Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.
A DECISION-THEORETIC APPROACH TO
THE PLANNING OF AGRICULTURAL EXTENSION

A THESIS PRESENTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER IN AGRICULTURAL SCIENCE
IN FARM MANAGEMENT AT
MASSEY UNIVERSITY

PETER MUNRO GAULT
1977
ABSTRACT

The extension agency, faced with the need to make more effective use of its resources, requires information about the value of the alternative extension messages which it expects will assist farmers to increase net income. It is hypothesised that Bernoullian decision theory is applicable to the extension agency's problem by helping it to assess the expected value of the increases in aggregate farm incomes following extension.

An extension message is seen as assisting farmers to make decisions and thereby increasing expected income. Where the extension information is aimed at helping the farmer estimate the occurrence of the uncertain events in a decision problem, Bayes' theorem provides the basis for a method of obtaining the value of the information. An extension message can also assist by helping to analyse the decision problem or by providing information about some new or innovative course of action for solving the problem.

The difficulty encountered by most published methods for evaluating agricultural extension is that of determining the proportion of the change in farm income due to extension and that due to other factors which are also affecting farm income. The method outlined in this thesis relies on a preposterior estimate of the value of an extension message which largely overcomes the problem of estimating the without-advice situation.

A start was made on testing the proposed method by obtaining information from several dairy farmers about specific decision problems, the alternative courses of action and the other details that would enable a model of the decision problems to be synthesised. Because of the difficulty of obtaining that information, and of developing an adequate model of a problem, the attempted application was reduced to one farmer and the particular problem of summer-feeding of the herd.
Summer rainfall, pasture growth, milkfat output and milkfat price were the sources of uncertainty which were incorporated into the decision model. The analysis indicated only limited potential for additional information to assist the farmer with the decision problem. The research provided some support for the hypothesis since it was found to be possible to simulate a farmer's decision problem under uncertainty and to obtain a pre-posterior estimate of the farmer's expected income without advice.
An extension agency, such as the Advisory Services Division of the Ministry of Agriculture and Fisheries, is faced with decisions of how to allocate its scarce resources in order to assist its clients to achieve their objectives. To assist with this problem the Ministry of Agriculture and Fisheries established a research fellowship in co-operation with Massey University. Part of the research by the first fellow, Mr J.D. Squire, was to describe a model for planning agricultural extension.

The research presented in this thesis was undertaken during the author's tenure of the fellowship and it is an attempt to tackle one of the first steps of the planning process; the question of how to evaluate the alternative extension messages to which the agency can allocate its resources?

The first chapter introduces the problem in the context of the process of agricultural extension, defines the basic research hypothesis and the goals of the extension agency. In chapter two there is a brief discussion of the ways in which extension can affect its clients' decisions and a review of some of the methods which have been proposed for the evaluation of agricultural extension. In chapter three the theoretical basis of the proposed method is outlined and chapter four reports on an attempt to apply the method in the context of a dairy farmer's decision problem of how to farm with the possibility of a dry summer. The final chapter includes the summary, conclusions from the research and some discussion of the problems which have arisen and their possible solutions.
ACKNOWLEDGEMENTS

The author is grateful for the opportunity provided by the Ministry of Agriculture and Fisheries to undertake the research.

Sincere thanks are extended to the staff of the Department of Agricultural Economics and Farm Management of Massey University and especially to the supervisor, Mr A.H. Hughes, and Dr A.L. Rae and Professor R.J. Townsley for their assistance.

The author is indebted to his wife for her encouragement throughout the term of this research project.
CONTENTS

PREFACE

ACKNOWLEDGEMENTS

CONTENTS

1. Introduction to the problem and the research
   1.0 Introduction
   1.1 The Context of the Problem
   1.2 The Hypothesis
   1.3 The Goals of the Extension Agency
   1.4 The Nature of the Extension Message
   1.5 Summary

2. The Effects and the Value of Extension
   2.0 Introduction
   2.1 The Effect of Extension
      2.1.1 Decision Analysis
      2.1.2 New Alternatives
      2.1.3 The Revision of Uncertainty
   2.2 Methods of Measuring the Effect of Extension
      2.2.1 Diffusion of Technical Change
      2.2.2 Changes in Efficiency
      2.2.3 Analysis of Commodity Potential
   2.3 The Need for Preposterior Analysis
   2.4 Uncertainty and the Evaluation of Extension
      2.4.1 Uncertainty and Technical Change
      2.4.2 The Client
      2.4.3 The Extension Agency
   2.5 Summary

3. The Theoretical Basis of a Method for the Preposterior Evaluation of an Agricultural Extension Programme
   3.0 Introduction
   3.1 The Prior Valuation of an Extension Message
3.2 The Decision to Obtain Additional Information About the Alternatives
3.3 The Value of an Extension Message to a Farmer
3.4 The Potential for Information in a Decision Problem
3.5 The Revision of a Prior Estimate of the Value of an Extension Message.
3.6 Departures from Normality
3.7 The Method and the Rules of Stochastic Dominance
3.8 Summary

4.0 Introduction
4.1 The Research Design
4.2 The Surveyed Farm
4.3 The Farmer's Decision Problem
4.4 The Farmer's Alternatives
4.5 The Farmer's Utility Function
4.5.1 The Dimensions of Utility
4.5.2 The Measurement of the Farmer's Utility Function
4.6 The Uncertain Events
4.6.1 The Assessment of the Uncertainty of Summer Rainfall
4.6.2 The Assessment of the Uncertainty of Milkfat Price
4.6.3 Definition of Two Other Sources of Uncertainty
4.6.3.1 Growth of Pasture
4.6.3.2 Output of Milkfat
4.6.3.3 Measurement of the Uncertainty
4.7 Method of Analysis
4.8 Results of the Analysis
4.9 The Value of Additional Information
4.10 Discussion
4.11 Summary
5. Summary, Conclusions and Problems with the Method

5.0 Summary
5.1 Conclusion
5.2 Problems with the Method

Appendices

I The Components of the Dairy Cow Grazing System
II Annual Budgets for the First Act/Event Combinations from the Monte Carlo Simulation

Bibliography
LIST OF FIGURES

FIGURE

2.1 Effect of Extension Intensity on the Value of an Extension Message

2.2 Effect of Extension on the Adoption Pattern

3.1 Decision to Obtain Sample Information

4.1 Farmer's Utility Curve for Money Losses and Gains

4.2 Cumulative Probability Distribution for Summer Rainfall

4.3 Farmer's Cumulative Judgemental Probability Distribution for 1976-77 Milkfat Price

4.4 Cumulative Probability Distributions for "Average Daily Pasture Growth Rate in Summer" Under Three Rainfall Levels

4.5 The Cumulative Probability Distributions for, the "Annual Production of Milkfat with Crop" Under Three Levels of Pasture Production

4.6 The Cumulative Probability Distributions for the "Annual Production of Milkfat Without Crop" Under Three Levels of Pasture Production

4.7 Relationship Between Summer Rainfall and the Median of the Distribution of Uncertain Summer Pasture Growth

4.8 Relationship Between Summer Pasture Growth and the Median of the Distribution of Uncertain Milkfat Production
LIST OF TABLES

TABLE

4.1 Judgemental Fractiles for the Uncertain Event
"Average Daily Pasture Growth in Summer" for
Three Levels of Summer Rainfall

4.2 Judgemental Fractiles for the Uncertain Event
"Annual Milkfat Output with Crop" Under Three
Levels of Pasture Production

4.3 Judgemental Fractiles for the Uncertain Event
"Annual Milkfat Output Without Crop" Under
Three Levels of Pasture Production

4.4 Points from the Cumulative Probability
Distributions of Rainfall, Pasture Growth, Milkfat
Output and Price Used in the Monte Carlo Simulation

4.5 The Sample of Milkfat Outputs and Prices from
the Monte Carlo Simulation and Resulting Net Farm
Incomes and Utilities

4.6 Summary of Expected Payoffs Using Three Criteria