

DECISION MAKING UNDER UNCERTAINTY  
A STUDY OF THE VALUATION OF INFORMATION

A Thesis

Submitted to the Faculty of Graduate Studies  
in Partial Fulfilment of the Requirements  
for the Degree of  
Master of Business Administration  
in the College of Commerce

by

Henry William Zadorozny

September, 1975

Copyright 1975. H.W. Zadorozny

The author has agreed that the Library, University of Saskatchewan, may make this thesis freely available for inspection. Moreover, the author has agreed that permission for extensive copying of this thesis for scholarly purposes may be granted by the professor or professors who supervised the thesis work recorded herein, or, in their absence, by the Head of the Department or the Dean of the College in which the thesis work was done. It is understood that due recognition will be given to the author of this thesis and to the University of Saskatchewan in any use of the material in this thesis. Copying or publication or any other use of the thesis for financial gain without approval by the University of Saskatchewan and the author's written permission is prohibited.

Requests for permission to copy or to make other use of material in this thesis in whole or in part should be addressed to:

Dean of the College of Commerce,

University of Saskatchewan,

Saskatoon, Canada.

## ACKNOWLEDGEMENTS

The author expresses his appreciation to Professor J.R. Edmonds who provided invaluable guidance and direction as thesis advisor. The author is also grateful to Dr. S.J. Hurka and Dr. H.J. Dart who were extremely helpful as members of the thesis committee. Sincere gratitude is also expressed to Mr. John Landgraf and Mary Steel, of the Saskatchewan Technical Institute, Moose Jaw, Saskatchewan, for their invaluable assistance in the preparation of this thesis.

## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
1. INTRODUCTION	1
1.1 Introduction to the Study	1
1.2 Definition of Terms and Concepts	1
1.3 The Present Study	10
1.3.1 Statement of the problem	12
1.4 The Importance of the Study	13
2. LITERATURE REVIEW	15
2.1 Research on Information-seeking Behavior	15
2.1.1 Review of Green's study	20
2.2.2 An alternate analysis of the experimental data	25
2.3 Dogmatism and Information-seeking Behavior	26
2.4 Statement of Hypotheses	28
3. METHODOLOGY	31
3.1 Measurement of How Subjects Value Information	31
3.1.1 Conduct of the game	32
3.2 The Measurement of Dogmatism	32
3.3 Subjects	33

## TABLE OF CONTENTS (continued)

4.	THE RESULTS OF THE STUDY	34
4.1	Information Buying Results	34
4.2	Results of the Post Exercise Question	35
4.2.1	Alternate analysis of the data	37
4.3	Dogmatism and Information	38
5.	SUMMARY, DISCUSSION AND CONCLUSIONS	40
5.1	Summary of the Study	40
5.2	Summary and Discussion of the Results	40
5.3	Conclusions and Summary Comments	49
	BIBLIOGRAPHY	52
	APPENDIX A	56
	APPENDIX B	65
	APPENDIX C	67

## LIST OF TABLES

TABLE	Page
1.1 Illustrative Problem	4
2.1 Basic Payoff Matrix and Response Form	21
2.2 Prices available on Response Forms (rearranged)	23
4.1 Summary Results of Information Buying In Comparison to Green's Results and Optimal Solution	34
4.2 Post Exercise Response Typologies (Percent of responses)	36
4.3 Significance of the Difference in Average Information Purchased	36
4.4 Observed Frequency of Overbuying Responses and Binomial Analysis	38
4.5 Significance of the Difference in the Average Amount of information Purchased by High and Low Dogmatic Groups	39
A.1 Basic Payoff Matrices	57
A.2 Game Conditions and Optimal Solutions	58
A.3 Illustrative Response Form - Condition 1	60
A.4 Computational Format	64
C.1 Subject Information Buying Response (\$ x 10 <sup>2</sup> ) using Green's Midpoint Assumption	67
C.2 Subject Information Buying Response (\$ x 10 <sup>2</sup> ) using The Post Exercise Question	68
C.3 Summary Characteristics of the Twenty-Nine Farm Operator Study Group	69

## CHAPTER I

### 1.1 Introduction to the Study

Management is increasingly being defined in terms of decision making. The environment within which the manager operates makes it necessary to emphasize his decision making capabilities. Foremost, among his capabilities is the way he uses information to make decisions.<sup>1</sup>

This study is concerned with the relationship between information and decision making. It deals with the psychological problem of understanding how decision makers value information in an environment characterized by uncertainty. In order to set a theoretical framework for this study, several terms and concepts have to be introduced. These concepts are: information and uncertainty, value of information, the expected value principle, the normative-descriptive research strategy, and the concept of dogmatism.

### 1.2 Definition of Terms and Concepts

Information and uncertainty. Information can be taken to mean data, observations or recorded facts which affect a decision maker's perception of the nature and extent of uncertainties associated with a given management problem.<sup>2</sup> In trying to solve a problem, a decision maker is normally faced with a set of possible alternative courses of action. The outcomes of these courses of action depend on a number

---

<sup>1</sup> Paul E. Green and Donald S. Tull, Research for Marketing Decisions, Toronto: Prentice-Hall, 1970, pp. 2-10.

<sup>2</sup> Robert D. Buzzell, Donald F. Cox, and Rex V. Brown, Marketing Research and Information Systems, New York: McGraw-Hill, 1969, p. 13.

of factors outside the manager's control.<sup>1</sup>

Uncertainty exists because there is a state of doubt as to which course of action should be taken. There is a lack of knowledge or information about what the outcomes would be. Thus, anything that can potentially reduce uncertainties can be regarded as information. This may be a fact, an estimate, a prediction, a market research result, or just a rumor.

Information, then, can be viewed as the raw material from which decisions emerge. The art of management depends on the ability to know what kind of information can be expected to reduce uncertainties associated with a problem. Judgements have to be made by the decision maker about the accuracy, timeliness, relevancy, and value of information.<sup>2</sup>

Value of information. In the face of uncertainty, one of the basic responsibilities of a decision maker is to optimize the operation of an enterprise, through the allocation of scarce resources. To do this he must not only assess his uncertainty about the environment, but he must also decide how many resources should be devoted to the gathering of information before a decision is made.<sup>3</sup>

Three basic elements determine the value of information in a business decision:

---

<sup>1</sup>David W. Millar and Martin K. Starr, The Structure of Human Decisions, Toronto, Prentice-Hall, 1967, p.26.

<sup>2</sup>Buzzell, Cox, and Brown, op. cit., p. 13.

<sup>3</sup>Rex V. Brown, Research and the Credibility of Estimates, Boston: Graduate School of Business Administration Harvard University, 1969, p.5.



- (1) The degree of uncertainty regarding the outcomes of the various possible courses of action;
- (2) The economic consequences of making an incorrect decision;
- (3) The amount by which the information is expected to reduce the initial uncertainty if obtained.

The greater the degree of uncertainty, the larger the economic consequences of making an incorrect decision; and/or the greater the amount by which the information is expected to reduce uncertainty, the more valuable the information.<sup>1</sup>

The expected value principle--a normative model. In real life information is obtained for a price in terms of money, other resources, discomfort and time. A decision maker normally gathers information if he feels the expected gain in payoff from having the information will more than compensate for the cost of obtaining it.<sup>2</sup> In dealing with the problem of how a decision maker copes with uncertainty and information, decision theorists have developed rules for prescribing rational choice behavior. A formal statement that indicates how man should decide is called a normative or prescriptive model. These models deal with the economics of decision and information.<sup>3</sup>

A widely advocated rule for decision making in relation to

---

<sup>1</sup> Kenneth P. Uhl and Bertram Schoner, Marketing Research: Information Systems and Decision Making, Toronto: John Wiley and Sons, Inc., 1969, p. 12.

<sup>2</sup> Wayne Lee, Decision Theory and Human Behavior, Toronto: John Wiley and Sons, Inc., 1971, p. 249.

<sup>3</sup> David A. Schum, "Behavioral Decision Theory and Man-Machine Systems," in Systems Psychology, Kenyon B. DeGreen, (ed.), New York: McGraw-Hill Book Co., p. 217.

information is the expected value principle.<sup>1</sup> This principle prescribes a way for decision makers to determine the expected value of information. This expected value of information represents a limit on the amount of resources (usually expressed in monetary terms) that a decision maker should allocate to obtaining information.

An example will illustrate the nature of the expected value principle. Assume that a decision problem has been structured into the two courses of action and two states of nature shown in Table 1.1.<sup>2</sup>

TABLE 1.1 Illustrative Problem

Acts	States of Nature		Expected Monetary Value of each Act
	State 1	State 2	
Act 1	\$50,000	\$10,000	\$38,000
Act 2	35,000	20,000	30,500
Probability of State	0.70	0.30	

In this problem the decision maker must choose between the two alternative courses of action referred to as "acts." The monetary return from each of the two acts will depend upon which of the two states of nature will prevail. The monetary returns associated with the occurrence of a particular act-state combination is called a payoff matrix.

<sup>1</sup> Lee, *op. cit.*, p. 30.

<sup>2</sup> The illustrative problem described here is a part of the decision exercises used in this study.

In the illustrative problem, states of nature represent occurrences that affect the achievement of the objectives in the problem. They are viewed as lying outside the control of the decision maker and constitute a mutually exclusive and complete set of outcomes. The decision maker does not know which state of nature will occur but he is able to assign numerical weights (probabilities) to each of the two possible states of nature. These probabilities may be based on either long-run experience with the states of nature in question, or they may, in the case of unique events, reflect the more subjective judgements of the decision maker, or they may be a combination of the two.<sup>1</sup>

By taking the weighted payoff of each act, the expected monetary value (EMV) of each act can be calculated.

$$\text{EMV of Act 1 : } 0.7(50,000) + 0.3 (10,000) = \$38,000$$

$$\text{EMV of Act 2 : } 0.7 (35,000) + 0.3 (20,000) = 30,500$$

In the absence of any further information, a decision maker following the choice criteria prescribed by the expected value model would select Act 1, with the expected payoff of \$38,000.

An alternative strategy for the decision maker would be to allocate resources to the gathering of information in order to reduce his uncertainty about the outcomes. In the simplest and least realistic case, he would obtain perfectly reliable information. This means that the information would disclose without error, which event, state 1 or state 2, is the actual state of nature.

---

<sup>1</sup> Morris Hamburg, Basic Statistics, New York: Harcourt Brace Jovanovich, Inc., 1974, p. 298.

The expected value of perfect information associated with the problem in Table 1.1 is represented by the difference between the expected payoff of the strategy which includes information collection, and the expected payoff associated with the best course of action without new information. Following the strategy of collecting information, the decision maker would take Act 1 if the new information indicated state 1 were the true state of nature and Act 2 if the information indicated state 2 were the true state. The expected value of the information gathering strategy would be:

$$0.7 (50,000) + 0.3 (20,000) = \$41,000$$

The decision maker must still apply the prior probabilities attached to state 1 and state 2 since the new information to be collected can report results indicating either of the two states.

Without perfect information, the decision maker's expected value associated with taking Act 1, the best strategy without collecting information, is \$38,000. The expected value of perfect information is the difference between these two alternate strategies or \$3,000. The difference of \$3,000 represents the cost of uncertainty associated with taking Act 1 without perfect information and represents the upper limit which a decision maker should spend for perfectly reliable information in this problem.<sup>1</sup>

Normative-descriptive research strategy. In addition to developing normative models for decision making, research on decision making focuses on the psychological problem of determining how

---

<sup>1</sup> Green and Tull, op. cit., pp. 27-28.

man actually makes decisions. This approach is called the development of descriptive models. These models attempt to describe and predict actual human choice behavior. A research strategy for the psychological study of decision making is to assume that a normative model, such as the expected value principle, is a model of how people make decisions and to evaluate this assumption by comparing observed behavior with the model's prescriptions. For example, by using the criterion of accuracy, a subject's behavior can be evaluated by determining how closely the decision maker's behavior corresponds to the normative model's prescriptions. Or, stated in another way, to what extent does the model explain human decision making and make correct predictions?<sup>1</sup> The purpose of this type of research is to develop a better conceptualization and understanding of decision making.

Dogmatism. According to MacCrimmon,<sup>2</sup> the main elements in the study of decision making are the decision maker and the decision environment. Whereas the expected value model provides a theoretical framework linking knowledge about the environment and decision making, conceptualizations about the decision maker's cognitive processes, his beliefs, values, and attitudes and how he relates to the decision environment provide an approach to the study of individual differences

---

<sup>1</sup> Scott Barclay, Lee Roy Beach, and Wanda P. Braithwaite, "Normative Models in the Study of Cognition," Organizational Behavior and Performance, 6, 1971, p. 392.

<sup>2</sup> Kenneth R. MacCrimmon, "Managerial Decision Making," in Contemporary Management, Joseph W. McGuire (ed.), Toronto: Prentice-Hall, 1974, p. 446.

in decision making.<sup>1</sup> Large individual differences exist in observed decision making in the real world<sup>2</sup> and in experimental studies dealing with decision making.<sup>3</sup> To develop a descriptive model of a decision maker's ability to use information, research on decision making includes observations of how human decisions deviate from normatively optimal decision making, and investigations on how personality variables predict individual differences in decision making.<sup>4</sup>

Several writers have suggested the usefulness of Rokeach's concept of dogmatism in understanding and predicting individual differences in decision making. Dogmatism, as defined by Rokeach, deals with the structure of belief systems that are held by an individual. Dogmatism indicates the receptiveness of an individual to the inclusion of additional information relative to pre-existing beliefs. According to Rokeach's theory, individuals who are distributed along the open-closed mind continuum differ in their ability to "...receive, evaluate, and act on relevant information received from the outside on its own merits, unencumbered by irrelevant factors in the situation arising from

---

<sup>1</sup> Barclay, Beach and Braithwaite, op. cit., p. 392 and Gordon M. Becker and Charles G. McClintock, "Value: Behavioral Decision Theory," Annual Review of Psychology, Vol. 18, 1967, p. 239.

<sup>2</sup> R.V. Brown, "Do Managers find Decision Theory Useful?" Harvard Business Review, Vol. 5, 1970, p. 86.

<sup>3</sup> Ramon L. Hershman and J.R. Levine, "Deviations from Optimum Information-Purchase Strategies in Human Decision-Making," Organizational Behavior and Human Performance, Vol. 5, p. 314.

<sup>4</sup> N. Kogan and M.A. Wallock, Risk Taking, A Study in Cognition and Personality, New York: Holt, Rinehart, and Winston, 1964, pp. 12-20.

within the person or from the outside... ." <sup>1</sup> Such irrelevant interval pressures are unrelated habits, irrational motives, a need to allay anxiety; irrelevant external pressures include rewards and punishments from external authorities. <sup>2</sup>

In discussing the concept of dogmatism and decision making, Kast and Rosenzweig state:

....the decision maker may use an approach that results in a relatively closed decision process. If he does not push beyond well-entrenched beliefs, conclusions may follow relatively automatically, given a problematic stimulus. The more a decision maker is disposed toward seeking new alternatives and additional information, the more open the decision making process. The process can be described as relatively open-minded or closed-minded. <sup>3</sup>

The term dogmatic is employed synonymously with closed mindedness. Much of the research on this personality variable has contrasted the performance of high dogmatic (closed) and low dogmatic (open) subjects. Dogmatism in an individual is assessed by Rokeach's Dogmatism Scale. It measures the degree of openness or closedness of the belief system held by an individual.

Furthermore, Brown suggests that decision makers who cannot face uncertainty do not attempt to reduce uncertainty by interacting with the environment. <sup>4</sup> This is a classic example of the high

---

<sup>1</sup> Milton Rokeach, The Opened and Closed Mind, New York: Basic Books, 1960, p. 57.

<sup>2</sup> Ibid., p. 57.

<sup>3</sup> Fremont E. Kast and James E. Rosenzweig, Organization and Management, Toronto: McGraw Hill, 1970, p. 411.

<sup>4</sup> Brown, op. cit., p. 88.

dogmatic personality.<sup>1</sup> Thus, the properties of the decision maker's belief system should determine his perception of uncertainty in a decision task and should be related to the way he values information. This study attempts to investigate these processes.

### 1.3 The Present Study

The use of normative models of decision making to evaluate human performance in decision making tasks is developing a considerable amount of interest.<sup>2</sup> These studies explore human decision making under the controlled conditions of laboratory simulations to test hypotheses and to develop descriptive data on decision making. One such study in the literature is the work of Green, Robinson, and Fitzroy.<sup>3</sup> This study deals with the issue of a prescriptive model being a good description of actual decision making. It deals with the question of whether subjects tend to overvalue or undervalue information when they are faced with uncertainty. The setting for Green's study was a laboratory decision making game modeled after the kinds of resource allocation problems faced by a marketing manager. The subjects had to assess the value of information under conditions of uncertainty

---

<sup>1</sup> Harvey J. Brightman and Thomas F. Urban, "The Influence of the Dogmatic Personality Upon Information Processing; A Comparison with a Bayesian Information Processor," Organizational Behavior and Human Performance, Vol. 11, 1974, p. 267.

<sup>2</sup> W.H. Starbuck and F.M. Bass, "An Experimental Study of Risk Taking and the Value of Information in a New Product Context," Journal of Business, Vol. 40, 1967, pp. 155-165.

<sup>3</sup> Paul E. Green, Patrick J. Robinson and Peter T. Fitzroy, Experiments on the Value of Information in Simulated Marketing Environments, Boston: Allyn and Bacon, Inc., 1967, pp. 1-43. Referred to hereafter as Green.



in an information buying game. This was done by having the subjects play the role of a marketing manager concerned with evaluating two alternative courses of action. The effectiveness of the two alternatives depended on events outside the manager's control. Perfect information, which would reduce all uncertainty in the problem by predicting which state of nature would prevail, was made available to the subjects. The subjects had to indicate the price they would be willing to pay for this information. This price was taken to be the value that the subject placed on information in the decision problem. The subjects' performance were evaluated by comparing their information buying behavior to the prescriptions of the expected value principle. The game was so designed that an optimal decision could be computed.<sup>1</sup>

The present study utilizes Green's experimental procedures to investigate the information processing abilities of another group of subjects, farm operators. Green's methodology was chosen for several reasons. First, the replication of Green's work can be viewed as an effort to extend this research approach to different setting and a different type of decision maker. By using a different study group one can ascertain whether similar results would follow with subjects of a different socio-economic background. Second, a major result reported by Green was a general tendency of subjects to overvalue information when their performance was compared to the expected value model. An attempt is made in the present study to determine if the extent of overvaluing of information as reported by Green is due to an assumption made by Green. This assumption

---

<sup>1</sup> Ibid., p. 3. See illustrative problem p. 4.

was used to estimate how subjects valued information in the decision making game.<sup>1</sup> It would appear that Green's results are inflated resulting in the conclusion that decision makers overvalue information. This study extends Green's research procedure to determine the validity of his results. This study also investigates the differential information-evaluation abilities of high and low dogmatic subjects.

#### 1.3.1 Statement of the problem.

It is the purpose of this study to assess the decision making characteristics of a group of decision makers. The specific research questions in the study are:

- (1) To what extent do the subjects' information processing behavior (the value they place on information) depart from the expected value model?
- (2) Utilizing the Green experimental procedures, can similar results be obtained using a different subject group?
- (3) Is the non-optimal behavior of subjects a result of the way the value of information is determined in the experimental game?
- (4) What is the relationship between the personality variable of dogmatism and how a subject values information under conditions of uncertainty?

---

<sup>1</sup> This assumption will be discussed in Chapter II.

<sup>2</sup> To be discussed in Chapter II.

#### 1.4 The Importance of the Study

As already stated, the ability of a manager to use information is an important aspect of decision making. It is an unfortunate aspect of many decisions that inadequate decisions are made through ignorance of important information or through misevaluation of information that may be available.<sup>1</sup> The need for a better understanding of decision making has come about because of the growing complexity of business decisions and the advent of modern computer and information technology. Information for decision making can be assembled and processed today on a scale never before possible. Computer based information systems may in fact be leading to a state where the decision maker is inundated with data. The quality of decision making then, depends partly on the efficiency of the information system and partly on the capability of the decision maker.<sup>2</sup> This study investigates how decision makers value information. This behavioral characteristic is an important consideration in the development of management information systems.<sup>3</sup>

Furthermore, the investigation of how decision maker's value information may have practical consequences in management development. If managers in their decision making collect too much information (overvalue information as Green has concluded) before reaching a decision, they may be wasting resources. Information gathering is

---

<sup>1</sup> David F. Wrench and Chris Wrench, Psychology A Social Approach, Toronto: McGraw-Hill Book Company, 1973, p. 376.

<sup>2</sup> Barry Maude, "How to Manage Committees," Management Today, January, 1975, p. 68.

<sup>3</sup> James Robert Cockran, Management Information Systems Structural Considerations, Unpublished Masters of Science Thesis, University of Saskatchewan, Saskatoon, 1969, p. 72.

costly, especially in the case where speed of decision is important. To deal with this problem it may be useful to identify and classify different types of decision making styles. Some decision makers may be quite conservative. They wait until they have enough (or even too much) information before they act. They want to know that the odds of making a correct decision are very good. On the other hand others may tend to be gamblers or high-risk decision makers who make decisions as soon as they have enough information to indicate a fair chance of being correct. Knowledge of these individual differences may be useful in the development of managerial decision making courses, or from an organizational point of view, delegating the right type of decision maker to the appropriate decision environment.<sup>1</sup> The approach used in this study, with further development, may reveal characteristics that are not readily apparent from day to day observations.

From a research point of view, the need for the replication and elaboration of studies on decision making is well noted.<sup>2</sup> Results from experimental research are often written into the literature without warning about the limitations on the significance of the results. Tentative and limited results should be investigated and verified. The re-examination of Green's decision making study is an important aspect of this study.

---

<sup>1</sup> Maude, op. cit., p. 69.

<sup>2</sup> Harold L. Johnson and Arthur M. Cohen, "Experiments in Behavioral Economics: Siegel and Fouraker Revisited, "Behavioral Science, Vol. 12, 1967, p. 353.

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Research on Information-seeking Behavior

The processes involved in individual decision making are complex. To carry out research on decision making, components of the decision process are abstracted and analyzed in isolation. This literature review focuses on the area of research dealing with prediscisional search behavior. This is the activity of acquiring information before a decision is made.<sup>1</sup> Researchers from several disciplines have carried out studies under a wide range of experimental conditions in order to develop a better understanding of how man values information before he makes a decision.

In laboratory studies designed to assess how man values information, an experimental subject is normally presented with a decision task and told what his possible choices can be. The subject has the option of deferring his decision while he gathers relevant information. As in real life, the subject must pay for the information in proportion to the amount he wants. The information made available to the subject will normally increase his certainty about the true state of the world and increase his chances of making a good decision.<sup>2</sup> The objective of this procedure is to determine how well a subject balances the value of information, as determined by a normative model, against the cost of obtaining it. In addition, this research also

---

<sup>1</sup> B.H. Long, and R.C. Zeller, "Dogmatism and Prediscisional Information Search," Journal of Applied Psychology, Vol. 49, 1965, p. 376.

<sup>2</sup> Paul Slovic and Sarah Lichtenstein, "Comparison of Bayesian Regression Approaches to the Study of Information Processing in Judgement." Organizational Behavior and Human Performance, Vol. 6, 1971, p. 670.

attempts to account for systematic deviations from normatively optimal behavior.<sup>1</sup> Optimal behavior may be defined by the probabilistic characteristics of the decision problem, the reward for making the right decision, the penalty for making a wrong decision, and the cost of the information.<sup>2</sup>

An example of this type of research is the experiment referred to as the binary choice or the paradigm designed by Phillips and Edwards.<sup>3</sup> This experimental procedure, with several variations, is used to test hypothesis about how decision makers acquired information. The following example of a binary choice experiment will illustrate how this procedure is used. The subject is presented with the following situation: Two bookbags are filled with poker chips. One bookbag has 70 red chips and 30 blue chips, while the other bag holds 30 red chips and 70 blue chips. The subject does not know which bag is which. The experimenter flips a coin to choose one of the bags. A sequence of chips is sampled, with replacement, from the bag with the proportion of red chips equal to  $P_1$  (70) or  $P_2$  (30). The subject must decide from which bag the sample is coming. In some studies, he must decide, prior to seeing the first chip, how many chips he wishes to see. This is called the fixed stopping sampling procedure. In other studies, he samples one chip at a time and can stop at any point and announce his decision. This sampling procedure is called optimal stopping.<sup>4</sup> The number of

---

<sup>1</sup> Ibid., p. 666.

<sup>2</sup> Ibid., p. 671.

<sup>3</sup> L. D. Phillips and W. Edwards, "Convervatism in Simple Probability Inference Task," in Decision Making, W. Edwards and A. Tversky, (eds.), Baltimore: Penquin Books, 1967, pp. 239-254.

<sup>4</sup> Slovic and Lichtenstien, op. cit., p. 671.

samples that the subject obtains or the amount that he is willing to pay for the sampling privilege is interpreted as the value the subject places on information before he makes a decision. The subject's sampling behavior provides descriptive data and this data may be compared to a predetermined optimal strategy in the study.

Research evidence from investigations in this area provide some information on how well decision makers can evaluate information when this behavioral characteristic is compared to optimal decision making. These research findings, however, are viewed as tenuous because of the variety of results that these investigations provide.<sup>1</sup> For example, Fried and Peterson,<sup>2</sup> report that subject's information purchasing strategies are nearly optimal when they used the fixed stopping sampling approach in their investigation. Green, Halbert, and Mina,<sup>3</sup> using the same approach, report that subjects overbuy information. Yet, when the above two studies used the optimal stopping sampling procedures, both report that subjects tend to purchase too little information. They stop buying samples too soon.

---

<sup>1</sup> Wayne Lee, Decision Theory and Human Behavior, Toronto: John Wiley and Sons, Inc., 1971, p. 332; and Ramon L. Hershman and J.R. Levine, "Deviations from Optimal Information-Purchase Strategies in Human Decision-Making," Organizational Behavior and Human Performance, Vol. 5, 1970, pp. 313-317.

<sup>2</sup> Lisbeth S. Fried and C.R. Peterson, "Information Seeking: Optimal versus Fixed Stopping," Journal of Experimental Psychology, Vol. 18, 1969, p. 528.

<sup>3</sup> Paul E. Green, M.H. Halbert, and J.S. Mina, "An Experiment in Information Buying," Journal of Advertising Research, Vol. 4, 1964, p. 20.

Edwards and Slovic<sup>1</sup> report from their work with an information buying task that subjects perform remarkably well. About one-half the strategies used by the subjects were optimal or approximately so, and serious divergencies from the optimal strategy were rare. They note that individual differences in information buying were large as one-half the subjects were characterized as too cautious (underbuying information) and one-half as too incautious (overbuying information) in terms of how they acquired information. In a military decision making setting, Kaplan and Neuman<sup>2</sup> report that subjects performance in terms of information acquisition was less than optimal. Summaries of their data indicate that subjects purchased the optimal amount of information in only one out of three conditions and overpurchased in two out of three conditions. Similarly, Pitz<sup>3</sup> indicates that subjects in his study overpurchased information (when compared to an optimal strategy) in 13 out of 18 experimental conditions.

In summary, the literature on information acquisition, would indicate that the experimental studies allow for only a general comparison of subject performance when this performance is compared to the prescriptions of a normative model. Lee's conclusion seems appropriate

---

<sup>1</sup> W. Edwards and P. Slovic, "Seeking Information to Reduce the Risk of Decisions, " American Journal of Psychology, Vol.78, 1965, p. 190.

<sup>2</sup> R.J. Kaplan and J.R. Neuman, "Studies in Probabilistic Information Processing, " IEEE Transactions on Human Factors in Electronics, HFE - 7, 1966, p. 62.

<sup>3</sup> G.F. Pitz, "Information Seeking when available Information is Limited, " Journal of Experimental Psychology, Vol.76, 1967, p. 32,



--no definite conception exists of human capabilities in terms of how they acquire information.<sup>1</sup>

Two studies in the management literature, however, report research results that show a consistent tendency of subjects to overpurchase information. These two studies conclude that this tendency to overvalue information appears to be a general human characteristic. Moskowitz<sup>2</sup> and Green, Robinson, and Fitzroy,<sup>3</sup> allowed subjects to play an active role in determining what value should be placed on information before they make a decision. Both of these studies attempted to reflect real world conditions in terms of the decision tasks that they presented their subjects. The subjects in both cases were practicing managers and graduate business students. Moskowitz, for example, allowed each subject the opportunity to reduce uncertainty in a research and development game. He found a significant amount of suboptimal behavior relative to the expected value of information model. Subjects were inclined to overpurchase information. Green reports similar results when his subjects had to evaluate market research information. Since the present study grew out of an attempt to reassess Green's work on another set of subjects and to investigate if his methodology led to the overbuying results, the essential features of his study need to be described here.

---

<sup>1</sup> Lee, op. cit., p. 332.

<sup>2</sup> Herbert Moskowitz, "An Experimental Investigation of Decision Making in a Simulated Research and Development Environment," Management Science, Vol. 19, 1973, p. 61.

<sup>3</sup> Paul E. Green, Patrick J. Robinson, and Peter T. Fitzroy, Experiments on the Value of Information in Simulated Marketing Environments, Boston: Allyn and Bacon, Inc., 1967, pp. 26-43. Referred to hereafter as Green.

### 2.1.1 Review of Green's study.

The main objective in Green's study was to see how subjects would value information under the controlled conditions of an experimental game.<sup>1</sup> The essential features of this study can best be understood if one considers Green's basic payoff matrix and response form given Table 2.1. This payoff matrix is one of eight game conditions used in the study. All eight game conditions and game instructions are described in APPENDIX A.

The subjects were asked to consider decision problems such as the one given in Table 2.1 and to decide how much they would be willing to pay for information to reduce uncertainty in the problem. Uncertainty exists in the problem because of the prior probabilities associated with the occurrence of alternative states of nature and the cost of wrong decisions as reflected in the payoff matrix entries. The instructions to the subjects were as follows:

You can purchase information which tells you without error which state of nature exists. The cost of this service will range from \$100 to \$53,000. Your problem is to decide whether you will buy or not buy perfect information at the prices indicated.<sup>2</sup>

If the subject decided to purchase information, he would indicate the amount he was willing to pay for information by checking off that amount on the response form. The assumption behind this procedure is that the subject's response with respect to the information purchased represents his intuitive judgement on the value of information,

---

<sup>1</sup> Ibid., p. 28.

<sup>2</sup> Ibid., p. 31.

Table 2.1 Basic Payoff Matrix and Response Form

		<u>State 1</u>	<u>State 2</u>
Act 1		\$50,000	\$10,000
Act 2		35,000	20,000
Probability of State		0.7	0.3

  

Trial	Cost of Perfect Information	Buy Information Survey Outcome Act	Not Buy Information Act	True State	Gross Return	Net Return
1	\$ 200					
2	4,000					
3	2,000					
4	6,000					
5	400					
6	25,000					
7	100					
8	15,000					
9	50,000					
10	800					

given the decision problem.<sup>1</sup>

To obtain an estimate of how the subject group valued information, the individual subject responses were aggregated over the subjects and games to obtain the average amount of information purchased by the subject group.<sup>2</sup> This estimate was compared to the average optimal information buying strategy. This strategy was not to pay more than \$4,500 for information in the eight game conditions.

In Green's study, the executive subject group and the student group paid \$8,046 and \$10,686 for information, respectively. Based on these statistics, Green concluded that subjects tend to assign more monetary value to information than it is worth as judged by the expected value model.<sup>3</sup>

A key factor leading to Green's overbuying results may have been the way he calculated the actual value subjects placed on information. His methodology may best be explained by considering Table 2.2 where the prices for information as they appeared on the response form are rearranged in ascending order. How much each subject was willing to pay for information was approximated in the following way:

An individual's assessment of the value of perfect information was approximated by the midpoint between the highest-cost survey he was willing to purchase in a given decision situation and the lowest cost survey that he declined to purchase.<sup>4</sup>

---

<sup>1</sup> Ibid., p. 27.

<sup>2</sup> Ibid., p. 23. Green's data analysis may be found in APPENDIX A.

<sup>3</sup> Ibid., p. 33.

<sup>4</sup> Ibid., p. 185.

Table 2.2 Prices available on Response Forms (rearranged)

Game # 1, 3, 5, 7		Game # 2, 4, 6, 8
\$ 100		\$ 3,100
200		3,200
400	Classified as "underbuying"	3,400
800		3,800
2,000*		5,000*
4,000		7,000
6,000		9,000
15,000	Classified as "overbuying"	18,000
25,000		28,000
50,000		53,000

\* Defined as optimal strategies by Green. The optimal value for information was \$3,000 in Game #1, 3, 5, 7 and \$6,000 in games # 2, 4, 6, 8. The average optimal solution was \$4,500 for the eight game conditions.

This approximation would work in the following way. If, for example, a subject indicated that he was willing to pay \$6,000 for information in Game #1, Green would use \$10,500 (the midpoint between \$6,000 and \$15,000) as an estimate of how a subject valued information in that particular game. This estimate of how the subject valued information would be averaged with the subjects responses in the other seven game conditions and into the overall subject group information buying results. Given the range of prices available to the subjects in the response form, \$100 to \$2,000 below the optimal solution, and \$4,000 to \$50,000 above the optimal solution, it would appear that Green's methodology could significantly inflate his measurement of how subjects value information. His conclusion, that subjects overvalue information may not be valid.

In the repetition of Green's experiment, this study first attempts to ascertain whether similar results would follow with different subjects, and second, to ascertain the effect of Green's approximation on the overall results. To carry out the second objective, an alternate measure of how subjects value information was introduced into this study to test the validity of Green's conclusions. The subjects were allowed to respond to a post exercise question in each of the eight game conditions. The responses to these questions provided another estimate of how subjects valued information. This estimate was compared to the results obtained by Green's methodology. The post exercise question will be outlined in Chapter III.

### 2.2.2 An alternate analysis of the experimental data

As already indicated in the review of Green's study, Green's conclusion on how subjects value information is based on what is called "gross behavior."<sup>1</sup> The average amount of information purchased by the subject group was compared to the average optimal solution for the eight game conditions. The magnitude with which the subjects' performance deviated from optimal behavior suggests that they overvalue information, or, that the expected value model is not a good predictor of how subjects value information.<sup>2</sup>

The issue of whether subjects overvalue information depends on the interpretation of the subjects' performance as a deviation from optimal behavior. Barclay, Beach, and Braithwaite<sup>3</sup> suggest that if one uses the normative-descriptive research strategy and subjects consistently deviate from the model's predictions, the data may merit a second look from a different point of view. In the case of this study, rather than considering the average magnitude with which subjects deviate from the optimal behavior, the subjects information buying responses may be classified as "underbuying" and "overbuying" information buying strategies (see Table 2.2, p. 23). By considering the frequency with which subjects choose each of these two strategies, a different interpretation may be obtained from the data and the

---

<sup>1</sup> Ibid., p. 23.

<sup>2</sup> Scott Barclay, Lee Roy Beach, and Wanda P. Braithwaite, "Normative Models in the Study of Cognition," Organizational Behavior and Performance, 6, 1971, p. 392.

<sup>3</sup> Ibid., p. 392.

and the extent to which subjects overvalue or undervalue information. With this approach to the data, the subjects responses may be considered as dichotomous.<sup>1</sup> Since subjects were to indicate their preference for information in each game by selecting a price from a set of given prices, 5 of which were below optimal and 5 of which were above optimal, each subject has a 5 in 10 chance of overbuying information in each game. If more than one-half the responses in a game are in the overbuying category, then one can start concluding that Green's results are valid. Subjects have a tendency to overbuy information. The experimental data representing the subject's responses may be compared to the Binomial Distribution to determine if the proportion of responses in the overbuying category are statistically significant.<sup>2</sup>

### 2.3 Dogmatism and Information-seeking Behavior

In dealing with the psychological problem of understanding how man uses information, the literature on decision making places an emphasis on using personality variables to explain how subjects perform in decision making tasks. According to Simon<sup>3</sup>, research must describe the subject as something more than a featureless

---

<sup>1</sup> Richard P. Runyon, and Audrey Haber, Fundamentals of Behavioral Statistics, Don Mills: Addison-Wesley Publishing Company, 1968, p. 201.

<sup>2</sup> Ibid., p. 203.

<sup>3</sup> Herbert A. Simon, "Theories of Decision-Making in Economics and Behavioral Sciences," in Selected Readings in Management, F.A. Shull and A.L. Delbecq, (eds.), Homewood, Ill: Richard D. Irwin, Inc., 1962, p. 129.



adaptive organism. Research must incorporate at least some description of the processes through which the adaption takes place. The personality concept of dogmatism provides a theoretical basis for hypothesizing about how an individual adapts in a decision situation. As a theory of cognition, it attempts to describe the mediating force between the stimulus (the decision task) and the response.<sup>1</sup> Research on decision making focuses on contrasting the behavior of high dogmatic (closed-minded) and low dogmatic (open-minded) decision makers in order to get a better understanding of individual differences in decision making.

Several studies in the literature have assessed the information processing capabilities of low dogmatic and high dogmatic subjects. Rokeach in his original research suggests that a relationship between dogmatism and information processing exists. He found that the high dogmatic subjects tend to reject additional information whereas low dogmatic subjects tend to utilize information to a greater extent.<sup>2</sup> In a decision making study dealing with the personality variable of dogmatism and information seeking behavior, Pruitt<sup>3</sup> reports that high dogmatic subjects consistently took less

---

<sup>1</sup> Fremont E. Kast and James E. Rosenzweig, Organization and Management, Toronto: McGraw Hill, 1970, p. 346.

<sup>2</sup> Milton Rokeach, The Opened and Closed Mind, New York: Basic Books, 1960, p. 192.

<sup>3</sup> Green, Robinson, and Fitzroy, op. cit., p. 9, citing D.G. Pruitt, An Exploratory Study of Individual Differences in Sequential Decision Making, Unpublished Doctoral Dissertation, Yale University, 1957.

information than their low dogmatic counterparts. Long and Zeller<sup>1</sup> demonstrate a relationship between the degree of dogmatism and predecisional information search. That is, low dogmatic subjects recognized uncertainty in a decision task and asked for more information as compared to high dogmatic subjects. In a rural sociology setting, Jamias and Troidahl<sup>2</sup> conclude that low dogmatic subjects show a generalized receptivity to new information which is routinely internalized according to its usefulness.

This phase of this study attempts to contribute to the knowledge of individual differences in decision making by assessing the relationship between dogmatism and the extent to which subjects purchase information in the decision game designed by Green.

#### 2.4 Statement of Hypotheses

To carry out the objectives of this study, the following four hypotheses were stated:

Information buying. The amount the subject group is willing to pay for information in Green's decision exercise is used to determine how subjects value information which reduces uncertainty.

To gain insight into how the subjects in this study evaluate information and to see if similar results can be obtained by using Green's

---

<sup>1</sup> Long and Zeller, op. cit., p. 376.

<sup>2</sup> J.F. Jamias and V.C. Troidahl, "Dogmatism, Tradition, and General Innovativeness," in Beliefs, Attitudes, and Values, Milton Rokeach, San Francisco: Jossey-Bass, Inc., 1968, pp. 145-146.

methodology on different subjects, the following hypothesis was stated:

$H_1$ : The subject group will on the average purchase more information in the decision exercise than the optimal solution (\$4,500) prescribed by the expected value model.

Post exercise question. Green's results indicate that subjects deviate substantially from the optimal information buying strategy in his decision exercise. To determine if the method Green used to estimate how subjects valued information significantly effects the information buying results in this study, an alternate measure in the form of a post exercise question was added to each of the eight game conditions. This question provides an alternate estimate of how much subjects are willing to pay for information. The responses to the post exercise question can be compared to the results obtained with Green's method.

$H_2$ : The mean value placed on information as determined by the post exercise question will be less and significantly different from the mean value as determined by Green's approximation.

Alternate analysis of the data. The criterion used by Green to assess the tendency of subjects to obtain too much versus too little information was the magnitude with which the subject's information buying responses deviated from optimal decision making. To get another interpretation of the data generated in this study, the subject's responses can be classified into two categories, "underbuying" strategies and "overbuying" strategies. In each game condition,

P can represent the frequency of responses in the "overbuying" category and Q, the frequency of responses in the "underbuying" category. If subjects are more likely to overbuy information than underbuy information then  $P > Q$ . If Green's overbuying results are valid, the following hypothesis should be confirmed:

H<sub>3</sub>: The subject's responses per game condition will be biased towards overbuying ( $P > 0.5$ ,  $Q < 0.5$ )<sup>1</sup>.

Dogmatism. To assess the relationship between the personality variable of dogmatism and how subjects value information in Green's decision making exercise, the subjects are divided into two groups. The mean score in information buying of the low dogmatic group is compared to the mean score of the high dogmatic group.

H<sub>4</sub>: The low dogmatic group will purchase significantly more information than the high dogmatic group.

---

<sup>1</sup> The statistical model for this approach may be found in Runyon and Haber, op. cit., pp. 129 - 133, 200 - 204.

## CHAPTER III

### METHODOLOGY

#### 3.1 Measurement of How Subjects Value Information

To carry out the objectives of the present study, the information buying exercise designed by Green, Robinson, and Fitzroy was administered to a group of subjects. This exercise was designed to operationally measure the variable of how subjects value information in a decision situation characterized by uncertainty. A complete description of the exercise may be found in APPENDIX A.

This study followed in all detail Green's research design. The same materials and procedures were used in briefing the subjects. Identical payoff tables and response forms were utilized with two exceptions. First, the decision problem presented to the subjects was in terms of planting two hypothetical crops, A or B, rather than two advertising campaigns. This was done to model the laboratory situation after the kind of resource allocation problem faced by a manager of a farm enterprise rather than a marketing manager. Second, a post-exercise question was added to each response form to obtain an alternate measure of how subjects valued information.

After each subject indicated how much he was willing to pay for information on the original response form, he was asked to respond in each of the eight game conditions to the following questions:

##### Post Exercise Questions

- (1) Please indicate the highest-cost survey that you purchased in the exercise above. \$\_\_\_\_\_

- (2) Obviously, you were prepared to buy the survey indicated in Question (1) but not the survey at the next highest cost. If you were not restricted by the survey costs as given in the exercise above, What is the highest figure that you would have been prepared to pay for perfect information in this exercise. \$ \_\_\_\_\_

(Please indicate, using your best judgement.)

This question was added to the decision making exercises to test the validity of Green's midpoint approximation. The responses to Question (2) above were compared to the results obtained using Green's computational procedures.

### 3.1.1 Conduct of the game

The decision making exercises were conducted in group sessions lasting approximately one and one-half hours. Two such groups (numbering nineteen and ten subjects, respectively) were involved. In each group, the subjects were given a set of written instructions and response forms illustrated in APPENDIX A. After each subject examined the written instructions, the instructions were read orally. All necessary terms were explained and all questions were answered. A team of three umpires assisted in conducting the decision making exercises. The subjects were not time paced and were permitted to make any calculations they wished.

The subjects received no payment for participation. The subjects played for imaginary money as did the executive subject group in Green's study. The game was discussed with the subjects in a following class period.

### 3.2 The Measurement of Dogmatism

The 15-item short-form dogmatism scale developed by

Troldahl and Powell<sup>1</sup> was administered after the subjects completed the information buying exercises. This scale was developed for testing Rokeach's theory in the field or where economics of space and time are needed. The fifteen items can be found in APPENDIX B.

### 3.3 Subjects

The present study was carried out with 29 farmers as subjects. The subjects were enrolled in the first year of a two-year diploma course in the School of Agriculture, University of Saskatchewan, Saskatoon, Saskatchewan. A brief tabulation of the characteristics of the subjects is shown in APPENDIX C, TABLE C.3. None of the subjects, in response to a general questionnaire, indicated familiarity with statistical decision theory or materials similar to the ones used in the decision exercises.

---

<sup>1</sup> Verling C. Troldahl and Fredric A. Powell, "A Short-Form Dogmatism Scale for Use in Field Studies," Social Forces, Vol. 44, 1965, pp. 211-214.

## CHAPTER IV

### THE RESULTS OF THE STUDY

#### 4.1 Information Buying Results

Table 4.1 Summary Results of Information Buying  
In Comparison to Green's Results and Optimal Solution

All Conditions	By Farmers	By Green's	
		Executives	Students
Average Amount Purchased	\$9,870 <sup>a</sup>	\$8,046	\$10,686
Optimal Solution	4,500	4,500	4,500
Deviation from Optimal	\$5,370	\$3,546	\$6,186

<sup>a</sup>Determined by Green's approximation. The individual subject information buying responses on which this data is based can be found in TABLE C.1 and TABLE C.2, APPENDIX C.

Table 4.1 presents the average amount of information purchased by the farmer subject group over eight game conditions. The table also compares the subject's performance to the optimal solution and to Green's results. From the comparable data in Table 4.1, where the mean value placed on information was \$9,870, it would appear that the subjects in this study tended to overbuy information as Green's subjects did.

$H_1$ : That the subject group would on the average purchase more information than the optimal decision prescribed by a normative model was accepted. The replication of Green's decision making exercises in a different setting indicates that his results were not unique to his subject groups.



The results reported in Table 4.1 are average group statistics. An analysis of how individual subjects responded to Green's eight game conditions indicated a large propensity toward buying information. In only two out of two hundred and thirty two trials (29 subjects x 8 games) did subjects choose not to buy information. The average values that individual subjects placed on information were widely dispersed. These values ranged from a low of \$3,300 to a high of \$22,400. Using Green's approach to determining how individual subjects valued information, resulted in 25 (86.2%) of 29 subjects overpurchasing information.

#### 4.2 Results of the Post Exercise Question

To get an indication of the effect that Green's midpoint approximation had on the information buying results, the subject's responses to the post exercise question were grouped into four typologies.<sup>1</sup>

1. Stay - Those subject responses that stayed at the original highest-cost survey indicated on the response form.
2. Reduce - Those subject responses that reduced the original highest-cost survey indicated on the response form.
3. Green's approximation - Those subject responses that raised the original highest-cost survey indicated on the response form to a value close to what Green's approximation would estimate.
4. Other - Those subject responses that raised the original highest-cost survey indicated on the response form to be a value close to the next highest-cost survey on the response form.

---

<sup>1</sup> An individual's assessment of the value of perfect information was approximated by the midpoint between the highest-cost survey he was willing to purchase in a given decision situation and the lowest-cost survey that he declined to purchase.

Table 4.2 Post Exercise Response Typologies (Percent of responses)

Type of Response	Percent of Responses
Stay	59.0% (137)
Reduce	3.0% ( 7)
Green's Approximation	23.3% ( 54)
Other	14.7% ( 34)

Note: Numbers in parentheses denote the actual number of subject responses falling into each typology.

Table 4.2 summarizes the subject's responses to the post exercise question. Overall, it would appear that Green's midpoint approximation would inflate 62% of the subjects responses when it is used to estimate the value subjects place on information. Green's approximation was valid in 23.3% of the trials.

Would the midpoint approximation have a significant effect on the average amount the subject group was willing to pay for information? Table 4.3 presents this analysis. As predicted, the

Table 4.3 Significance of the Difference in Average Information Purchased

<u>Green's Approximation</u> (N = 29)	<u>Post Exercise Question</u> (N = 29)	t	p
$\bar{X} = \$9,870$	$\bar{X} = \$8,458$	4.66	<0.05
S.D. = 5,090	S.D. = 4,322		

difference between the two estimates of how subjects valued information was significant at beyond the 0.05 level (one-tailed test, the calculated t-ratio is for two dependent means).  $H_2$ : The mean value placed on information as determined by the post exercise question will be less and significantly different from the mean value as determined by Green's approximation, was accepted. Green's methodology may overstate the amount that subjects deviate from optimal decision making.

#### 4.2.1 Alternate analysis of the data

Table 4.4 presents the results when the information buying responses are treated as dichotomous (overbuying versus underbuying responses) and compared to a binomial distribution.<sup>1</sup> The data in Table 4.4 is treated as a two-category population. Since  $np > 5$ , the normal approximation to the binomial curve was used to obtain the Z values where

$$Z = \frac{|x - NP| - 0.5}{\sqrt{NPQ}}$$

Based on the obtained Z values in Table 4.4,  $H_3$ : The subject's responses per game condition will be biased toward overbuying ( $P > 0.5$ ,  $Q < 0.5$ ), is accepted in two of eight game conditions (#3, 8). The frequency with which subjects overpurchased information is not significant at the 0.05 level in six game conditions (#1, 2, 4, 5, 6, 7). The above analysis demonstrates that subjects may not be as likely to overbuy information to the extent that Green's approach to the data indicates.

---

<sup>1</sup> Richard P. Runyon and Audrey Haber, Fundamentals of Behavioral Statistics, Toronto: Addison-Wesley Publishing Company 1968, p. 204.

Table 4.4 Observed Frequency of Overbuying Responses and Binomial Analysis

Game number	( $\chi$ ) Observed frequency of "overbuying"	Frequency expected by chance ( $\frac{1}{2} \times 29$ )	Z	P( $\chi$ ) <sup>a</sup>
1	16	14.5	0.37	n.s./
2	16	14.5	0.37	n.s.
3	20	14.5	1.86	<.05
4	19	14.5	1.49	n.s.*
5	15	14.5	0	n.s.
6	19	14.5	1.49	n.s.*
7	16	14.5	0.37	n.s.
8	23	14.5	2.97	<.05

<sup>a</sup> P( $\chi$ ) = the probability of  $\chi$  responses in the overbuying category  
 \*Significant at the .065 level.

#### 4.3 Dogmatism and Information

Based upon their dogmatism score, the subjects were split into two groups at the median. Table 4.5 presents the mean scores in information buying behavior of the low dogmatic group and the high dogmatic group. The results were not as predicted. First, the low dogmatic group purchased less information than their high dogmatic counterparts instead of more, and the difference between the two means was not significant at the 0.05 level of confidence.

Table 4.5 Significance of the Difference in the Average Amount of Information Purchased by High and Low Dogmatic Groups

	Low Dogmatism Group (N = 15)	High Dogmatism Group (N = 14)	t	p
Dogmatism Score	$\bar{X} = 65.57$ S.D. = 4.23	$\bar{X} = 51.92$ S.D. = 6.71	6.43	<0.05
Information Buying Index	$\bar{X} = \$9,271$ S. D. = 5180	$\bar{X} = 10,032$ S.D. = 5000	0.378	n.s.

## CHAPTER V

### SUMMARY, DISCUSSION, AND CONCLUSIONS

#### 5.1 Summary of the Study

This study investigated the problem of how decision makers value information when they are making decisions under conditions of uncertainty. Descriptive data on this behavioral characteristic was obtained by utilizing a decision exercise designed by Green, Fitzroy, and Robinson.<sup>1</sup> Twenty-nine subjects had the option of purchasing information before making a decision between two alternative courses of action. The subject's performance was evaluated with respect to an optimal purchasing strategy which maximized the expected value of information. This study concerned itself with the following questions: (1) to what extent do decisions made by subjects deviate from decisions prescribed by the expected value principle, (2) to what extent are these deviations from optimal decision making due to the way Green estimated how subjects valued information, and (3) whether the personality trait of dogmatism is related to how a subject values information in the decision task?

#### 5.2 Summary and Discussion of the Results

The repetition of Green's decision making exercise with a different study group resulted in information buying responses which substantially deviated from normatively optimal behavior. The subjects paid \$9,870 for market research information. The optimal strategy was not to pay more than \$4,500. Using this optimal strategy

---

<sup>1</sup> Paul E. Green, Patrick J. Robinson, and Peter T. Fitzroy, Experiments on the Value of Information in Simulated Marketing Environments, Boston: Allyn and Bacon, Inc., 1967, pp. 26-43.

as an objective criterion by which to judge subject performance, all but four of the twenty-nine subjects could be described as having the characteristic of overvaluing information.

This phase of the study would tend to confirm the findings Green reported. Green's executive and graduate student groups paid \$8,046 and \$10,686, respectively for the same information. The comparable results in this study indicate that Green's results were not peculiar to the subjects and setting in his study.

An important aspect of this study was to investigate a major finding reported by Green--the tendency of subjects to overvalue information. Another estimate of how subjects valued information in each game condition was obtained through a post-exercise question. This question allowed the subject to indicate the highest price that he would be willing to pay for information if he was not restricted by the survey costs given in the response form. This was done to determine if Green's method of estimating the price subjects were willing to pay for information was valid.<sup>1</sup>

This study did not find an agreement between Green's method and the post-exercise question method of estimating how a subject valued information.

---

<sup>1</sup> Green estimated the price a subject was willing to pay for information as the midpoint between the highest-cost survey he was willing to purchase and the lowest cost survey he declined to purchase. The range of prices made available to the subjects is described in CHAPTER II.

Green's method significantly inflated the value that a subject placed on information and thus the degree to which the subject's performance deviated from optimal decision making. The average deviation from the optimal solution (\$4,500) was reduced by the post exercise question estimate by \$1,412, (from \$9,870, as determined by Green's method, to \$8,458, as determined by the post exercise question) a statistically significant amount.

The results of the post exercise question phase of this study indicated that subjects may not have as large a tendency to overvalue information as Green concluded. Also, care should be taken in the interpretation of research findings that focus on a particular form of suboptimal performance in decision making. The methodology used to evaluate the subject's performance may overstate the argument for the conclusion that decision makers deviate substantially from optimal decision making. In the case of this study, the post exercise question, which obtained a more direct estimate of how a subject values information, provided a better fit of the subject's responses to the predictions of the expected value model.

Since this study focused on one possible explanation as to why subjects overpurchase information in a decision making exercise, other factors should be mentioned here that were not considered in this study. These factors might also explain the suboptimal performance on the part of subjects.

Subjects in this study played with imaginary money and received no payment for participation. This was also the case for the executive study group in Green's study. The students in Green's study received payments ranging from \$3.00 to \$4.50 per subject. This payoff was determined on a random basis not on how well they



played the decision making game. Experiments on decision making typically instruct subjects to respond as they would if real money was involved. But subjects normally realize that they will actually neither gain nor lose money as a result of their behavior. The assumption that the results will in some way be the same as if real money had been employed may not be a good one. The subjects in hypothetical decision making do not experience the positive and negative consequences of their decisions.<sup>1</sup> Since no real money is involved in the decision, the subject's ego-involvement may be weak. Substantial deviations from optimal behavior may be due to the lack of ego involvement on the part of the subjects.

Although the comparative effects of real versus imaginary rewards in decision making have not been thoroughly investigated, several studies do indicate that the introduction of real money into gaming situations significantly affect subject behavior.<sup>2</sup> Slovic<sup>3</sup>, in his study on the effect of real money on choice behavior found that in real payoff conditions, subjects tend to take a more cautious and balanced view of alternatives. Under hypothetical conditions, subjects were more likely to gamble with money.

---

<sup>1</sup> N. Kogan and M.A. Wallock, Risk Taking, A Study in Cognition and Personality, New York: Holt, Rinehart, and Winston, 1964, p. 18.

<sup>2</sup> Edgar W. Vinanche, "Variables in Experimental Games: Toward a Field Theory, " Psychological Bulletin, Vol. 71, 1969, p. 306.

<sup>3</sup> Wayne Lee, Decision Theory and Human Behavior, Toronto: John Wiley and Sons, Inc., 1971, p. 135, citing Paul Slovic, "Differential Effects of Real versus Hypothetical Payoffs on Choices among Gambles, " Journal of Experimental Psychology, Vol. 80, 1969, p. 437.

Gallo,<sup>1</sup> in another area of research, examined the effects of real money on subject behavior by replicating an experimental game used by Deutsch and Krauss to study competitive and cooperative behavior. In this research subjects could choose between cooperative behavior in order to achieve individual goals. Gallo, in his replication, had the subjects play for real money as well as for hypothetical rewards as Deutsch and Krauss had done. In the real money condition subjects had the opportunity of winning up to \$16.00. Under real money conditions, Gallo found that subjects cooperated five times as often in comparison to the imaginary condition. It is suggested that the replication of Green's work, with a real cost for information, may show that subjects make optimal decisions more frequently than what this study found.

Along with the nature of the reward structure in an experimental setting, a factor which may significantly affect subject behavior is that of demand characteristics. According to Orne,<sup>2</sup> a subject's performance in an experiment may be viewed as problem-solving behavior, and the total cues in the experiment become significant determinants of behavior.

The total cues in any experimental situation can be described by two sets of variables: (1) experimental variables (the decision matrices in this study), and (2) perceived demand characteristics of the experimental situation. The information buying behavior of a subject may be a function of the uncertainty in the task and/or

---

<sup>1</sup> Vinanche, op. cit., p. 306.

<sup>2</sup> M.T. Orne, "On the Social Psychology of Psychological Experiments: with Particular Reference to Demand Characteristics and their Implications," American Psychologist, Vol. 17, 1962, p. 779.

the subject's subjective interpretation of what the experiment is supposed to elicit from him.

The subject's perception of the procedures, instructions, explanations, and response forms are a part of the demand characteristics. The availability of information as displayed in the response form may, for example, give the subject more opportunities to buy information than not buy information. This may create a strong belief in the subject that he is expected to buy information and he complies accordingly. Buying information may be an inherent characteristic of the decision making game used in this study. The complete elimination of demand characteristics from an experiment is impossible, but an awareness of this factor should be taken into consideration when results of a study are interpreted and when future studies are designed.

According to Slovic and Lichtenstein,<sup>1</sup> the manner in which information is displayed and the nature of the required response greatly influence the use of information in decision making research. If this was the case in this study, the alternate analysis of the subject's information buying responses that was introduced into this study provides a different interpretation of the data. It provides a better understanding of the capabilities of the subjects in evaluating information. Rather than considering the magnitude with which subjects deviated from the optimal solution, it considered the frequency with which subjects chose information prices that were

---

<sup>1</sup> Paul Slovic and Sarah Lichtenstein, "Comparison of Bayesian Regression Approaches to the Study of Information Processing in Judgement," Organizational Behavior and Human Performance, Vol. 6, 1971, p. 724.

below and above the optimal solution. This approach may eliminate the effect of the large range of prices made available to the subjects in the above optimal category.<sup>1</sup> On the basis of the price that each subject was willing to pay for information in each game, each subject response was categorized as "underbuying" (paying less than \$4,500, the optimal strategy) or "overbuying" (paying more than \$4,500). Considering each game independently, and using a binomial analysis, it was found that subjects overpurchased information significantly in 2 of 8 game conditions. Overall, the subjects exhibited a larger frequency of overbuying responses than underbuying responses. For the eight game conditions, 62% of the responses were in the overbuying category. This interpretation demonstrates that the extent of overbuying of information may not be as great as Green's methodology indicates.

The study also examined the relationship between the personality variable of dogmatism, as assessed by a dogmatism scale, and the subject's performance in the decision making task. Large individual differences existed in how subjects valued information in this study. These differences were not related to the subjects score on the dogmatism scale. Low dogmatism subjects did not indicate a greater preference for information in terms of the money that they were willing to pay for information than their high dogmatic counterparts. The prediction that low dogmatic subjects would buy more information was made because they are, according to Rokeach,<sup>2</sup> more receptive to infor-

---

<sup>1</sup> See Table 2.2, p. 23.

<sup>2</sup> Milton Rokeach, The Opened and Closed Mind, New York: Basic Books, 1960, p. 10.

mation under conditions of uncertainty. The nature of the decision maker's personality in terms of dogmatism should influence his feelings of uncertainty. The intrinsic properties of the subject's belief system should determine his perception of uncertainty in the game and this would determine the information buying response.

The interaction of task variables in the decision making game and the demand characteristics in the experimental setting may also explain why low dogmatic subjects and high dogmatic subjects responded in the same way. They both responded in the same way to the option of purchasing information before making a terminal choice. In each game condition, the subject perceives not only the game conditions, but the total experimental setting. The experimenter, as an authority figure may have been an important situational variable. High dogmatics prefer to rely heavily on the pronouncements of authorities and tend to accept information primarily on the basis of who said it (the message source), while low dogmatics tend to act upon their independent evaluation of the information itself (message content).<sup>1</sup> Support for this relationship can be found in the social-psychology literature.<sup>2</sup> In this study, the low dogmatic subjects may have responded to the uncertainty in the game while high dogmatics may have responded to the influence of the experimenter, an authority making information available. Both groups may have been aroused by different factors in this study. This variable (the influence of the pronouncements of authority figures) should be controlled for in further investigations

---

<sup>1</sup> Ibid., p. 58.

<sup>2</sup> H. J. Ehrlich and D. Lee, "Dogmatism, Learning, and Resistance to Change: A Review and a New Paradigm," Psychological Bulletin, Vol. 71, 1969, p. 255.

into the relationship between dogmatism and how subjects value information.

Because of the importance of decision making to management theory and practice, and more specifically how man uses information to make decisions, this study suggests other areas of research. Further replication of Green's decision making exercise and other laboratory simulations of how decision makers use information should be carried out. Within the laboratory setting, the effects of real money and imaginary money on decision making should be explored. The data in this study was based on the assumption that individual differences in decision making in a hypothetical context represents a simulation of what a subject would do in a real decision situation. Important real world decisions, however, require that a decision maker spend a considerable amount of time, effort or money to obtain information. To get better descriptive data on how subjects value information under conditions of uncertainty, a monetary reward system should be introduced in the experimental procedures so that the subject experiences the negative and positive consequences of his decisions. This study may have identified decision making characteristics in only one type of situation--where information is very easy to obtain. It may be that a decision maker's evaluation of information is more optimal in situations where information is difficult to obtain.

In the approach used in this study the decision situation was already defined. The subjects were presented with a well defined problem and instructions on what they could do. Although this approach provides information about a certain aspect of decision making, further research should be carried out to determine how

decision makers reduce uncertainty when attempting to diagnose problems and to generate alternatives as possible solutions to problems. How much effort a decision maker puts into clarifying decisions is as important an aspect of decision making as evaluating information where the decision is well defined. An indication of this effort could be obtained by measuring the speed with which decisions are made in the laboratory.<sup>1</sup> It was noticed in this study that there was a considerable difference in the time that subjects took to complete the decision tasks. A measure of decision speed could be obtained without the subjects knowledge. An interesting relationship to evaluate would be the relationship between the speed of decision and the way the subject evaluates information relative to the expected value principle. Research studies on how subjects use information and evaluate information can increase understanding of this important variable by employing diverse methods of assessing this variable.

### 5.3 Conclusions and Summary Comments

The results of this study may be summarized in the following way. First, the replication of Green's study with a different subject group supports the hypothesis that people have a bias for overvaluing information when the value of the information is defined by the expected value model. Second, and more important however, this study examined the issue of whether subjects are judged as overvaluing information because of the methodology used in Green's study. The findings in this study suggest that Green's information buying results are based on an approximation that inflates the estimate of how subjects

---

<sup>1</sup> Slovic and Lichtenstein, op. cit., p. 699.

value information. The extent to which subjects overvalue information may not be as large as Green's results indicate.

In the context of the above discussion and the data obtained from the post exercise question, any conclusions regarding the nature of how people value information should be at best viewed as tentative. The state of the research on this issue does not allow for the conclusion that the bias to overvalue information is a general human characteristic. Additional research is needed to establish what experimental factors may lead suboptimal performance and to clarify what types of environmental situations are related to decision makers overvaluing information.

Thirdly, large individual differences were observed in how subjects value information, but the personality variable of dogmatism does not explain these differences. The work of Brightman and Urban<sup>1</sup>, dealing with the influence of the dogmatic personality upon information processing suggests that dogmatism is an explanatory variable for individual differences in information processing only when the decision environment is ambiguous. In the present study, what the subject had to do with regard to information seeking may have been too straight forward. No ambiguity existed. The dogmatism variable has no explanatory power in such a case.

The purpose of the above results is to provide information on decision making and to develop a better conceptualization and understanding of this process. The replication and extension of

---

<sup>1</sup> Harvey J. Brightman and Thomas F. Urban, "The Influence of the Dogmatic Personality Upon Information Processing; A Comparison with a Bayesian Information Processor," Organizational Behavior and Human Performance, Vol. 11, 1974, p. 274.



Green's decision making study was quite useful in this regard. The re-examination of Green's methodology also underlines the importance of subjecting experimental studies on decision making to the test of replication. Although the results of studies like Green's are important, their results should be interpreted carefully and the limitations of these results should be recognized.

## BIBLIOGRAPHY

- Archer, Stephen H., "The Structure of Management Decision Theory," in Information for Decision Making, Rappaport, Alfred, (ed.), Toronto: Prentice-Hall, 1970.
- Barclay, Scott, Beach, Lee Roy, and Braithwaite, Wanda P., "Normative Models in the Study of Cognition," Organizational Behavior and Human Performance, Vol. 6., 1971.
- Buzzell, Robert D., Cox, Donald F., and Brown, Rex V., Marketing Research and Information Systems, New York: McGraw-Hill, 1969.
- Becker, Gordon M., and McClintock, Charles G., "Value: Behavioral Decision Theory," Annual Review of Psychology, 1967.
- Brightman, Harvey J., and Urban, Thomas F., "The Influence of the Dogmatic Personality upon Information Processing: A Comparison with a Bayesian Information Processor," Organizational Behavior and Human Performance, Vol. 2, 1974.
- Brown, Rex V., Research and the Credibility of Estimates, Boston: Graduate School of Business Administration, Harvard University, 1969.
- Brown, R.V., "Do Managers Find Decision Theory Useful?" Harvard Business Review, Vol. 48, (May-June), 1970.
- Cochran, James Robert, Management Information Systems; Structural Considerations, Unpublished Masters of Science Thesis, University of Saskatchewan, Saskatoon, Saskatchewan, 1969.
- Edwards, W., and Slovic, P., "Seeking Information to Reduce the Risk of Decisions," American Journal of Psychology, Vol. 78, 1965.
- Edwards, W., "The Theory of Decision Making," in Decision Making, Edwards, W., and Tversky, A., (eds.), Baltimore: Penquin Books, 1967.
- Ehrlich, H.J., and Lee, D., "Dogmatism, Learning, and Resistance to Change: A Review and a New Paradigm," Psychological Bulletin, Vol. 71, 1969.
- Fried, Lisbeth S., and Peterson, C.R., "Information Seeking: Optimal Versus Fixed Stopping," Journal of Experimental Psychology, Vol. 18, 1969.

- Green, P.E., Halbert, M.H., and Minas, J.S., "An Experiment in Information Buying," Journal of Advertising Research, Vol. 4, 1964.
- Green, Paul E., Robinson, Patrick J., and Fitzroy, Peter T., Experiments on the Value of Information in Simulated Marketing Environments, Boston: Allyn and Bacon, Inc., 1967.
- Green, Paul E., and Tull, Donald S., Research for Marketing Decision, Toronto: Prentice-Hall, 1970.
- Hamburg, Morris, Basic Statistics: A Modern Approach, New York: Harcourt Brace Jovanovich, Inc., 1974.
- Hershman, Ramon L., and Levine, J.R., "Deviations from Optimum Information - Purchase Strategies in Human Decision-Making," Organizational Behavior and Human Performance, Vol.5, 1970.
- Jamias, J.E., and Troidahl, V.C., "Dogmatism, Tradition, and General Innovativeness," in Briefs, Attitudes, and Values, Rokeach, Milton, San Francisco: Jossey-Bass, Inc., 1969.
- Johnson, Harold L., and Cohen, Arthur M., "Experiments in Behavioral Economics: Siegel and Fouraker Revisited," Behavioral Science, Vol. 12, 1967.
- Kaplan, R.J., and Neuman, J.R., "Studies in Probabilistic Information Processing," IEEE Transactions on Human Factors in Electronics, HFE-7, 1966.
- Kast, Fremont E., and Rosenzweig, James E., Organization and Management, Toronto: McGraw-Hill, 1970.
- Kogan, N., and Wallock, M.A., Risk Taking a Study in Cognition and Personality, New York: Holt, Rinehart, and Winston, 1964.
- Lee, Wayne, Decision Theory and Human Behavior, Toronto: John Wiley and Sons, Inc., 1971.
- Long, B.H., and Zeller, R.C., "Dogmatism and Predicisional Information Search," Journal of Applied Psychology, Vol. 49, 1965.
- Maude, Barry, "How to Manage Committees," Management Today, January, 1975.
- MacCrimmon, Kenneth R., "Managerial Decision Making," in Contemporary Management, McGuire, Joseph W., (ed.), Toronto: Prentice-Hall, 1974.

- Millar, David W., and Starr, Martin K., The Structure of Human Decisions, Toronto: Prentice-Hall, 1967.
- Minuim, Edward W., Statistical Reasoning in Psychology and Education, Toronto: John Wiley and Sons, Inc., 1970.
- Moskowitz, Herbert, "An Experimental Investigation of Decision Making in a Simulated Research and Development Environment," Management Science, Vol. 19, February, 1973.
- Orne, M.T., "On the Social Psychology of the Psychological Experiment: with Particular Reference to Demand Characteristics and their Implications," American Psychologist, Vol. 17, 1962.
- Peterson, Cameron R., and Beach, Lee Roy, "Man as an Intuitive Statistician," Psychological Bulletin, Vol. 78, 1967.
- Phillips, L.D., and Edwards, W., "Conservatism in Simple Probability Inference Task," in Decision Making, Edwards, W., and Tversky, A., (eds.), Baltimore: Penguin Books, 1967.
- Pitz, G.F., "Information Seeking when available Information is Limited," Journal of Experimental Psychology, Vol. 76, 1967.
- Rokeach, Milton, Beliefs, Attitudes, and Values, San Francisco: Jossey-Bass Inc., 1968.
- Rokeach, Milton, The Opened and Closed Mind, New York: Basic Books, 1960.
- Runyon, Richard P., and Haber, Audrey, Fundamentals of Behavioral Statistics, Don Mills: Addison-Wesley Publishing Company, 1968.
- Schum, David A., "Behavioral Decision Theory and Man-Machine Systems," in Systems Psychology, DeGreene, Kenyon B., (ed.), New York: McGraw-Hill Book Co., 1970.
- Simon, Herbert A., "Theories of Decision-Making in Economics and Behavioral Sciences," in Selected Readings in Management, Shull, F.A., and Delbecq, A.L., (eds.), Homewood, Illinois: Richard D. Irwin, Inc., 1962.
- Slovic, Paul and Lichtenstein, Sarah, "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgement," Organizational Behavior and Human Performance, Vol. 6, 1971.

- Starbuck, W.H., and Bass, F.M., "An Experimental Study of Risk-Taking and the Value of Information in a New Product Context," Journal of Business, Vol. 40, 1967.
- Troldahl, Verling C., and Powell, Frederic A., "A Short-Form Dogmatism Scale for use in Field Studies," Social Forces, Vol. 44, 1965.
- Vinanche, Edgar W., "Variables In Experimental Games: Toward a Field Theory," Psychological Bulletin, Vol. 71, 1969.
- Uhl, Kenneth P., and Schoner, Bertram, Marketing Research: Information Systems and Decision Making, Toronto: John Wiley and Sons, Inc., 1969.
- Wrench, David F., and Wrench, Chris, Psychology, a Social Approach, Toronto: McGraw-Hill, 1973.

## APPENDIX A

### DESCRIPTION OF EXPERIMENT ON THE VALUE OF INFORMATION IN SIMULATED MARKETING ENVIRONMENT

Research design. Green, Robinson, and Fitzroy, in their investigation of how subjects value information when they are making decisions under conditions of uncertainty, give the following description of the research design and required subject decision activity:

...the game players were asked to assume that they were product managers in a large firm with the objective of maximizing net monetary return. They were further asked to imagine that two advertising campaigns (see detailed instructions below) were available for choice. The net payoff associated with each option depended upon which of two possible marketing conditions prevailed. Prior probabilities regarding the occurrence of each of the two events were given. On each condition the subject was given a set of ten "perfect" market surveys (trials) at varying costs which would--without error--report the true state regarding market conditions. The subject was asked to state which surveys he would buy and which he would not buy, given the specific conditions of the problem. (Eight such conditions were constructed and presented in a preset randomized order.)

In effect, the assumption is made that the subject's behavior (with respect to surveys chosen) represents an imputation of his valuation of the cost of uncertainty as derived by considering the prior probabilities and payoff table entries. For those surveys which the subject agreed to purchase, he was given the survey results and then asked to choose one of the two advertising campaigns. For those surveys which the subject

did not wish to purchase, he was asked to choose one of the two advertising campaigns on the basis of the "given" prior information alone.<sup>1</sup>

The basic payoff matrices used by Green are shown in TABLE A.1. The first payoff matrix has prior probabilities of 0.7 and 0.3 assigned to state 1 and state 2, respectively. The second payoff matrix has prior probabilities of 0.5 and 0.5 assigned to state 1 and state 2, respectively. The entries of the second payoff

TABLE A.1 Basic Payoff Matrices

Condition 1	State 1	State 2
Act 1	50,000	10,000
Act 2	35,000	20,000
Probabilities of State	0.7	0.3
Condition 5		
Act 1	50,000	10,000
Act 2	29,000	16,000
Probability of State	0.5	0.5

matrix are adjusted to yield the same expected value of perfect information as in the first payoff matrix.

The eight game conditions and the optimal solutions are summarized in TABLE A.2. These eight games are obtained with systematic changes of the basic payoff matrices given in TABLE A.1.

<sup>1</sup> Paul E. Green, Patrick J. Robinson and Peter T. Fitzroy, Experiments on the Value of Information in Simulated Marketing Environments, Boston: Allyn and Bacon, Inc., 1967, p. 28. Referred to hereafter as Green.

TABLE A.2 Game Conditions and Optimal Solutions

	Act 1	Act 2	Probability of State	Expected Value of Perfect Information
Game #1				
State 2	\$10,000	\$20,000	0.3	\$3,000
State 1	50,000	35,000	0.7	
Game #2				
State 2	20,000	40,000	0.3	6,000
State 1	100,000	70,000	0.7	
Game #3				
State 2	160,000	170,000	0.3	3,000
State 1	200,000	185,000	0.7	
Game #4				
State 2	170,000	190,000	0.3	6,000
State 1	250,000	220,000	0.7	
Game #5				
State 2	10,000	16,000	0.5	3,000
State 1	50,000	29,000	0.5	
Game #6				
State 2	20,000	32,000	0.5	6,000
State 1	100,000	58,000	0.5	
Game #7				
State 2	160,000	166,000	0.5	3,000
State 1	200,000	179,000	0.5	
Game #8				
State 2	170,000	182,000	0.5	6,000
State 1	250,000	208,000	0.5	



The response form. A sample response form is given in TABLE A.3. Ten survey prices are made available to the subjects in each of the eight game conditions. These prices range from \$100 to \$53,000.

TABLE A.3 Illustrative Response Form - Condition 1

				State 1	State 2		
Act 1				50,000	10,000		
Act 2				35,000	20,000		
Probability of State				0.7	0.3		
Trial	Cost of Perfect Information	Buy Information Survey Outcome	Act	Not Buy Information Act	True State	Gross Return	Net Return
1	\$ 200						
2	4,000						
3	2,000						
4	6,000						
5	400						
6	25,000						
7	100						
8	15,000						
9	50,000						
10	800						

All odd-numbered conditions contain the above-listed set of survey costs. All even-numbered conditions contain the following sequence of survey costs: \$3,200, 7,000, 5,000, 9,000, 3,400, 28,000, 3,100, 18,000, 53,000, and 3,800.

Game instructions. Green gives the following game instructions for his experiment:

Your cooperation is requested on an experiment designed to determine how people value information. Assume that you are a product manager in a large firm. You are responsible for making a choice between two advertising campaigns for a particular product. Your objective is to maximize net monetary return.

The two advertising campaigns are called act 1 and act 2. For each of these options there are two gross returns, depending on the prevailing market conditions, or states. Although you do not know which state will prevail, you are given the probability--or likelihood--of the occurrence of each state.

However, you do have available a good market research agency which can predict perfectly which state will prevail. As is true of many good things, however, this service costs money.

To clarify the problem, consider the illustrative situation below. If act 1 is used and state 1 occurs, the net return is \$50,000, while if state 2 occurs, the return is \$10,000. Similarly, if act 2 is employed and state 1 occurs, the return is \$35,000, while the return is \$20,000 if state 2 occurs. We know, however that the probability of state 1 occurring is 0.7 while the probability of state 2 is 0.3. This may be summarized as follows:

#### Illustrative Problem

	State 1	State 2
Act 1	50,000	10,000
Act 2	35,000	20,000
Probability of State	0.7	0.3

You can, however, purchase the market survey service, which tells you without error which state will exist. The cost of this service will range from \$100 to \$53,000. Your problem is to decide: (a) whether you will buy or not buy perfect information at the price indicated; and (b) given this decision, which act (1 or 2) you wish to choose.

As an example of how you may wish to respond in this game, look at the illustrative situation above. Suppose the cost of perfect information in this situation is \$20,000 and at this price you decide not to buy the perfect survey. If so, you will check the "not buy" column of your response form and insert the act-- 1 or 2--that you select.

Suppose, however, you decide under these conditions to purchase the perfect survey. The umpire will then tell you which state is indicated by the survey. You will then select the option you wish--act 1 or act 2--based on this new information. If you decide to buy the perfect information, your net return must, of course, reflect the deduction of information purchasing cost from the gross returns shown in the payoff table.

We have found that most subjects prefer to ascertain for a given set of conditions, the anticipated value of the information, checking the "buy" column for all survey costs under this figure.

After you have determined whether or not you wish to buy information for all of the ten surveys the umpire will write in your response form the survey outcomes in all those cases in which you elected to purchase the survey. You are then asked to select a final act,  $A_1$  or  $A_2$ , for all ten cases (considered individually) after which the umpire will write in the appropriate "actual" state outcomes,  $S_1$  or  $S_2$ , for each of the ten cases.

Bear in mind that the survey results have been selected beforehand in accord with the chance characteristics of the problem. However, the individual results have been

selected from a table of random numbers, so there is no way to predict what will happen on the next survey from what happened on the previous surveys.

After you have made all final decisions and the umpire has written in the appropriate "actual" states, you can then proceed to the next set of conditions, and so on, until all conditions are complete.

After all eight sets of conditions are completed, please hand in your response forms to the referee who will check over your advertising decisions and returns.

Do you have any procedural questions before we start?<sup>1</sup>

Data analysis. In the methodology given above, each subject, in each game condition, has to choose an information buying act. This included foregoing the purchase of information. To operationalize the value that subjects place on information, their buying responses are entered into a computational format given in Table A.4.<sup>2</sup> An estimate of how an individual subject values information is obtained by averaging the value placed on information over eight game conditions by that subject. An estimate of how the subject group values information is obtained by averaging the value placed on information over eight game conditions by the subjects. The basic research question which the above methodology addressed itself to is: Over all eight game conditions, for the subject group,

---

<sup>1</sup> Green, op. cit., p. 31.

<sup>2</sup> Green, op. cit., p. 139.

does a positive bias (in comparison to the optimal solution) exist for information?<sup>1</sup> Or, stated in another way, do individuals tend to obtain too much versus too little information?

TABLE A.4 Computational Format

Subject	Condition 1, 2, ....8	Total	Mean
1	$x_{11} \dots x_{18}$	$P_1$	$\bar{P}_1$
2	$x_{21} \dots x_{28}$	$P_2$	$\bar{P}_2$
.	.	.	.
.	.	.	.
$n$	$x_{n1} \dots x_{n8}$	$P_n$	$\bar{P}_n$
Total		$G$	
Mean			$\bar{G}$

where  $P_i$  = sum of all amounts purchased by subject  $i$

$$G = \sum P_i$$

$$\bar{G} = \text{grand mean} = \sum \bar{P}_i / n$$

<sup>1</sup> Green, op. cit., p. 30.

## APPENDIX B

### SHORT-FORM DOGMATISM SCALE

With this test, the subjects indicate disagreement or agreement with each item on a scale ranging from -3 to +3, with the 0 point excluded in order to force responses toward disagreement or agreement. This scale is subsequently converted, for scoring purposes, to a 1 - to - 7 scale by adding a constant 4 to each item score. The total score is the sum of scores obtained on all items in the test. A low score would indicate dogmatism and closed-mindedness. The scale is illustrated below.

### OPINION QUESTIONNAIRE

We want your personal opinion on each statement. When I read each one, first tell whether . . . in general . . . you agree or disagree with it . . . then tell me a number . . . one, two, or three . . . that indicates how strongly you agree or disagree with it.

#### AGREE

- 1. Agree a little
- 2. Agree on the whole
- 3. Agree very much

#### DISAGREE

- + 1. Disagree a little
- + 2. Disagree on the whole
- + 3. Disagree very much

1. In this complicated world of ours the only way we can know what's going on is to rely on leaders or experts who can be trusted.
2. My blood boils whenever a person stubbornly refuses to admit he's wrong.
3. There are two kinds of people in this world: those who are for the truth and those who are against the truth.
4. Most people just don't know what's good for them.
5. The highest form of government is a democracy and the highest form of democracy is a government run by those that are most intelligent.
6. The main thing in life is for a person to want to do something important.

7. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.
8. Man on his own is a helpless and miserable creature.
9. Most people just don't give a "damn" for others.
10. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.
11. It is often desirable to reserve judgement about what's going on until one has had a chance to hear the opinions of those one respects.
12. The present is all too often full of unhappiness. It is only the future that counts.
13. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.
14. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.
15. It is better to be a dead hero than be a live coward.

# APPENDIX C

TABLE C.1 SUBJECT INFORMATION BUYING RESPONSE (\$ X 10<sup>2</sup>) USING GREEN'S MIDPOINT ASSUMPTION

Subject Number	Game Condition							
	7	4	5	8	1	2	6	3
1	30	230	105	230	105	135	135	200
2	30	80	14	80	105	80	60	50
3	105	405	105	135	105	230	135	105
4	105	405	375	80	30	60	60	50
5	105	135	50	60	105	135	135	105
6	105	230	50	80	105	50	135	50
7	105	44	105	44	30	16	44	14
8	30	60	50	60	50	80	60	50
9	105	44	105	44	30	135	44	105
10	50	23	105	135	105	135	135	105
11	14	80	105	135	1	135	23	105
12	30	44	14	44	14	36	33	105
13	30	135	50	60	105	135	60	30
14	105	230	30	135	30	80	60	105
15	14	135	20	405	50	135	405	50
16	14	60	30	44	14	44	44	14
17	105	135	105	80	50	80	230	105
18	105	60	30	135	30	230	135	105
19	14	60	50	135	30	60	60	14
20	200	230	30	23	30	230	135	200
21	30	60	14	36	14	44	44	30
22	105	60	105	230	375	405	405	105
23	105	135	105	405	105	405	230	200
24	105	60	30	135	30	31	135	105
25	30	44	14	44	14	60	33	50
26	200	230	50	230	50	135	135	200
27	50	105	105	80	50	80	80	30
28	30	60	50	44	50	405	230	50
29	30	135	50	80	30	44	31	50



TABLE C.2 SUBJECT INFORMATION BUYING RESPONSE ( $\$ \times 10^2$ ) USING THE POST EXERCISE QUESTION

Subject Number	<u>Game Condition</u>							
	7	4	5	8	1	2	6	3
1	60	180	60	180	150	90	90	150
2	29	80	10	79	90	70	60	50
3	60	300	60	120	100	200	120	90
4	60	280	250	70	20	50	50	40
5	60	90	40	50	60	90	90	60
6	60	180	40	70	60	50	90	40
7	60	38	40	40	18	0	32	8
8	40	60	50	60	50	80	60	50
9	70	40	90	38	20	90	38	60
10	60	200	60	120	100	135	120	100
11	10	90	60	100	0	100	200	100
12	20	40	10	40	10	35	35	60
13	40	180	65	50	75	100	50	30
14	60	180	20	90	20	70	50	60
15	14	100	150	300	50	100	300	50
16	10	50	20	40	10	45	40	10
17	60	140	60	90	50	100	180	70
18	90	60	30	170	30	200	180	120
19	20	70	60	120	40	70	70	20
20	200	240	20	180	20	200	90	150
21	30	50	14	34	14	38	44	20
22	90	60	90	200	30	280	280	80
23	130	120	130	280	120	280	250	170
24	60	50	40	90	20	31	90	60
25	22	39	9	39	9	52	33	41
26	150	200	50	200	50	100	100	200
27	50	50	60	70	50	80	70	40
28	25	68	50	38	42	285	190	60
29	30	100	40	80	30	45	32	45

TABLE C.3 SUMMARY CHARACTERISTICS OF THE TWENTY-NINE FARM OPERATOR STUDY GROUP

Median Age - 25 years		
Median Number of Years Farming - 8 years		
Educational Background		
Some High School	10	
High School Graduate	18	
Some University	1	
	<hr/>	
	100%	

  

Number of Acres Farmed		Average Gross Farm Sales	Average Annual Net Farm Income
3000 - 3499	3	\$35,000 and	\$10,000 and
2500 - 2999	1	over - 4	over - 3
2000 - 2499	4	25,000 - 34,999 4	8,000 - 9,999 1
1500 - 1999	2	15,000 - 24,999 10	6,000 - 7,999 3
1000 - 1499	4	7,450 - 14,999 6	4,000 - 5,999 9
500 - 999	12	under 7,450 5	under 4,000 13
		<hr/>	<hr/>
		100%	100%
0 - 499	3		
	<hr/>		
	100%		