wrong and not cases where you postponed decisions until you could learn more.

____

____

____

46. Please give me some examples of situations during the last year in which you postponed a decision to act or not to act until you could learn more.

____

____

____

47. Please give me some examples of situations that occurred last year in which you did not have enough information for taking action and in which you felt that what you could learn would not be worth the cost and effort of learning it.

____

____

48. Now I'd like you to give me some examples of situations occurring last year in which you were certain of the outcome, that is, situations in which you could act without worrying about being wrong.

____

____

49. Were there any occasions last year when circumstances forced you to make decisions and act without information you would have been willing to spend time and effort to get--if you had not been forced to act?

___No
___Yes: Could you please tell me what they were?__________________

____

____

50, 51, 53-56.
We would like to ask you what you think should be done in the following situation. A farmer wants to trade his combine for a tractor. There are other farmers in the neighborhood who also want to deal for a tractor. (RECORD ANY COMMENTS)

a. While he's still looking around to see who has a tractor to trade for, should he keep quiet about his intentions so as to keep the people he might want to trade with from having plenty of time to decide on how much they would want to get?

___Should
___Shouldn't

b. When he finally decides who he'd like to trade with, is it a good idea for him to act as though he's not sure whether he wants to trade so that other farmers who might also be interested in a trade would think the tractor was not desirable?

___Yes
___No

c. If he finds out that his neighbor is trying to make a trade for the same tractor, should he improve his competitive position by trying to find out what his neighbor is offering without letting his neighbor know what his offer is?

___Yes
___No

d. If he meets someone else who wants to trade for a tractor but doesn't know about the one that he's interested in, is it better for him not to mention that he knows about this tractor?

___Yes
___No

e. Is it wise for him to try to make the man he's dealing with think that a combine is what he needs most, so that trades for other items won't be given much consideration?

___Yes
___No

f. If he finds the tractor needs minor repairs the owner hasn't told him about, is it better for him not to mention anything that might be wrong with his combine so that he can make the trade successfully?

___Yes
___No

52. Sometimes a man may attempt to build a greater sense of responsibility in the people he's dealing with in order to make <u>them</u> more reliable. Do you know of a case in which this was done?________________________

____

____

Have you yourself ever done this?

___No
___Yes: Who are the people that you do this with and under what conditions?______________________________

57. If you were in a group of 1500 people in which you knew one person would have to bear a loss of $10,000, would you be willing to pay $10 in order to get out of the group, and, thus, avoid the risk of having to bear this loss?

___Yes
___No

(READ STATEMENT ON SHEET OF QUESTIONS AND HAND TO RESPONDENT FOR HIM TO FILL OUT)

58. If you know that one person out of a group of 1,400 would get a piece of property worth $15,000, at no further cost to him, would you be willing to pay $15 out of your present income to become a member of that group.

___Yes
___No

(READ STATEMENT ON SHEET OF QUESTIONS AND HAND TO RESPONDENT FOR HIM TO FILL OUT)

59. a. Did you grow up on a farm?

___All of childhood spent on farm
___Part of childhood spent on farm
___None of childhood spent on farm

b. What are the names of the schools you've attended? | How long did you go there? | Did they give you any training in agriculture?

What are the names of the schools you've attended?	How long did you go there?	Did they give you any training in agriculture?	
________	________	___Yes	___No
________	________	___Yes	___No
________	________	___Yes	___No
________	________	___Yes	___No

c. What was the last grade of school you completed?________

d. Have you had any additional training, such as short courses or vocational training?

___No
___Yes: What was it? ________ How long did it run? ________

________ ________

e. Did you ever belong to:

a 4-H Club? ___Yes ___No
The Future Farmers of America? ___Yes ___No

60. Is this the only farm you've operated for yourself?

___Yes: How many years have you run this place?________

___No: How many years have you operated farms for yourself?________
How many years have you run this place?________

61. Were you ever out of farming for a while?

___No
___Yes: For how long?________

What kinds of work did you do during this time?________

____

Have you ever lived in a city?

___No
___Yes: What kinds of work did you do during that period?___

____

62. Do you ordinarily do any work off the farm for income during the year?

___No
___Yes: Do you have regular year-round work, or do you just work off the farm parts of the year?

___All year: Is it a full day's work? ___Full day
___Part day

___Part of the year: What part of the year do you work?_____
Do you work a full day or just part of the day?

___Full day
___Part day

What proportion of your total gross income from all sources came from farming operations last year? (INTERVIEWER PRESENT CARD)

___Less than 1/2
___About 1/4
___Between 1/4 and 1/2
___About 1/2
___Between 1/2 and 3/4
___About 3/4
___More than 3/4
___Don't know how much, but not all
___No answer

63. a. We'd appreciate knowing who also lives here, their approximate ages, and whether they're dependent on you?

Relationship to Respondent	Age	Dependent (INTERVIEWER CHECK IF SO)
RESPONDENT	___	___
___	___	___
___	___	___
___	___	___
___	___	___
___	___	___

b. Are there any other persons not living with you to whom you contribute financial support?

___No
___Yes: How many?___________

c. (IF RESPONDENT HAS ANY CHILDREN AT ALL) Have any of your children belonged to 4-H or FFA?

___Yes
___No

64. Did you use any hired labor in running your farm last year?

___No
___Yes: Did they work for you year round or part time?

___Year round: How many full time workers did you have?_____

___Part time: How many were there?__________
On the average, how many days did the average part-time worker work for you?____________

65. What was your average gross farm income in the last three years?_____

66. We'd like to establish an estimate of your net worth.

a. Could you please give me your best estimates of the value of your assets at the beginning of the year. We want estimates of the actual values, not the book values for accounting purposes. The point is, what were these items worth to you.

Value of your land and buildings ______________

Value of your livestock ______________

Value of your machinery and equipment ______________

Value of your feed and crops ______________

Cash on hand ______________

Value of your stocks, bonds, and other investments ______________

Amount of money owed to you ______________

Value of your other assets ______________

(TOTAL) ______________

b. Now, how about your financial obligations at the beginning of the year? What was the amount of:

Your real estate debt ______________

Your short-term notes ____________

Your other notes ____________

Your accounts payable (money you owe) ____________

Your household installment debts ____________

Your other installment debts not covered in short term notes ____________

Your other debts ____________

(TOTAL) ____________

NET WORTH ____________

ENTER THE FOLLOWING

STATE ____________

COUNTY ____________

TOWNSHIP ____________

INTERVIEWER ____________

DATE ____________

INTERVIEW NUMBER ____________

		PEOPLE FROM FARM ORGANIZATIONS	CO. AGENTS, VOC. AG. TEACHERS, & AG. COLL. REPRESENTATIVES	GOVERNMENT PEOPLE	TRUCKERS, CUSTOM OPERATORS & ROUTE DRIVERS	NEIGHBORS & RELATIVES	PROFESSIONAL FARM MANAGERS	BANKERS & LENDING AGENTS	DEALERS, SALESMEN, & BUYERS	DEMONSTRATIONS, MEETINGS, LECTURES	PUBLICATIONS OF EXP. STAT. & EXT. SERVICES	FARM MAGAZINES	PUBLICATIONS OF FARM ORGANIZATIONS	FORMAL SCHOOLS	MAIL ADVERTISING	NEWSPAPERS	RADIO	TELEVISION	AUCTIONS
PRICES OF THINGS SOLD	PAST PRICES AND PRICE TRENDS																		
	CURRENT PRICES AND CHANGES IN PRICES																		
	PRICE OUTLOOK																		
OF THINGS BOUGHT	PAST PRICES AND THEIR TRENDS																		
	CURRENT PRICES AND CHANGES IN COSTS																		
	PRICE OUTLOOK																		
PRODUCTION FACTORS	EXISTING VARIETIES OF CROPS & LIVESTOCK																		
	EXISTING METHODS OF PRODUCING CROPS & LIVESTOCK																		
	CLIMATE, SOIL, AND DISEASE CONDITIONS																		
NEW DEVELOPMENTS	NEW INVENTIONS, DEVELOPMENTS, AND DISCOVERIES																		
HUMAN FACTORS	PEOPLE YOU HAVE TO DEAL WITH IN RUNNING YOUR FARM																		
	PEOPLE WHOSE REACTIONS MAY BE IMPORTANT TO YOU IN RUNNING YOUR FARM																		
POLITICAL, SOCIAL, RELIGIOUS FACTORS	CHANCES FOR DEPRESSION OR PROSPERITY																		
	ACTIONS & ATTITUDES OF LOCAL INFORMAL GROUPS THAT MAY AFFECT YOUR FARM																		
	ACTIONS OF NON-GOV'T GROUPS AFFECTING FARMING (E.G., FARM BUREAU, AMERICAN LEGION, ETC.)																		
	FEDERAL, STATE, AND LOCAL GOV'T ACTIONS AFFECTING FARMING																		

INTERVIEW NUMBER ____________

		PAST EXPERIENCE	TRIAL AND ERROR ON WHOLE OPERATION	EXPERIMENTATION ON A LIMITED SCALE	OBSERVING THE EXPERIENCE OF OTHERS	REASONING FROM INFORMATION KNOWN TO BE TRUE	KEEPING WRITTEN RECORDS
PRICES OF THINGS SOLD	PAST PRICES AND PRICE TRENDS						
	CURRENT PRICES AND CHANGES IN PRICES						
	PRICE OUTLOOK						
OF THINGS BOUGHT	PAST PRICES AND THEIR TRENDS						
	CURRENT PRICES AND CHANGES IN COSTS						
	PRICE OUTLOOK						
PRODUCTION FACTORS	EXISTING VARIETIES OF CROPS & LIVESTOCK						
	EXISTING METHODS OF PRODUCING CROPS & LIVESTOCK						
	CLIMATE, SOIL, AND DISEASE CONDITIONS						
NEW DEVELOPMENTS	NEW INVENTIONS, DEVELOPMENTS, AND DISCOVERIES						
HUMAN FACTORS	PEOPLE YOU HAVE TO DEAL WITH IN RUNNING YOUR FARM						
	PEOPLE WHOSE REACTIONS MAY BE IMPORTANT TO YOU IN RUNNING YOUR FARM						
POLITICAL, SOCIAL, RELIGIOUS FACTORS	CHANCES FOR DEPRESSION OR PROSPERITY						
	ACTIONS & ATTITUDES OF LOCAL INFORMAL GROUPS THAT MAY AFFECT YOUR FARM						
	ACTIONS OF NON-GOV'T GROUPS AFFECTING FARMING (E.G., FARM BUREAU, AMERICAN LEGION, ETC.)						
	FEDERAL, STATE, AND LOCAL GOV'T ACTIONS AFFECTING FARMING						

APPENDIX B

The table below (Table 58) shows the distribution of the 66 questions used in the I.M.S. survey over the six field schedules. The numbers in the first column correspond to the question numbers of the schedule in Appendix A. The six columns of numbers in the body of the table show the order of the questions on the field schedules. The last column indicates whether or not an information card was used during interviewing with the question. The information on the card is shown with the question in Appendix A.

TABLE 58

DISTRIBUTION OF QUESTIONS ON THE FIELD SCHEDULE USED IN THE I.M.S. SURVEY

Question Number	FIELD SCHEDULE FORM A	B	C	D	E	F	Information Card on Question Number
	Schedule Question Number						
1	1	1	1	1	1	1	
2	2	2	2	2	2	2	
3	17			5		5	
4	18	19	4	6	3		
5	19	20	5	7	6	6	X
9	20	21	6	8	7	7	X
10			7	3			X
11			8			3	X
12				4	4		X
13		26	3		5		X
15	3	3	10	10	8	4	
17						8	
18			9				
19				9			
20	22			12			
21	21	22	13	13	9	9	
22	24	24					
23	23	23					
24	23	23					
25			12		10	10	
26						11	
27	25	25		14			
28			14				
29	26						
30	4	4	15	15	18	19	
31	5	5	16	16	19	20	
32	6	6	17	17	20	21	
33	7	7	18	18	21	22	
34	8	8	19	19	22	23	
35	9	9	20	20	23	24	
36	10	10	21	21	24	25	
37	11	11	22	22	25	26	
38	13	13	24	24	27	28	
39	14	14	25	25	28	29	
40	15	15	26	26	29	30	
41	16	16	27	27	30	31	
43	12	12	23	23	26	27	
44	27	27	28	28	12	12	
45	28	28	30	30	14	14	
46	29	29	29	29	13	13	
47	30	30	31	31	15	15	
48	31	31	32	32	16	16	
49	32	32	33	33	17	17	
50			11	11			
51			11	11			
52					11	18	
53			11	11			
54			11	11			
55			11	11			
56			11	11			
57		17			31	32	
58		18			32	33	
59	33	33	34	34	33	34	
60	34	34	35	35	34	35	
61	35	35	36	36	35	36	
62	36	36	37	37	36	37	
63	37	37	38	38	37	38	X
64	38	38	39	39	38	39	
65	39	39	40	40	39	40	
66	40	40	41	41	40	41	

APPENDIX C

WORK SHEET

	Loss			Gain			Loss				Gain			
	10	25	40	10	25	40		10	25	40		10	25	40
All No							100				500			
1-5 No							500				1,000			
1-4 No							1,000				5,000			
1-3 No							10,000				10,000			
1-2 No							25,000				25,000			
1 No							50,000				50,000			
All Yes														
Inconsistent														

No Answer - Reason

APPENDIX D

The methods of fitting the utility functions and the assumptions made about the location of the indifference points and other identification points are given in the following outline.

I. Method of least squares

A. Equation derived using four given points

1. Three indifference points

a) In different intervals

b) Two in the same interval and one in another interval

(1) two at extreme values of the interval

(2) one at the center of interval

c) Three in the same interval

(1) more-than-fair point at lower extreme of interval

(2) fair point at center of interval

(3) unfair point at upper extreme of interval

2. The origin

B. Equation derived using three given points and one assumed

1. One indifference point for each of the fair and more-than-fair odds

a) In different intervals

b) In the same interval at its extreme values

2. The origin

3. One assumed point at 50,000 dollar gain (or loss) and $q(u) = 2/3 \left(\frac{1-\alpha}{\alpha}\right)$ (8).

II. Method of Lagrange interpolation

A. Equation derived using three given points (all Yes answers to the more-than-fair odds)

1. Two indifference points

a) In different intervals

b) In the same interval at its extreme values

2. The origin

B. Equation derived using two given points and one assumed (all Yes to the more-than-fair odds)

1. One indifference point at the center of the interval for the fair odds

2. One assumed point at 50,000 dollar gain (or loss) and $q(u) = 2/3\ (\frac{1-\alpha}{\alpha})$ (8)

3. The origin

C. Equation derived using two given points and one assumed (all No answers to the unfair odds)

1. One indifference point at the center of the interval for the more-than-fair odds.

2. One assumed point at 50,000 dollar gain (or loss) and $q(u) = 2/3\ (\frac{1-\alpha}{\alpha})$ (5)

3. The origin

D. Equation derived using two given points and one assumed (all Yes answers to the more-than-fair and fair odds)

1. One indifference point at the center of the interval for the unfair odds.

2. One assumed point at 50,000 dollar gain (or loss) and

$$q(u) = 3/2 \left(\frac{1-\alpha}{\alpha}\right) \quad (8)$$

For those cases in which there was no indifference point after replacements and transpositions, the following assumptions were made concerning the slope of the utility curve:

1) For the cases of all Yes answers to the more-than-fair odds and No answers to the fair and the unfair odds, the slope at any value was assumed to be

$$\frac{1}{2} \left(\frac{u_{MF} + u_F}{50,000}\right)$$

Where u_{MF} = the (dis)utility if the indifference point existed at 50,000 dollar gain (loss) on more-than-fair odds.

u_F = the (dis)utility if the indifference point existed at 50,000 dollar gain (loss) on fair odds

2) For the cases of all Yes answers to the more-than-fair and the fair odds and all No answers to the unfair odds, the slope at any value was assumed to be

$$\frac{1}{2} \left(\frac{u_F + u_{UF}}{50,000}\right)$$

Where u_F = the (dis)utility if the indifference point existed at 50,000 dollar gain (loss) on fair odds

u_{UF} = the (dis)utility if the indifference point existed at 50,000 dollar gain (loss) on unfair odds

3) For the cases of all Yes answers to all three odds, the slope was assumed to be $\frac{1}{2M_c}$ where $M_c = \frac{u_{UF}}{50,000}$ and u_{UF} = the (dis)utility if the indifference point existed at 50,000 gain (loss) on the unfair odds.

Date Due

~~Jul 7 '58~~			
[illegible] 26 '5 3			
8 Apr 59			
JUN 6			
~~JUN 11 1960~~			