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**AN ANALYSIS OF CONSUMER BELIEFS AND ATTITUDES TOWARDS
AGRICHEMICAL USE AND AGRICHEMICAL RESIDUES ON FRESH FRUIT
AND VEGETABLES**

**A thesis presented in partial fulfillment
of the requirements for the degree of
Master of Agricultural Economics**

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ABSTRACT

Agrichemicals have been extensively used to control pests on fresh fruit and vegetables since the Second World War and virtually since this time controversy has surrounded their use. Agrichemicals present an unknown hazard to consumers, one which consumers feel they have little control over.

Agrichemical use and residues are not confined to fresh fruit and vegetables, but this is one product where their use is prominent. Consumers are concerned about agrichemical use for many reasons. One such issue is the safety of the fresh fruit and vegetables they eat, in terms of their health. If a new product is introduced, which addresses this issue, and differs on only the characteristic of food safety, classical demand theory has little to say about the adoption of this new product. In classical demand theory a good is bought for itself.

Goods characteristics theory however considers the good as a bundle of characteristics. The price of a good represents the sum of the marginal values of the characteristics. Goods characteristics theory however, would consider that the consumer is perfectly informed about these characteristics. This study assumes this is not the case. The consumer has a subjective evaluation of the characteristics which is more or less close to the objective reality. This subjective evaluation can be ascertained by asking a consumer about their beliefs and attitudes (considered to be synonymous with the terms perception and concern) and using these variables as explanatory variables in a model of consumer choice.

Respondents to a mail survey in this study were asked if they would consider buying a new product, fresh fruit and vegetables which differed on only one characteristic from currently available fresh produce, the use of agrichemicals in their production. Respondents were asked about their attitude and beliefs about the use of agrichemicals and possible presence of agrichemical residues on fresh fruit and vegetables.

The attitude and belief variables were used as explanatory variables in a logistic regression, with the dependent variable indicating whether or not they would consider buying fresh fruit and vegetables grown using integrated pest management. Results from this study suggest that respondents can be divided into groups (three in this study) which have different probabilities of considering buying the new product at various levels of concern. These groups could be characterised reliably by demographic variables and variables which indicate the respondents level of knowledge or information.

Respondents were also asked if they would be willing to pay more for the new product. A logistic regression model was again used to estimate the probability that these respondents would be willing to pay at least 20% more for fresh produce grown using integrated pest management. The respondents can again be grouped on this basis and the groups characterised in terms of demographic variables and variables which indicate the respondents level of knowledge or information.

The results indicate that respondents who were employed, non-Maori, could recall information about agrichemical use or residues in the previous six months and who used agrichemicals to control pests and diseases around the outside of the home were more likely to consider buying integrated pest management produce and to consider paying at least 20% more for such produce.

As it is the underlying attitude and beliefs of consumers that explain the probability of considering buying the new product and paying more for it, producers may be interested in changing the beliefs of respondents in the groups with a low probability of considering buying such produce and paying at least 20% more for it, to the beliefs of groups with a higher probability of considering buying such produce and paying at least 20% more for it. Research has shown that people's beliefs are easier to influence than their attitudes. Since it is proposed that beliefs are a function of a person's information as well as demographic variables and this is supported by the research findings, the groups are investigated with regard to the information sources they consider reliable and the channels they obtain information through. For the groups who are least likely to considering buying such produce and to pay at least 20% more for it, the Department of Health, public interest groups, government research agencies and university scientists are considered to be the most reliable sources of information. Respondents were generally most likely to obtain information from television, newspapers and magazines.

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TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF FIGURES	viii
LIST OF TABLES	ix
CHAPTER 1. INTRODUCTION	1
CHAPTER 2. BACKGROUND	3
2.1 Agrichemical use	3
2.2 Residues as an externality	3
2.3 Residues as a private good	4
2.4 The role of government	6
2.5 Agrichemical regulation in New Zealand	6
2.6 The agrichemical industry's response to consumer concerns	8
2.7 Producers' response to consumer concerns	8
2.8 Consumer concern about agrichemical residues in the food supply	11
CHAPTER 3. LITERATURE REVIEW	12
3.1 Perception, concern or attitude?	12
3.2 Empirical analyses of consumer concerns	18
3.3 The research question	23
CHAPTER 4. DATA MEASUREMENT	26
4.1 Measurement	26
4.2 Reliability and validity	30
4.3 General issues in question design	34

CHAPTER 5	DATA COLLECTION	36
5.1	Defining the population	36
5.2	Sample size	37
5.3	Selecting respondents	37
5.4	Carrying out the mail survey	39
CHAPTER 6.	DESCRIPTIVE RESULTS	42
6.1	Introduction	42
6.2	Treatment of missing values	42
6.3	Summary of survey responses	43
6.3.1	Sample Profile	43
6.3.2	How do respondents rank food issues?	46
6.3.3	Respondents' level of concern about agrichemical use	47
6.3.4	Respondents' beliefs about agrichemical use	49
6.3.5	Will respondents consider buying fresh produce grown using integrated pest management and how much will they pay?	50
6.3.6	Responses to information questions	51
6.3.7	Responses to other questions	53
CHAPTER 7.	MODEL FORMULATION AND RESULTS	54
7.1	Introduction	54
7.2	A model of consumer choice	54
7.3	Explaining consumer choice	68
7.4	Are respondents willing to pay more for IPM produce?	79
7.5	Explaining willingness to pay	83
CHAPTER 8.	DISCUSSION	89
8.1	Introduction	89
8.2	Consumer ranking of food issues	89
8.3	Consumers' level of concern	91
8.4	Other concerns	92
8.5	Respondent beliefs about the benefits of agrichemicals	93

8.6	Reasons for not buying IPM fresh produce	94
8.7	Will respondents consider buying IPM fresh produce?	95
8.8	An alternative approach	98
8.9	Will respondents pay more for IPM fresh produce?	100
8.10	Will consumers change behaviour based on information?	102
8.11	Conclusion	103
REFERENCES		104
APPENDIX 1 SURVEY INSTRUMENT		110
	COVER LETTER	111
	SURVEY	112
	REMINDER LETTER	122
APPENDIX 2 MODELS COMPARED IN SECTION 8.9		123
	MODEL A	124
	MODEL B	125
	MODEL C	126

LIST OF FIGURES

Figure 3. 1	A model of behavioural intention (Fishbein and Ajzen, 1975)	12
Figure 3. 2	Fishbein and Ajzen's attitude variable	13
Figure 3. 3	Consumer choice in goods' characteristics theory	14
Figure 3. 4	Consumers' subjective beliefs differ	17
Figure 3. 5	Differing consumer preferences	18
Figure 3. 6	The potential behavioural modes tested by Huang (1993)	21
Figure 3. 7	Relationships tested between variables	22
Figure 3. 8	Relationships tested between the dependent variables in Ott's analysis	22
Figure 3. 9	A possible model using variables in Ott's analysis	23
Figure 3. 10	Respondent values for IPM produce in relation to conventional produce	24
Figure 3. 11	The model to be tested	25
Figure 4. 1	Statements of concern used by Ott	26
Figure 4. 2	Attitude question (<i>level of concern</i>)	28
Figure 4. 3	Semantic differential question (level of concern)	28
Figure 4. 4	Information on integrated pest management used in the survey	29
Figure 4. 5	Semantic differential question (level of concern)	30
Figure 4. 6	Alternative measure of consumer concern about agrichemicals (<i>rank</i>)	32
Figure 4. 7	Alternative measure of consumer beliefs about agrichemicals (<i>use</i>)	33
Figure 4. 8	Some open-ended questions in the survey	35
Figure 6. 1	Information about GROWSAFE	53
Figure 7. 1	Numbers of respondents by X_1, X_2, X_3 categories	59
Figure 7. 2	Cell frequencies in the nine cell model	60
Figure 7. 3	Possible four cell models	62
Figure 7. 4	Cell frequencies in the four cell model	62
Figure 7. 5	Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern (Model 4)	63
Figure 7. 6	Frequencies in the three cell model	64
Figure 7. 7	Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern (Model 5)	65
Figure 7. 8	Models to be compared	71
Figure 7. 9	Plot of canonical function 1 by canonical function 2 by group	76

Figure 7. 10	Cell frequencies in the four cell model	81
Figure 7. 11	Probability that respondents in each group will pay at least 20% more for IPM fresh produce, as a function of their level of concern (Model 4)	82
Figure 7. 12	Models to be compared	83
Figure 7. 13	Plot of canonical function 1 by canonical function 2 by group	86
Figure 8. 1	Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern	96
Figure 8. 2	Results of the model by Huang (1993)	98
Figure 8. 3	Probability that respondents in each group will consider paying at least 20% more for IPM produce, as a function of their level of concern	101

LIST OF TABLES

Table 5. 1	Evaluation of techniques developed to improve response rates to mail surveys	41
Table 6. 1	Location, sex, ethnicity and age	44
Table 6. 2	Income	45
Table 6. 3	Survey results for education	45
Table 6. 4	Respondent ranking of food issues	46
Table 6. 5	Respondents ranking of other health risks compared with eating fresh fruit and vegetables grown with agrichemicals	47
Table 6. 6	Concerns other than food safety	48
Table 6. 7	Concerns about specific fruit and vegetables	48
Table 6. 8	Beliefs about the use of agrichemicals on fresh fruit and vegetables	49
Table 6. 9	Responses to statements about the safety of conventional and IPM fresh produce	50
Table 6. 10	Why respondents would not buy fresh produce grown using IPM	51
Table 6. 11	Number of sources of information	52
Table 6. 12	Who should be responsible for information and who is a reliable source of information	53
Table 7. 1	Parameter results for four cell model	63
Table 7. 2	Parameter results for Model 5	65
Table 7. 3	Loglikelihood ratio between successive models	65
Table 7. 4	Likelihood ratio statistic for all models	66
Table 7. 5	Loglikelihood ratio for alternative models compared with Model 5	67
Table 7. 6	Explanatory variables used in the analysis	69
Table 7. 7	Variables in each analysis	70
Table 7. 8	Univariate F statistics for explanatory variables included in the models	72
Table 7. 9	Statistics for model comparison	72
Table 7. 10	Pooled within canonical structure	74
Table 7. 11	Total sample correlation coefficients	74
Table 7. 12	Pooled within-group standardized canonical coefficients	74
Table 7. 13	Group means	75
Table 7. 14	Ranking of group means	77
Table 7. 15	Sample statistics for the predictors	77

Table 7. 16	Respondents' willingness to pay to buy IPM produce	79
Table 7. 17	Loglikelihood ratio between successive models	80
Table 7. 18	Likelihood ratio statistic between all models	80
Table 7. 19	Parameters for the four cell model	81
Table 7. 20	Variables in each analysis	83
Table 7. 21	Univariate F-statistics of variables included in the models	84
Table 7. 22	Percent of between groups variability explained by function 1	84
Table 7. 23	Pooled within canonical structure	85
Table 7. 24	Total sample canonical coefficients	85
Table 7. 25	Pooled within-group standardized canonical coefficients	85
Table 7. 26	Group centroids	87
Table 7. 27	Ranking of group means	87
Table 7. 28	Sample statistics for the predictors	88
Table 8. 1	Comparison between food concern rankings for different questions in the study	90
Table 8. 2	Respondent level of concern	91
Table 8. 3	Respondent concerns about the use of agrichemicals	93
Table 8. 4	Respondent beliefs about the benefits of agrichemicals	93
Table 8. 5	Reasons for not buying certified pesticide residue free produce (Weaver et al, 1992)	94
Table 8. 6	Why respondents would not buy fresh produce grown using IPM	94
Table 8. 7	Sources of information considered reliable	96
Table 8. 8	Media channels recalled	97
Table 8. 9	Belief and attitude parameter results	99
Table 8. 10	$-2 \log L$ statistic for models	99
Table 8. 11	Likelihood ratio statistic between models	100
Table 8. 12	Sources of information considered reliable	101
Table 8. 13	Media channels recalled	102
Table 8. 14	Changes in purchase habits for fresh fruit and vegetables, as a result of information seen or heard in previous six months	103

CHAPTER ONE

INTRODUCTION

Controversy over the use of agrichemicals began virtually with their inception. The benefits of agrichemical use seem readily apparent yet their costs are often hidden and do not always affect the same parties who benefit from their use. Like any market good, agrichemicals are subject to supply and demand. Any change in their use can be effected by regulation, restrictions due to which must then be monitored and enforced, or driven by market demand for the products they are inputs to.

It is the purpose of this thesis to investigate the relationship between consumer beliefs and attitudes towards agrichemical use and agrichemical residues and the demand for a product which seeks to decrease reliance on agrichemicals.

Objectives of the thesis

1. to determine how consumers' attitudes towards the possible presence of agrichemical residues on the fresh fruit and vegetables they buy, and their beliefs about the safety of conventional fresh produce and fresh produce grown using integrated pest management, relate to their hypothetical choice to consider buying fresh produce grown using integrated pest management.
2. to characterise or group consumers by their attitudes, beliefs, and willingness to consider buying fresh produce grown using integrated pest management and describe the demographic profile of the groups.
3. to discuss, from the results obtained in objectives 1 and 2, how consumer adoption of such a new product might be enhanced.

Outline of the thesis

This thesis consists of eight chapters. Chapter Two discusses the background to agrichemical use, issues arising from agrichemical use and some responses to those issues. In Chapter Three consumer concerns are discussed in relation to consumer demand. Several models of consumer choice that incorporate consumer concerns or perceptions are discussed and the model for this study is presented. There are then three aspects of the methodology to be discussed; measurement

of the data to be collected and analysed in the model of consumer choice; the means for collecting it; and the statistical techniques used to analyse the data. The first aspect is covered in Chapter Four, where issues of measurement of the data required for this study are discussed. Data collection is discussed in Chapter Five. Chapters Six and Seven present the final aspect of the methodology. Descriptive results from the study are presented in Chapter Six, while Chapter Seven presents a model of consumer choice and the statistical techniques used to analyse the model. Chapter Eight discusses the results of this analysis in the context of other studies.

CHAPTER TWO

BACKGROUND

2.1 Agrichemical Use

Agrichemicals have been extensively used to control pests on fresh fruit and vegetables, among other crops, since the Second World War. The major wartime discoveries were DDT (dichlorodiphenyltrichloroethane), BHC (benzene hexachloride or hexachlorocyclohexane) and the selective weedkillers (chlorinated phenoxyacetic acid compounds, of which 2,4-dichlorophenoxyacetic acid, 2,4-D, is the most well known) (Ordish, 1976). The benefits from initial use were obvious, crop yields increased as much as fourfold due to the impact of agrichemicals on pest populations (Crone, 1986).

However, in the 1950s, less than a decade after the introduction of extensive agrichemical use, controversy over residue contamination of food had already surfaced (Brown, 1969). Concerns for the environment arose in the same decade (Ordish, 1976) and in 1962 Rachel Carson wrote "The Silent Spring", an emotive account of a world dying from chemical poisoning, which, published first as a serial in the "New Yorker", reached a wide and general public.

Despite ongoing controversy over agrichemical use, its continued use indicates an implicit assumption that the costs of agrichemical use are outweighed by the benefits. While agrichemicals used in production both enhance the product's appearance, size and other characteristics and provide the producer with a risk management tool against crop loss from pests, their use may have unintended effects.

2.2 Residues as an externality

The direct costs of using agrichemicals that producers incur are private costs. These include the cost of the chemicals, cost of equipment and time and knowledge required for use. The use of agrichemicals then gives private benefits in terms of, for example, decreased crop loss. If these are the only costs and benefits then the user of the agrichemicals is the best person to decide how and where they will be used. But agrichemicals are used on open fields and in orchards and it is inevitable that complete control of agrichemicals when used by the producer is difficult if not impossible. As such the use of agrichemicals can affect people not party to the decision to buy and use agrichemicals. In order to recognise the full benefits and costs to society of agrichemical use, these third party effects need to be incorporated into the decision to use agrichemicals. Issues of such environmental contamination be dealt with by, for example, internalising the costs of environmental contamination and passing these back to the users of

agrichemicals, or through incentives to producers to change their behaviour, among other mechanisms. These are supply side changes.

Consumers may express concern about the effects of agrichemicals on the environment and change their purchasing behaviour accordingly, thus bringing about a change in production practices through a change in demand for goods produced using agrichemicals. Environmental concerns are not the only concerns consumers have about agrichemical use however. Consumers also report concern about the safety of food for consumption when agrichemicals have been used.

2.3 Residues as a private good

When consumers purchase produce, any residues present on the good from agrichemical use affect only the consumer (and his or her household), and as such are part of a private good. However the consumer is unlikely to possess the technology to be able to detect possible residues. Even at known toxic levels residues can be odourless, flavourless and colourless. Assuming that the consumer cannot assess the situation, he or she may turn to alternative sources for information such as labelling on the product or general information available through the media. Even given specific information however the consumer may be unable to assess the risk a component of food may represent. Scientists, as experts, are able to detect residues in the realms of parts per trillion yet even their ability to determine the risk these residues pose is relatively primitive (Kennedy, 1989). Consumers are therefore dealing with a good with a hidden characteristic that may be hazardous.

The production of information about the level of risk such goods present is also unlikely to be performed by the market, since the information will have widespread beneficiaries but the identification and collection of payment from these will be extremely difficult. In other words, information has public good characteristics. If the producer can clearly link information to their product, and their product only, there may be an incentive to provide information. But the next problem may be that it is difficult for the consumer to verify such information.

The use of agrichemicals has increased the production of food and reduced the occurrence of naturally occurring toxins, such as those from fungal contamination of grains. However many consumers appear to feel that these problems have simply been replaced by new and perhaps worse threats from the chemicals used to control the pests and diseases that threaten the food supply. Therein may lie a paradox. Consumers in the Western world are now so well-fed due to the increase in supply achieved by chemical control of pests and diseases that their food intake, which is relatively inelastic, has reached its peak and consumers are now turning their attention to other issues including the level of residues.

Yet the food supply has rarely been as safe as it is now. Not only is natural contamination reduced but greater regulation, monitoring and enforcement have also reduced deliberate adulteration of the food supply. For example, in 1906 the New York Health Commission found that more than 50% of the 4000 milk samples it tested were adulterated with water, chalk and/or plaster of Paris (Senauer, 1991). To monitor and enforce food safety standards set by regulation requires resources and safety standards set to achieve complete safety, if such is possible, will do so only at enormous cost. In fact Kramer (1990b, p16) comments that “[b]ecause of production, resource and knowledge constraints, it is not possible to have risk free food”.

A further complication of risk measurement is the observation that consumers' estimates of risk do not always correlate with scientific estimates (Hammit 1986, Kramer 1990a). Kramer (1990a, p14) proposes that, for the American consumer, one explanation may be that the “consumer is poorly grounded in basic scientific principles”. The consumer does not understand that toxicity may be related to dose, that some agents initiate cancers while others only enhance their progress and that natural substances are also chemicals and may be as, or more, toxic than agrichemicals. Consumers also have problems understanding and finding credibility in the concepts of statistical probability and inference often used in sampling and interpretation of epidemiological evidence.

However there may be an alternative explanation for the difference between perceived risk and actual risk. Risk is a multi-attribute concept with some attributes having greater significance for the individual as a consumer than the individual as a scientist. It is quite often observed that while consumers may balk at a low level of agrichemical residues in the food supply, known with some high probability as being safe, the same consumers will continue to consume, say, cigarettes with no qualms, a known and severe health risk. Such an apparent discrepancy can be explained when it is observed that consumers react differently according to, for example; whether they consider the risk to be within their own control, that is, not imposed by others; unlikely to result in catastrophic consequences no matter how small the probability and; to be familiar, that is, they have had previous experience with similar risks (Slovic et al, 1982).

It is not only the attributes of the risk which influence the pattern of consumption of a hazardous good. Ippolito (1981) developed a model of the response of a rational consumer to a hazardous good. The consumer can react to new information and the impact of that information on the consumer's demand for the good depends on; the age of the consumer at the time of the receipt of information; the nature of the hazard, whether it presents a constant, non-cumulative hazard or a cumulative hazard which may be instantaneous or delayed and; life expectancy related to exogenous factors such as genetics. Once the information is provided the consumer is able to fully interpret the information and adjust his or her consumption path to maximise utility accordingly.

2.4 The role of government

Government solutions to the issues arising from agrichemical use can include government provision of information, regulation to ensure producers provide a minimum level of information, setting standards for the use of agrichemicals and acceptable residue levels, and control of the market for agrichemicals. Of these interventions, provision of a minimum level of information with the product and setting of minimum standards have the most relevance for the consumer.

Bowbrick (1990) has discussed the loss of welfare which follows the imposition of minimum standards for a product when the consumer can fully assess the situation for himself. In the case of a hidden characteristic however the consumer is unlikely to be able to assess the characteristic, thus providing some justification for the imposition of a minimum standard. Two considerations are necessary, preferably the standard should be set such that only products unacceptable to the consumer are banned and the standard should take into account the diminishing marginal returns to increasing standards.

But Choi and Jensen (1991, p40) propose that "[t]he role of government should be limited to verifying producer claims about the hazard content, and should not extend to regulating the levels of food safety or output when the market is perfectly competitive. Regulation of food safety below or above the free market level would result in a welfare loss". In their discussion, however, a perfect market is related to market structure rather than other conditions such as perfect information.

Falconi and Roe (1991) point out health is a luxury good and if quality can only be guaranteed by a higher price, some consumers will be priced out of the market for safe goods. If this argument is followed then the imposition of minimum standards will similarly price some consumers out of the market, since the low cost low quality products will be excluded, but Bowbrick in his discussion makes the assumption that the minimum standards are relevant to the consumers' wants, and that no consumer wants to buy the product below the minimum standard. Thus the minimum standard prevents the possibility of a consumer buying a non-optimal product due to the inability to assess all of the characteristics of the good.

2.5 Agrichemical regulation in New Zealand

The Government in New Zealand has intervened in markets for agrichemicals and products grown using agrichemicals in several ways.

From the supply side, the Pesticides Board, formed under the Pesticides Act 1979, controls the registration and use of agrichemicals and examines the environmental impacts (Agricultural Compounds Unit Annual Report, 1992). The Pesticides Board regulates supply through registration by a number of criteria which include the furnishing by the applicant of specific scientific data for

registration of an agrichemical, such as analyses of residue decay data. The Board is likely to review or revoke a registration if it decides that the agrichemical is likely to have an adverse effect on non target species including humans, export produce, and/or environmental quality. The Pesticides Board receives financial, administrative and technical support from the Agricultural Compounds Unit (Agricultural Compounds Unit Annual Report 1992), within the Ministry of Agriculture and Fisheries. Agrichemicals must be registered with the Pesticides Board before they can be legally sold in New Zealand and as MacIntyre et al (1989, p33) comment “[r]egistration and revocation of registration decisions are... probably the most significant power for controlling the use of [agrchemicals]. Once... registered and dispersed in the marketplace, it becomes extremely difficult to police their use”.

The Pesticides Act 1979 is not the only act to impact on agrichemical use. For example, the Meat Act 1981 gives MAF inspectors the power to condemn or destroy an animal containing chemical residues or ingredients not permitted by the Act (MacIntyre et al 1989).

At the consumer end of the spectrum, it is the Ministry of Health which is responsible for monitoring the safety of the food supply (MacIntyre et al, 1989). The Ministry of Health is authorised under the Food Act 1981 to regulate the sale, advertisement, and labelling of food and the Food Regulations 1984 set the standards of composition, labelling and container requirements and the maximum residue levels (MRL) for foods. Where no MRL is set a default residue level is used (MacIntyre et al, 1989).

The limit of the Ministry of Health's powers, however, is significant. MacIntyre et al comment that “If the [Pesticides] Board registered a product the [Ministry] of Health viewed as dangerous to public health, [the Ministry] would have limited regulatory options.” It could respond by setting a detectable MRL at zero but would then need to monitor and enforce this limit. Such systematic monitoring and enforcement for any MRL has not been carried out by the Ministry of Health to date.

Safety standards for agrichemical residues are set as acceptable daily intakes, the “level of residue which, if ingested by humans daily over an entire lifetime, will not, based on current knowledge, result in “appreciable risk” [sic] of injury” and as maximum residue levels (MRLs), the “upper limit for [agrchemical] residues permitted to appear in or on human food” (MacIntyre et al, 1989, p206).

There has been some intermittent research on agrichemical levels in the food intake of the New Zealand population. Two studies in New Zealand, by Dick et al (1978; cited in Pickston et al, 1984)) and Pickston et al (1984) (a joint study by the Department of Scientific and Industrial Research (now reorganised as Crown Research Institutes) and the Department (now Ministry) of Health), found that daily dietary intakes of organochlorine and organophosphate agrichemicals were below the maximum acceptable daily intakes of these agrichemicals as defined by the Ministry.

The “NZ Commercial Grower” magazine (1990) also reports that tests conducted in 1990 showed that “just over 81 percent of the large sample sent for MAF [Ministry of Agriculture and Fisheries] and

DSIR [Department of Scientific and Industrial Research] testing passed with no measurable levels of EBDC [ethylenebisdithiocarbamate, a fungicide] chemical residues and 18 percent showed samples below the maximum permissible level" (emphasis in the original).

2.6 The agrichemical industry's response to consumer concerns

The agrichemical industry itself has responded to consumer concerns by actively promoting the benefits of agrichemical use, both to producers using them and consumers who buy products produced using agrichemicals.

In New Zealand there is a professional association, the Agricultural Chemicals and Animal Remedies Manufacturers' Association of New Zealand Inc.(AGCARM) which publishes the AGCARM review, a news letter addressing broad agrichemical issues, and also publishes intermittent promotional publications such as "Beyond Organics: The Agriculture of the Future" (AGCARM, 1992).

The agrichemical industry position, as represented in "Beyond Organics: The Agriculture of the Future" (AGCARM, 1992, p26), is as follows: "the [Ministry of] Health and MAF regularly test NZ foods for residues of agrichemicals, minute residues [of which] do not pose any risk because MRLs have 100- to 1000-fold safety factors built into them" and "99 percent of export produce and 90 percent of domestic produce have residues below the maximum residue levels".

2.7 Producers' response to consumer concerns

Producers, as users of agrichemicals, have responded to consumer concerns in a number of ways. Producer groups have organised themselves to provide and certify training in the safe use of agrichemicals. Producers have also responded to consumer concerns through niche marketing of foods which in some way reduce the possible or potential hazard content presented by agrichemical use and possible residues.

In March 1992, Producer representatives, including the Apple and Pear Marketing Board and the Kiwifruit Marketing Board, together set up the New Zealand Agrichemical Education Trust (NZAET). The Trust was set up to avert what was seen by the plant products industry as the imminent threat of government intervention and regulation in the use of agrichemicals on plants (New Zealand Commercial Grower, July/August 1992, and October/November 1992).

The objectives of the NZAET are to educate farmers and growers in the safe use of agrichemicals, inform the general public on the need for safe use of agrichemicals in commercial, recreational, and

domestic situations, to ensure that agrichemical users safeguard the environment and human health, and to maintain access for New Zealand produce on domestic and international markets (New Zealand Agrichemical Manual Partnership, 1993).

To meet these objectives the NZAET set up training courses to provide two levels of certification, the Standard Certificate for users of agrichemicals and the Advanced Certificate for managers of personnel using agrichemicals. Both the Apple and Pear Marketing Board and the Kiwifruit Marketing Board require their suppliers to satisfy either the Standard Certificate or the Advanced Certificate. The NZAET has also developed a GROWSAFE logo which may only be used by growers and farmers who have completed a training course satisfactorily or satisfied the assessment requirements where they are exempt the training.

While key organisations involved in the trust, Vegfed, Fruitfed, Federated Farmers, the Apple and Pear Marketing Board, the Kiwifruit Marketing Board, and the forestry organisations, may require their growers to obtain certification, it is voluntary for independent growers (New Zealand Commercial Grower, October/November 1992, p20).

New Zealand examples of niche marketing of foods, which in some way reduce the possible or potential hazard content presented by agrichemical use and possible residues, include the certification of organic producers through the Biogro and/or Demeter certification, which the producer can indicate on his or her product labels.

Bio-Gro is the trademark of the New Zealand Biological Producers and Consumers Council (Inc.) (NZBPC). This council is a private organisation founded in 1984 "to promote the interests of organic production in New Zealand"(NZBPC, 1994, p(A)1). The NZBPC produces the "Certified *Bio-Gro* Organic Production Standards" and producers who wish to use the *Bio-Gro* certification undertake an evaluation process. Such producers "must be able to demonstrate the implementation of a positive management system based on the principles ...of the *Standards*" (1994, p(A)1) not merely the "absence of technical breaches of the *Standards*" (1994, p(A)1).

Demeter is the trademark of the New Zealand Biodynamic Association. This produce is grown using biodynamic principles developed by Rudolf Steiner, in the 1920s, in Germany. It is a holistic approach that incorporates "the world of life forces and... the feeling or astral world... [and]... in turn allows the true spiritual nature of humans... to come to expression" (Lamont, 1993).

Biodynamic farming has been practised in New Zealand since the 1920s and in this time a detailed set of principles for biodynamic farming have been developed, which are specific to the specific climate and other physical aspects of farming in New Zealand. The Demeter trademark has been registered in other countries, but each country can adjust the standards, within limits, to suit local conditions. The

Biodynamic Farming and Gardening Association in New Zealand registered the Demeter trademark in 1986. To be able to use the Demeter trademark, a farmer must have practised biodynamic farming for at least three years, and in this initial period biodynamic preparations must be obtained from the Association, and regular visits by a field officer of the Association are carried out. Certification to use the trademark is reassessed each year (Lamont, 1993).

Mainstream producers, such as Wattie Frozen Foods in New Zealand, have included lines of organic produce in the domestic market, although their largest market is overseas, particularly Japan. The volume of such produce sold however remains small when compared with non-organic produce, less than 1% of Wattie Frozen Foods produce is organically grown (Export News, December 13, 1993).

Both the *Bio-Gro* and Demeter principles and processes of certification have been approved by IFOAM, the International Federation of Organic Agricultural Movements. There is not however any government supported definition or certification of organic production or produce in New Zealand. Wattie Frozen foods require their lines which are grown organically to be grown by *Bio-Gro* certified producers (Export News, December 13, 1993).

Another possible response of producers to consumer concerns about agrichemicals is to evaluate the plausibility of reducing dependence on agrichemical use. Organic production aims to cut out agrichemical use completely. This does not recognise the role of agrichemicals as a risk reduction tool.

Integrated pest management (IPM) is a management process used to grow fresh fruit and vegetables. Growers use various monitoring methods to determine the number of pests in the area where the produce is grown and also take into account weather conditions which affect pest numbers. Agrichemical sprays are not used until pest numbers reach a preset threshold level. Growers also encourage the natural predators of the pests that attack their produce by careful selection and timing of spray applications.

Cameron and Beck (1992) instituted such a system for cabbage, broccoli and cauliflower production. They found that by monitoring pest numbers and timing applications of agrichemicals when the numbers reached pre-set levels, they could reduce the number of agrichemical applications by two to three applications per crop. They estimated the costs of the monitoring programme to be the same as one agrichemical application, therefore saving one to two applications per crop. In addition, because the applications of agrichemicals were targeted specifically at times of increasing pest numbers, pest damage was also reduced. This meant 20% more acceptable broccoli and cauliflower heads and 24% more acceptable cabbage heads in the crop.

In the United States, some supermarkets have set up their own testing and certification procedures to

certify that the produce they sell is residue free (Hammitt, 1986; Weaver et al, 1992). This does not indicate that the produce has not been grown without agrichemicals. Producers who use agrichemicals, but follow the specified with-holding periods for agrichemical application prior to harvesting and sale, are however, more likely to have produce which meets such standards. The produce of growers who do follow these standards, and even organic produce, can have residues due to contamination from the use of agrichemicals by nearby producers. The certification procedure is designed to provide additional information for the consumer about the residue levels specifically in the produce they buy.

2.8 Consumer concern about agrichemical residues in the food supply

Despite government regulation and monitoring in New Zealand of the use of agrichemicals and the levels of residues, consumers still report concerns about such residues. In a survey of consumers in Palmerston North, New Zealand, in 1990, 64 percent of consumers ranked agrichemical residues in food in the top three of seventeen food concerns (Department of Marketing, Massey University, 1990), the highest for any nutritional concern. Similarly in the United States, where agrichemical use and residue levels are also monitored, consumers also report concerns about agrichemical residues in foods (McGuirk et al (1990), Ott et al (1991), Weaver et al (1992), Ott (1990)).

This concern would appear to be increasing. In the United States, where consumer surveys are frequently and regularly carried out, Kramer (1990a) noted a 23 percent fall in consumer confidence that food in supermarkets is wholesome and safe to eat, from 90 percent in 1985 to 81 percent in February 1989 to 67 percent in August 1989 (not surprisingly perhaps, since this last survey was conducted subsequent to the release of a Natural Resources Defense Council (US) report titled "Intolerable Risks: Pesticides in Our Children's Food", 1989; cited in Kramer, 1990a).

In response to these concerns producers are introducing new goods, which may be differentiated on the basis of whether they contain agrichemical residues or agrichemicals were used in their production. For example, in New Zealand products can be purchased which are certified as grown organically (without agrichemicals) through the Demeter and *Bio-Gro* labels.

Intuitively it might be assumed that consumer concerns will impact on consumer behaviour but consumer adoption of goods, developed in response to their concerns, has been haphazard and often insignificant. Incorporating consumer concerns into the economic model may clarify the effect of such concerns.

CHAPTER THREE

LITERATURE REVIEW

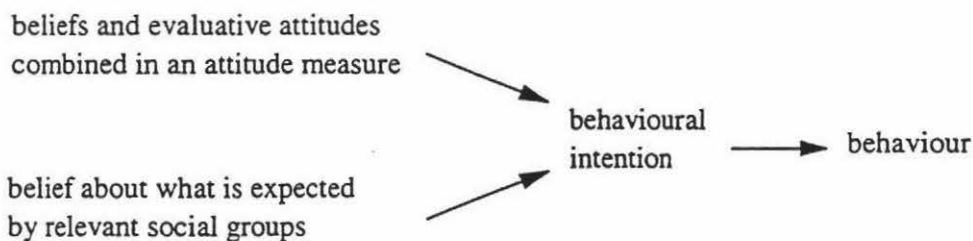
3.1 Perception, concern or attitude?

In the discussion which follows, papers are discussed which use various terms to describe consumers' sensory and cognitive assessment of a good, such as perception (Menkhaus et al (1993), Gao et al (1993)), concern (Ott (1993), Weaver et al (1992)), and attitude (Fishbein and Ajzen, 1975).

It is not the intention or purpose of this study to argue the case for the separate meanings for each of these terms, they are here considered synonymous. Other studies also consider the terms synonymous. Menkhaus et al (1993, p60) for example consider that concern is a negative perception; "[s]ince the perceived characteristics are measured as concerns, each is expected to adversely affect the quality perception or overall opinion of [the good]".

Fishbein and Ajzen (1975) use the term attitude in a theory of reasoned action in which an individual has an overall attitude towards an object (or action) formed by the combination of attitudes and beliefs about each of the characteristics of the object. This variable and a subjective norm variable, a measure of how the individual thinks he or she should behave toward the object according to the norms of society, are used as explanatory variables in a model of behavioural intention (Figure 3.1).

Figure 3. 1



Ajzen and Fishbein (1980, p149) have suggested that the theory of reasoned action can be used to both predict and understand behaviour, including consumer behaviour, as "[t]he ubiquity of acts falling within this category ... makes it clear that there is really nothing unusual about consumer behaviour" when compared with behaviour in other areas of a person's life.

With respect to consumer behaviour, the consumer's intention (proposed action) would then be their intention to buy a good or service. Their overall attitude towards buying a good or service would be formulated from their attitudes and beliefs about the characteristics of the good or service, and their perception of the expectations of relevant social groups.

In empirical work using Fishbein and Ajzen's model, the scores for attitudes and beliefs related to an object's characteristics are multiplied together and summed over the characteristics to give the attitude variable (Figure 3.2). The success of the subjective norm variable as an additional explanatory variable in their model has been questioned, with some researchers judging the influence of the subjective norm to already be incorporated in the attitude variable.

Figure 3. 2 Fishbein and Ajzen's attitude variable

$$A = f\left(\sum_{i=1}^n b_i e_i\right)$$

where:

A = overall attitude

b_i = belief towards *i*th attribute

e_i = attitude towards *i*th attribute

n = number of salient attributes

The concepts perception and attitude use different operational definitions and yet similarities can be seen. Gao et al (1993) formulate a model of consumer perception of orange juice as a latent variable which they derive by respondents' answers to questions such as "Which beverage do you say is good value?" and "Which beverage do you say is thirst quenching?". The questions were open ended allowing the respondent to indicate any beverage. If the consumer indicated orange juice as their reply to the question the particular indicator was given a score of one, and zero otherwise. The responses to the indicator variables were modeled using a multiple indicator/multiple cause model which has similarities to the probit and logit models but is a more efficient estimation technique. The perception variable developed in this estimation was not however related to any action, whether hypothetical or actual, such as "Did you buy *x* beverage in the last week?".

Gao et al (1993) base their model on that of Capps and Schmitz (1991) who consider consumer perception to be a function of information. Similarly Fishbein and Ajzen (1975) also consider the belief variable in their theory of reasoned action to be a function of the consumer's information.

Both perception and attitude measures are multi-attribute or characteristic measures but while the studies of Gao et al (1993) and Fishbein and Ajzen (1975) consider that the objects of consumer choice

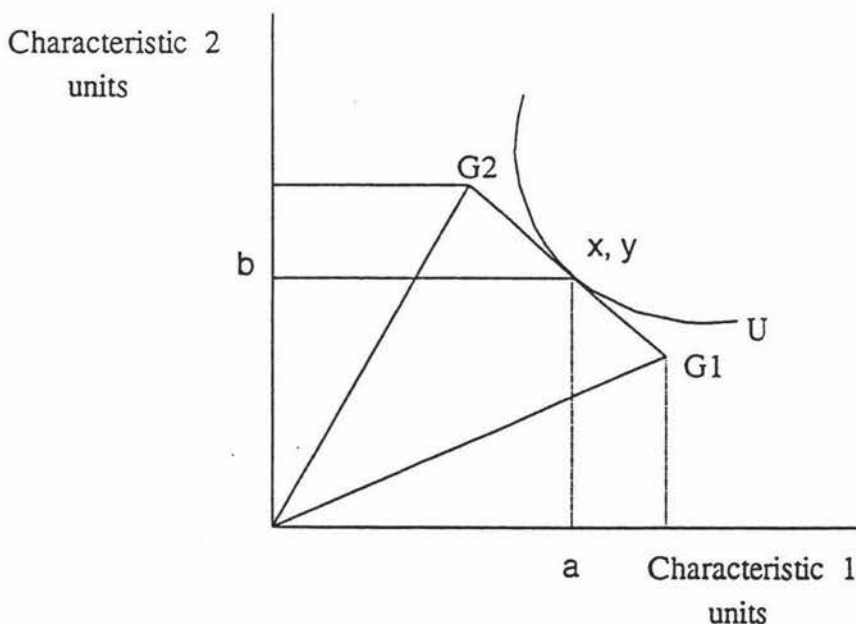
consist of characteristics, classical demand theory assumes consumer demand is for the good per se. Lancaster (1966) has alternatively proposed that demand for a good is a derived demand for its characteristics rather than the good.

Lancaster's approach embodies three propositions; that consumer preferences are defined on characteristics not goods; that goods have more than one characteristic and many goods may share the same characteristics and; that combinations of goods may produce characteristics different from those held by the individual goods (Lancaster, 1966).

To illustrate Lancaster's theory consider two goods with two characteristics. The consumer wishes to buy a mix of these two characteristics subject to the usual consumer choice conditions, more is preferred to less and there is an income constraint. The consumer's choice problem is illustrated in Figure 3.3 (adapted from Green, 1976).

The characteristics are measured along the axes. The goods are represented by vectors (G_1 , G_2) which illustrate the quantities of characteristics the consumer can buy for his or her income if he or she buys only that good. The information about the goods that these vectors represent is known by the consumer. The consumer makes his or her choice, along the consumption possibilities frontier G_1G_2 , illustrated by the usual consumer indifference curves. This consumer would buy x units of good 1 and y units of good 2 to obtain a units of characteristic 1 and b units of characteristic 2. The continuous line between the vectors implies that goods are perfectly divisible, any quantity can be bought. This is not a central issue to this analysis but it is noted here that there are likely to be many goods for which this is not the case.

Figure 3. 3 Consumer choice in goods' characteristics theory



Assuming linear relationships between the characteristics Lancaster's model can be formulated as

$$P_g = \pi_0 + \pi_1 c_1 + \pi_2 c_2 + \dots + \pi_n c_n$$

where P_g is the price of the good and $c_{1,n}$ are the characteristics of the good.

This is known as the hedonic technique where the price of a good is the sum of the marginal values of the characteristics of the good (Smallwood and Blaylock (1991, p11) and Deaton and Muellbauer (1980, p245)). If the price of a good is the sum of the marginal values placed on its characteristics then a decrease (or increase) in the quantity of one of the characteristics must be accompanied by a decrease (or increase) in the price of the good, otherwise demand for the good will change.

Lancaster assumes the relationship between goods and characteristics to be both linear and objective. He states that an objective relationship means that "the equations are assumed to hold for all individuals [and are] determined by the intrinsic properties of the goods themselves and possibly the context of technological knowledge in the society" (1966, p135). This would mean that each and every consumer of a particular good can agree on exactly the mix of characteristics, presence and quantity, in the good. This is the same as the perfect information assumption of classical demand theory and is disputed here.

The increasing technical knowledge of society can be seen in the increase in our knowledge over time of the effects of different components of food such as saturated fats, cholesterol and fibre. Therefore it is possible that the information a consumer has about a good today is different from that he or she may have some time in the future. Such information may change his or her purchasing behaviour over time.

The increase in technical knowledge itself does not invalidate the assumption of perfect information since the assumption could be taken to mean that once new information is available the consumer is instantaneously aware of that information. But to assume perfect information as meaning consumer awareness of all possible information is to implicitly assume that obtaining this information must be costless, since all consumers have perfect information despite a budget constraint.

Information is not costless to obtain and the consumer must decide how much information he or she wants. The assumption of a rational consumer would imply that such a consumer will only search for new information if the expected payoff from the search is greater than the cost of the search and processing of information (Stigler, 1961). That is, the consumer will look for information to the point where the cost of obtaining information is equal to the benefit gained from the information. This is not to be interpreted as consumers receiving benefit from information for its own sake but that information assists the consumer to make a choice which better represents his or her preferences. Stigler (1961,

p219) also suggests that the amount of information a consumer will search for will be influenced by the proportion of the consumer's budget the expenditure represents. This is because "the larger the fraction of [the budget], the greater the savings from search".

While Stigler (1961) describes consumers' actions to obtain information as 'search', the principle cost of which (according to Stigler) for the consumer is time, Darby and Karni (1973) take the costs of search a step further and define the qualities or characteristics of a good according to the amount of information about these characteristics that can be conveyed at the point of purchase to the consumer. "Search [characteristics] are those that can be ascertained in the search process prior to purchase ...[,] experience [characteristics] are those that can be discovered only after purchase as the product is used [and c]redence [characteristics] are those which... cannot be evaluated in normal use. Instead the assessment of their value requires additional costly information" (1973, p67).

Search characteristics, as defined by Darby and Karni (1973), incur no additional costs. For example, in the case of fresh fruit and vegetables, search characteristics might be size, colour and external blemishes. These characteristics are known at the point of purchase, which implies that all information is available at the point of purchase, and can be assessed by the consumer.

Goods containing experience characteristics such as flavour, freshness or internal blemishes in fresh fruit and vegetables, must be consumed for the characteristic to be known. According to Darby and Karni (1973) it costs no more to evaluate these characteristics once the good has been purchased. However, there is a potential loss of consumer welfare if the good does not contain the collection of characteristics the consumer thought he or she was buying.

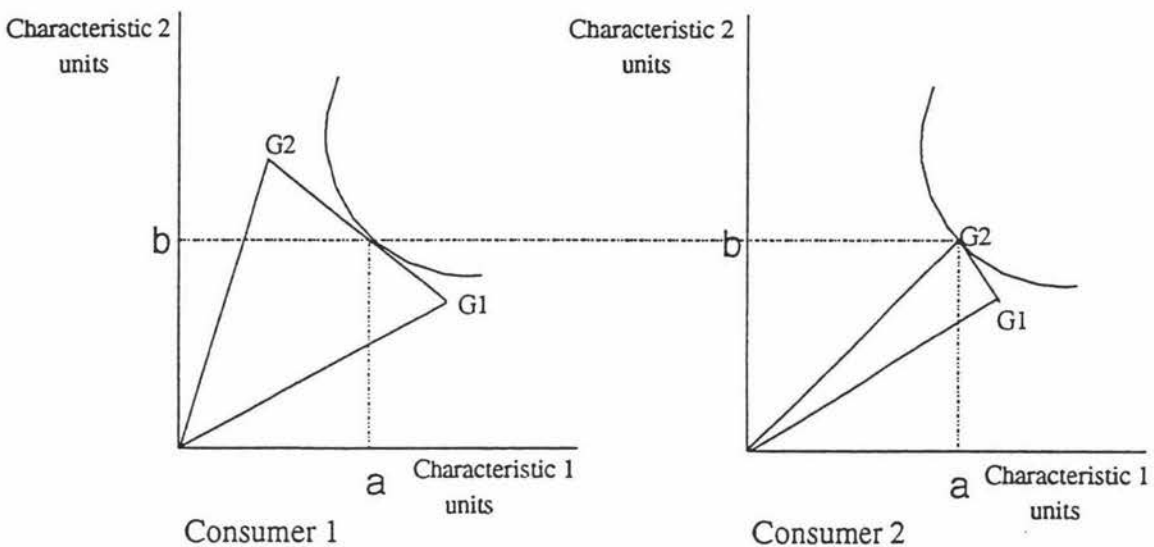
An example of a credence characteristic might be the level of agricultural residues or natural toxins, to evaluate which might require say laboratory tests and so will entail further costs post-purchase if the consumer wishes to know about these characteristics. There is again a potential loss of consumer welfare if the good does not contain the characteristics the consumer thought it did.

All characteristics could essentially be 'converted' to search characteristics if information or the technology for measurement is made available at the point of purchase. A decrease in the cost of information gathering, that is a decrease in the costs of search, would effectively lower the price of the good if the information is desired by the consumer.

Any measure of what consumers think about which characteristics are present and their quantities in the good, is compromised if they cannot easily measure the characteristics themselves and at any one point in time the consumer has a given state of information, to update which has a cost. A consumer's current knowledge or perception of the characteristic of a good may be a more valid explanatory variable of consumer behaviour than the actual measure of the characteristic. This is also proposed by Earl (1995).

Consider the possibility that the vectors in Figure 3.3 instead represent the consumer's subjective evaluation of the presence and quantity of the characteristics. Although there is some actual vector of the characteristics in a good, the consumer has a subjective evaluation of these characteristics in the good which is dependent upon, among other factors, their level of information. This evaluation may differ between consumers or for the same consumer at different points in time. The implication of this assumption is that, if two consumers want to buy the same quantities of a characteristic, and if the subjective beliefs of the consumers about these characteristics are different, the consumers will purchase different quantities of goods to obtain what they believe is the same quantity of characteristics (Figure 3.4).

Figure 3. 4 Consumers' subjective beliefs differ

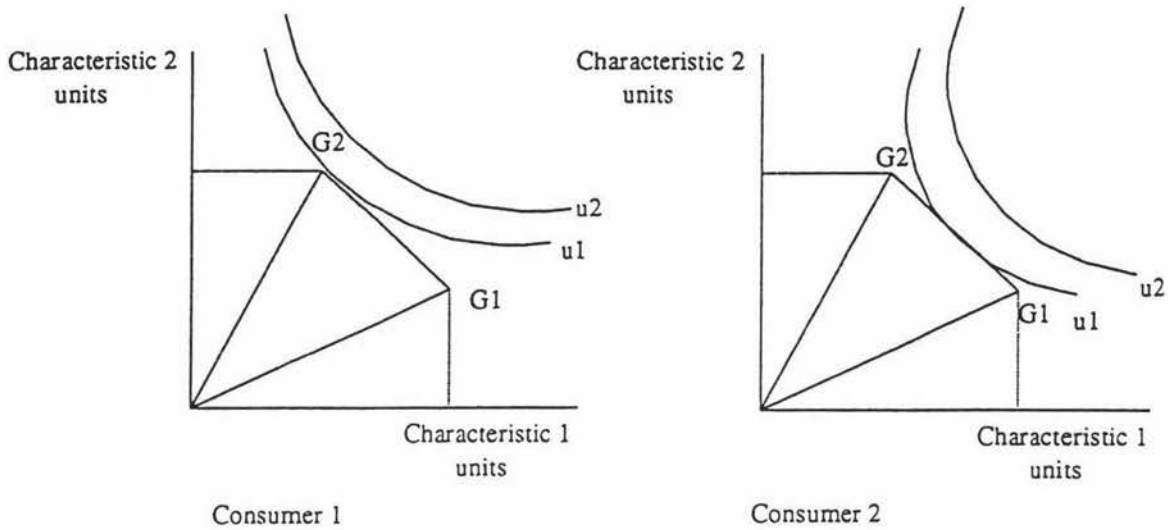


Consumer 1 will buy a mix of goods 1 and 2, while consumer 2 will buy only good 2 yet both consumers think they are buying the same quantity of the two characteristics.

The usual assumptions about preferences hold however. For example, if both consumers have the same subjective beliefs, that is they believe the two goods represent a certain amount of each of the two characteristics and they would agree on the amounts, but they have differing preferences for the characteristics, then the differences in the quantities of the goods purchased to obtain the characteristics reflects this (see Figure 3.5).

In this situation, consumer 1 will buy only good 2, while consumer 2 will buy a mix of the goods to produce the desired mix of characteristics which will maximise his or her utility.

Figure 3. 5 Differing consumer preferences



Thus, in the previous representation of the price of a good as a linear sum of the values of its characteristics,

$$P_g = \pi_0 + \pi_1 c_1 + \pi_2 c_2 + \dots + \pi_n c_n$$

the assumption that these characteristics are known objectively by all consumers is challenged. It is proposed that $c_{1..n}$ represent the consumer's perceptions or subjective evaluations of the characteristics in the good.

It would seem reasonable to assume that the consumer must make a subjective evaluation of the characteristic based on all information available, which may include immediate sensory assessment, previous experience, what she or he knows about possible government regulation of levels of the characteristic, media information, and point of sale information. This subjective evaluation may be more or less close to the objective reality of each characteristic's presence and the quantity of the characteristic.

3.2 Empirical analyses of consumer concerns

Measures of consumer perceptions, attitudes and concerns are not readily available in secondary economic data, the usual components of which are prices, quantities and income.

Van Ravenswaay and Hoehn (1991) used market data to estimate a demand curve for apples which approximates a change in consumer perception regarding one characteristic of apples by a change in an information measure.

This model is applied to the demand for apples at the time of the daminozide (tradename Alar) controversy. Daminozide is a growth regulator that some toxicity studies have shown to cause cancer in laboratory rats and mice at high doses. In 1984 the United States Environmental Protection Agency re-evaluated the risk posed by daminozide and in 1985 recommended a ban on the use of daminozide to its Scientific Advisory Panel.

Van Ravenswaay and Hoehn hypothesize that a shift in demand for apples at the time of the Alar controversy was due to a change in the perception of product safety (one characteristic of the good) brought about by information on the risks posed by daminozide. They assume that perceived safety is the only characteristic of the product which changed at this time. This information, for the purpose of the analysis, was assumed to be obtained without cost by the consumer.

The demand function is as follows:

$$q_a = q_a(p, x_{as}, y)$$

where q_a is the quantity of apples, p is a vector of prices, x_{as} is safety information about apples and y is income.

The information variable was measured in several ways. The initial model incorporated a dummy variable to indicate the change in consumer information which resulted from a CBS Sixty Minutes television programme. This programme focused on the Alar controversy and the release of a report by the Natural Resources Defense Council titled "Intolerable Risk: Pesticides in Our Children's Food" (van Ravenswaay and Hoehn, 1991). This variable was not however significant and subsequent models used an index of the number of articles per month in the New York Times (the relevant information source to the population considered in the study) which focused on the controversy.

These articles were used as a proxy for risk information for the consumer. A weighted index was developed which indicated each article's prominence in the newspaper but this did not provide any additional information and an unweighted measure was used. Different lag structures were formulated to test alternative hypotheses about the effect over time of such information on consumer behaviour, as estimated through the demand curve.

The demand curve derived was used to produce estimates of willingness to pay for risk reduction and to calculate a risk perception measure. Dividing willingness to pay to avoid daminozide by the perceived amount of risk would yield the marginal willingness to pay for risk reduction, however the perception of such risk was not known for this study. To obtain the measure, van Ravenswaay and Hoehn assume that consumers thought the risks were as reported by the media.

As an alternative to using secondary data, primary data can be collected through survey methods to obtain direct measure of consumers' perceptions and attitudes.

Huang (1993) conducted a mail survey to obtain consumers' risk perceptions (RP), attitudes towards regulatory actions concerning pesticide use (ATTI) and willingness to pay a premium for residue free produce (WTP). He used these measures as dependent variables in a simultaneous equation model where,

$$RP = f(ATTI, USPEST, KNOW, DEMOGRAPHICS, EMPLOYED, EDUC)$$

$$ATTI = g(RP, WTP, DEMOGRAPHICS, EDUC)$$

$$WTP = h(RP, ATTI, TEST, DEMOGRAPHICS, INCOME)$$

RP and *ATTI* are both binomial variables and *WTP* is a discrete ordinal variable which ranges from 0% to more than 20% with 5% increments.

TEST indicates whether testing or certifying fresh produce for pesticide residues is considered an important means to ensure food safety

USPEST measures personal use of pesticides in the home

KNOW measures awareness of potential produce contamination due to chemical drift

EDUC represents the years of schooling obtained

INCOME is total household income

EMPLOYED is a binary variable indicating whether the respondent is employed or not

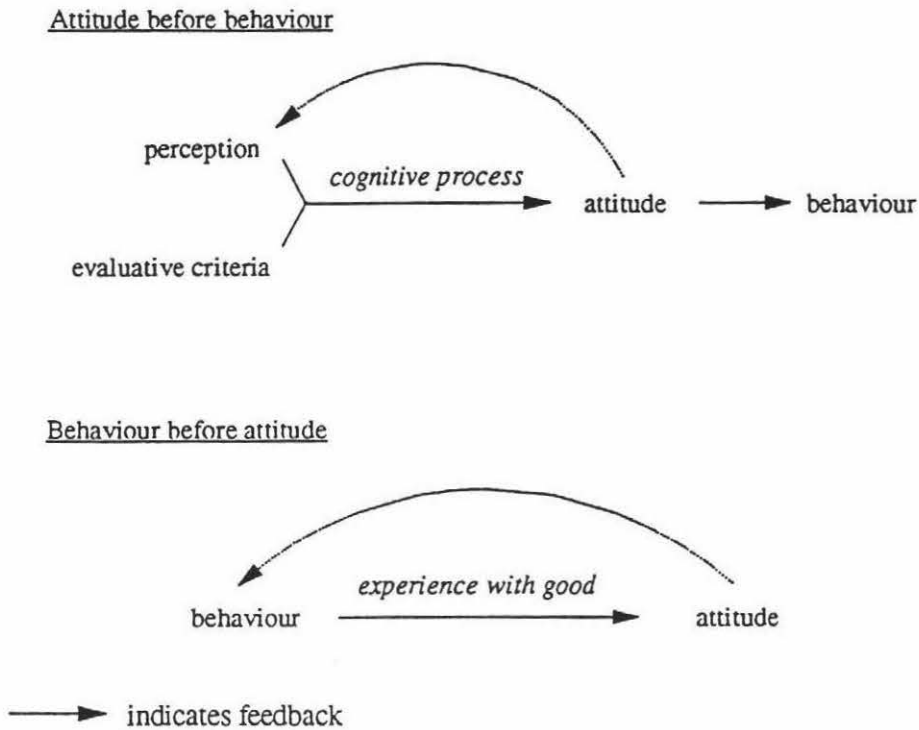
DEMOGRAPHICS is the group of demographic variables common to all three analyses: sex (*FEMALE*), age (*AGE 35-50*), ethnicity (*BLACK*), marital status and presence of children in household (*HSTATUS*), whether the respondent resides in a city (*CITY*), and whether the respondent owns their home (*RENTER*), are binary variables, and *HSIZE* is the number of people in the household.

Huang uses this model to test the hypothesis (Figure 3.6) that of two potential behavioural modes, attitude before behaviour and behaviour before attitude, the second is most likely for products which do not require high consumer involvement in the decision.

Products which do not require a high level of consumer involvement are those which are bought frequently and are a small proportion of the consumer's total budget. Attitudes are formed primarily from the consumer's experience of the good, although personal and social influences will also affect that experience. Where products require a high level of consumer involvement, attitudes will be formed first from information and other influences, such as a person's individual and social influences and then the decision to purchase or not purchase the good will be made. The subsequent experience of the good will feed back into the consumer's attitude.

If the behaviour before attitude paradigm holds, Huang considers that the statistics used to evaluate simultaneity of the relationships will hold, and for this analysis he finds that they do.

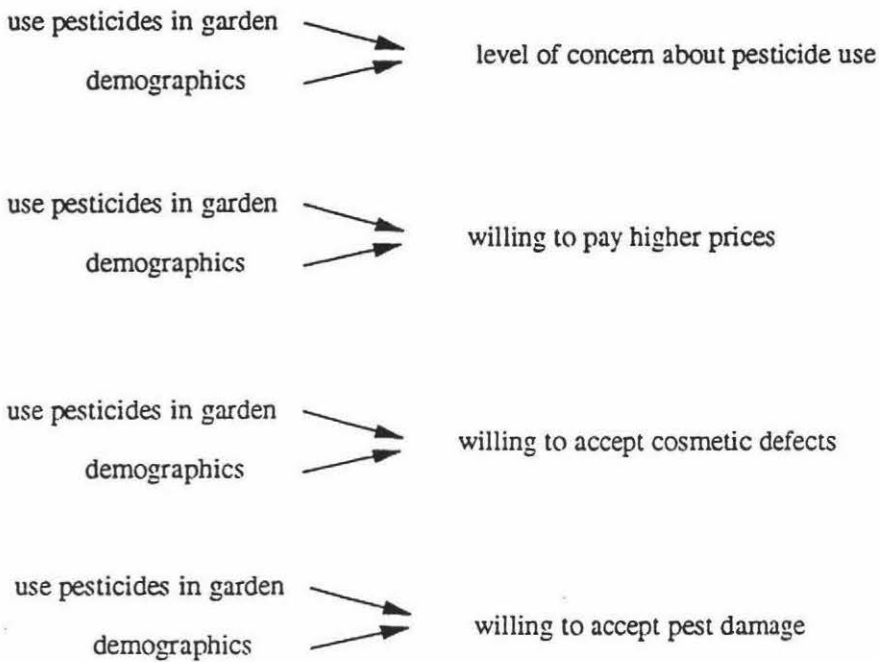
Figure 3. 6 The potential behavioural modes tested by Huang (1993)



The structure of the model by Huang raises the issue of whether attitudes or perceptions should be modeled with demographic variables as causal variables in the same equation. It is likely that these variables are highly correlated and therefore seek to explain a large proportion of the same variance in the dependent variable.

Ott (1990) models attitude as a function of demographics and a variable which indicates the respondent uses pesticides themselves. This model assumes the paradigm of attitude before behaviour, because Ott assumes that attitude can be used to explain self-reported hypothetical behaviour such as willingness to pay a premium for certified pesticide residue free produce. Ott carried out a face to face survey of shoppers which asked respondents about their attitudes toward pesticide use on fresh produce, their willingness to pay higher prices for certified pest residue free (CPRF) fresh produce, and whether they would accept lower cosmetic quality or insect damage for CPRF fresh produce. These four variables were considered dependent variables and the effects of demographic variables on these variables were analysed using contingency table tests (Figure 3.7). Using contingency table tests between each of the demographic variables and the dependent variable means any interrelationships between the demographics are not removed from the relationship between the particular demographic variable and the dependent variable.

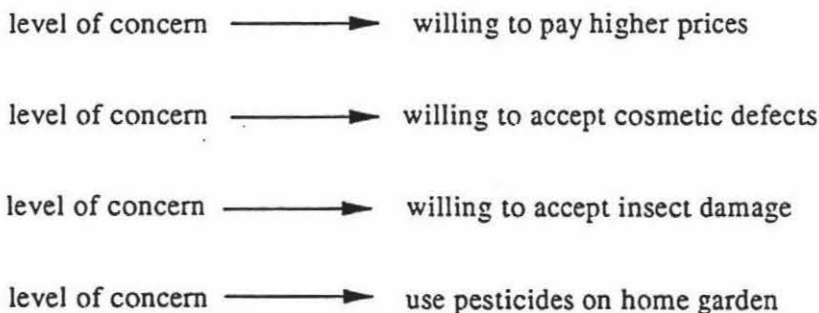
Figure 3. 7 Relationships tested between variables



where the demographic variables are sex, race, education and income and a dichotomous variable was used to indicate if the respondent was a home gardener and used pesticides in the home garden

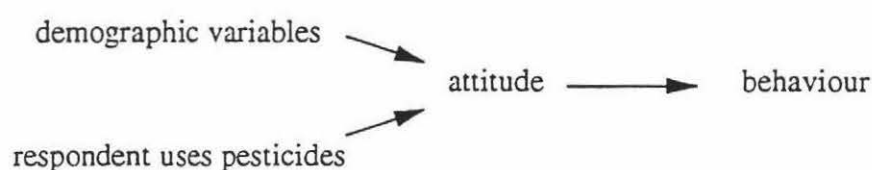
A further set of relationships was tested in Ott's study (see Figure 3.8), the effect of the respondents' level of concern on their willingness to pay, willingness to accept lower cosmetic quality and willingness to accept insect damage. Respondents were divided into two groups, "concerned" and "unconcerned" according to whether they favoured banning all or some agrichemicals (Ott used the term pesticides) or whether they believed agrichemicals could be used safely. The willingness of the concerned shoppers to pay more was significantly higher than that of the unconcerned shoppers.

Figure 3. 8 Relationships tested between the dependent variables in Ott's analysis



It would be possible then to use Ott's information to formulate a model in which attitude is a function of demographic and other indicators such as whether the respondent uses pesticides and in turn model behaviour as a function of attitude (Figure 3.9). While, as Huang has pointed out, purchases with low consumer involvement may involve behaviour before attitude, it seems likely that any attitudes already present prior to purchase will also affect the consumer's decision and, essentially, this is the paradigm that Ott's model assumes.

Figure 3.9 A possible model using variables in Ott's analysis



3.3 The research question

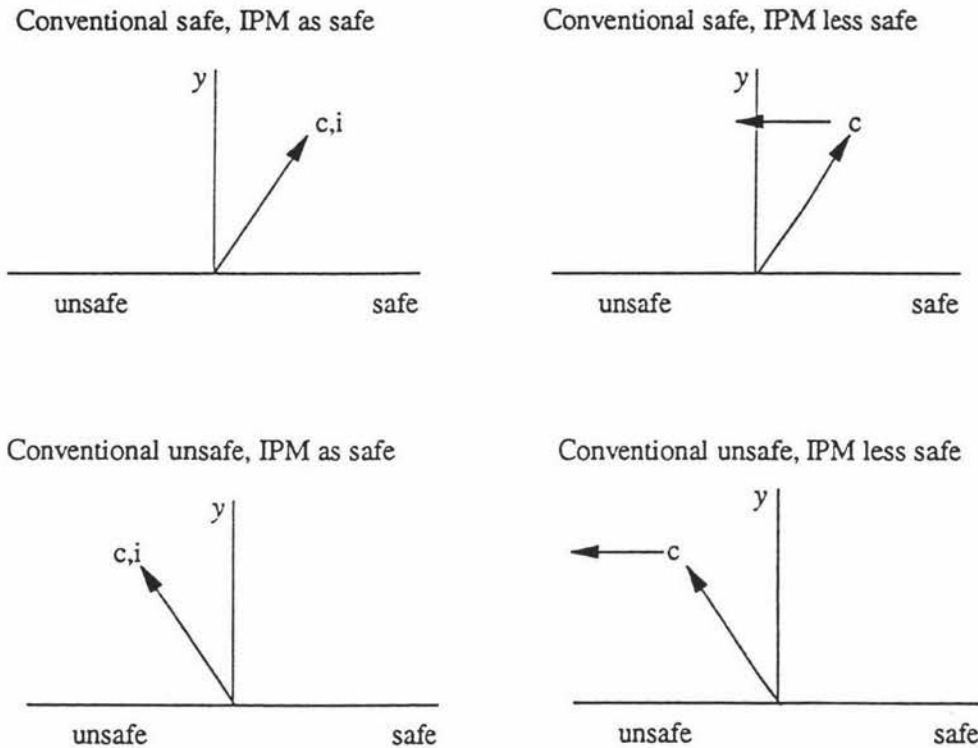
For the purpose of this analysis, it is assumed that the overall attitude or perception of a good is the sum of the attitudes or perceptions of its characteristics. Perception or overall attitude is composed of two components, a belief and an attitude, summed over all characteristics. A consumer's perception of a characteristic is their subjective evaluation of that characteristic's presence. If only one characteristic is varied then any change in consumer behaviour relative to the good with the changed characteristic must be attributable to the changed characteristic.

Consumers in this study were asked about their level of concern about the possible presence of agrichemicals of the fresh fruit and vegetables they eat. They were also given information on integrated pest management and asked to consider that fresh fruit and vegetables (or produce) grown using integrated pest management would be of exactly the same quality as conventional produce apart from the way it was grown. They were then asked to indicate whether they agreed or disagreed with two statements about the safety of fresh fruit and vegetables: "Fresh fruit and vegetables grown using integrated pest management will be less safe than conventional produce" and "Current conventional fresh fruit and vegetable supplies are safe".

This means, in terms of a Lancaster diagram, that all other characteristics are held constant (the y-axis in Figure 3.10) while the safety characteristic is allowed to vary, and the vector always has the same y co-ordinate. However rather than a safety being a continuous variable along the x-axis, respondents were only asked whether they agreed or disagreed that conventional fresh produce was safe.

Consumers either agreed or disagreed¹ that conventional produce was safe, therefore conventional produce is allowed to take the values safe or unsafe and there are only two values and two vector positions. Respondent values for integrated pest management produce were then set in relation to their values for conventional produce. IPM fresh produce is either less safe (if the respondent agrees with the statement) or as safe (if the respondent disagrees with the statement), see Figure 3.10.

Figure 3. 10 Respondent values for IPM produce in relation to conventional produce



where c represents conventional produce and i represents integrated pest management produce

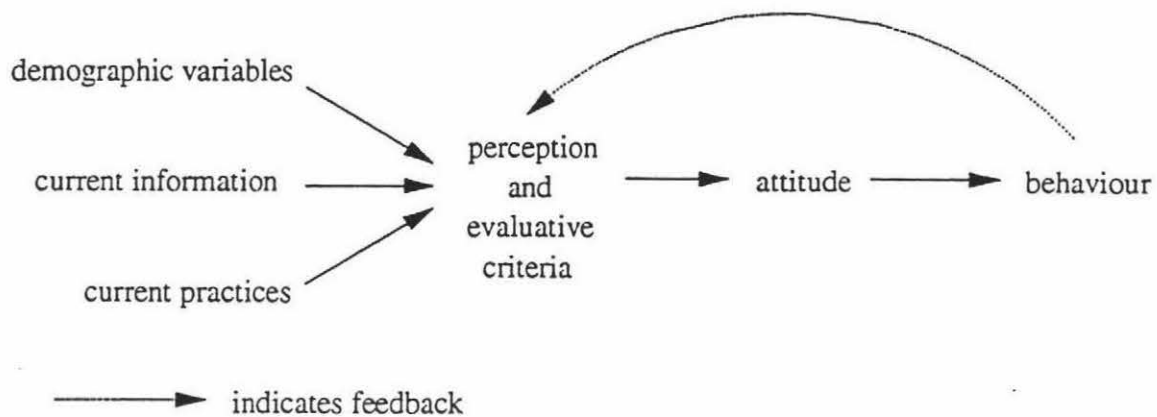
The respondent's level of concern and their beliefs regarding the safety of the two types of fresh produce are used as explanatory variables for the consumers hypothetical indication that they would consider buying fresh produce grown using integrated pest management. Consumers can be grouped by their attitudes and beliefs and these groups of consumers can be characterised by their demographic profile, their responses to several information questions and their response to a question about chemical use around the outside of the home (Figure 3.11).

This model assumes that, although fresh produce is likely to be a frequently purchased good and is only likely to be a small proportion of the consumer's total expenditure, the consumer's demographic profile, their responses to information questions and a question about chemical use around the outside

¹ Respondents could indicate that they neither agreed nor disagreed with each statement and these responses were tested to see whether these respondents were a group on their own or more closely identified with either the agree or disagree categories. This is dealt with in detail in Chapter 7.

of the home will affect their decision to consider buying a new product. Information search and evaluation may not be as extensive as for consumer durables, but current attitudes and beliefs will affect the initial purchase decision. Once the new product has been experienced, this experience will feed back into attitude. It is not possible to test this in the study however.

Figure 3. 11 The model to be tested



CHAPTER FOUR

DATA MEASUREMENT

4.1 Measurement

The model to be tested in this analysis requires the elicitation of consumer evaluative attitudes and beliefs about the use of agrichemicals on fresh fruit and vegetables.

The theoretical model was developed in Chapter Three. This model uses a measure of attitude which is the construct (or abstract concept) central to Fishbein and Ajzen's theory of reasoned action. In order for a construct to be empirically useful, a variable, or operational definition, must be developed for the construct (Judd et al, 1991).

Constructs can always be measured or operationalised in one of a number of ways. Judd et al (1991, p42) use the example of power which "could be represented as the amount of influence a person has at work, at home, in the neighbourhood or in the mass media".

Ott (1990) illustrates this point. He measured consumer concern by asking respondents to select one of four statements which would represent their level of concern about pesticide use (Figure 4.1). Ott used this presentation rather than a direct question, such as "How concerned are you about pesticide use...?" because "using statements about pesticide use as opposed to one word to describe respondents' attitudes may result in a more moderate measure of concern" (1990, p597).

Figure 4. 1 Statements of concern used by Ott

-
1. All pesticides should be banned.
 2. Some pesticides should be banned with greater restrictions on remaining pesticides.
 3. Pesticides can be used safely, but there should be greater testing.
 4. Current pesticides are safe and consumer fears are unwarranted.
-

Ott defined a response to statements 1 or 2 as indicating that the respondent was concerned and a response to statement 3 or 4 as indicating that the respondent was unconcerned.

Fishbein and Ajzen (1975, p53) define attitude as “a person’s location on a dimension of affect or evaluation” and belief as “a person’s location on a probability dimension” and indicate that these variables can be measured using one of several scale measures such as the Thurstone, Likert or Guttman scales (Fishbein and Ajzen (1975), Anderson et al (in Anderson et al (eds.),1983), and Judd et al (1991).

It must be made clear that in Fishbein and Ajzen’s theory of reasoned action, *overall attitude towards*, in this analysis, *a good*, is used to predict or explain the behavioural intention (to buy or not buy that good) and this variable is the sum of the respondents’ *evaluative attitudes towards the characteristics* of the good multiplied by the beliefs about the characteristics of the good. The unfortunate use of the term *attitude* in two parts of the model can lead to the apparent tautology that the sum of (attitudes multiplied by beliefs) equals attitude.

Evaluative attitudes and beliefs can be measured as single scale items, that is, a respondent is only asked one question or statement about the item and then asked to indicate a response on the scale given for that question or statement. In this analysis, the evaluative attitude towards a single characteristic has been measured by a single item scale, the respondents’ level of concern about agrichemical use on the fresh fruit and vegetables they eat. A single scale item such as this is the simplest measure of attitude. Anderson et al (in Anderson et al (eds.), 1983, p247-48) comment that “for some types of measurement... single item measures are adequate... However...[f]or variables such as attitudes, beliefs... and so on, a single item measuring device is a risky venture”.

This points out a flaw in this analysis. The evaluative attitude measure uses only a single item to locate respondents in terms of their evaluative attitude about the use of agrichemicals on fresh fruit and vegetables. Similarly the belief measure only uses a two item scale to locate respondents in terms of their beliefs about the relationship of the safety of fresh fruit and vegetables to agrichemical use on the same. Even though the purpose of the analysis is to elicit the overall attitude related to only one characteristic, multiple measures of the evaluative attitude toward and belief about the object, in this case, IPM fresh produce, would improve the reliability and validity of the measure. In fact reliability cannot be measured for a single item scale.

However many questions are asked about the object for which attitude is to be measured, there are formats with detailed theoretical bases, such as the Likert scale and others, mentioned

previously, which can be used. These are all described, with application to the Fishbein and Ajzen model, in Fishbein and Ajzen (1975).

For the purpose of this analysis a respondent was asked to indicate his or her level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables he or she eats on a uni-polar, single-item scale (Figure 4.2).

Figure 4. 2 Attitude question (*level of concern*)

How would you personally rate your level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables you eat? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Not at all concerned	.....	1
Moderately concerned	.....	2
Quite concerned	.....	3
Very concerned	.....	4

This format most closely resembles a semantic differential scale as presented in Judd et al (1991, p167) and the question is re-written to illustrate this (Figure 4.3).

Figure 4. 3 Semantic differential question (*level of concern*)

How I feel about the possible presence of agrichemicals use the fresh fruit and vegetables I eat.

concerned	1	2	3	4	5	6	7	unconcerned
-----------	---	---	---	---	---	---	---	-------------

The respondent is required to indicate where along the scale he or she is located.

A Likert scale was used to ask the respondent about his or her beliefs regarding the safety of fresh fruit and vegetables grown using integrated pest management and conventional fresh produce (Figure 4.4). The food safety issue, with regard to agrichemical use, was not specifically indicated in the question because the respondent was given information about integrated pest management prior to the question asked and the difference in terms of management using agrichemicals was highlighted in this information (also Figure 4.4).

Figure 4. 4 Information on integrated pest management used in the survey

INTEGRATED PEST MANAGEMENT					
<p>Integrated pest management (IPM) is a management process used to grow fresh fruit and vegetables. Growers use various monitoring methods to determine the number of pests in the area where the produce is grown and also take into account weather conditions which affect pest numbers. Agrichemical sprays are not used until pest numbers reach a preset threshold level. Growers also encourage the natural predators of the pests that attack their produce by careful selection and timing of spray applications.</p>					
<p>Use of an integrated pest management programme means the number of spray applications MAY be reduced compared with a conventional (non-IPM, non-organic) programme which uses a programme of sprays on a regular basis to prevent the build up of pests.</p>					
<p>The IPM programme produces fresh fruit and vegetables which are of the same quality and size as those produced using a conventional spray programme.</p>					
<p>Fresh fruit and vegetables grown using integrated pest management are NOT the same as organic fresh fruit and vegetables which are grown without the use of conventional agrichemicals.</p>					

Given the information above [*about fresh produce grown using integrated pest management*] please indicate the extent to which each of the following statements describes your opinion by **CIRCLING THE NUMBER OF YOUR RESPONSE TO EACH STATEMENT.**

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
a) Fresh fruit and vegetables grown using integrated pest management will be LESS SAFE than conventional produce (<i>belief 1</i>)	1	2	3	4	5
b) Current conventional fresh fruit and vegetable supplies are safe (<i>belief 2</i>)	1	2	3	4	5

Fishbein and Ajzen (1975) suggest that any measure of belief should not only indicate that the characteristic is or is not linked with the item but also measure the belief strength by, for example, a probability scale. The structure of the belief question asked in the survey allows a strength measure on a bi-polar measure. The probability strength, for the question "Fresh fruit and vegetables grown using integrated pest management will be LESS SAFE than conventional produce", is, for respondents indicating 1 (strongly agree) a 'very probable' association, for respondents indicating 2 (agree) a 'probable' association, and for respondents indicating 3 through 5

Where a question format such as the semantic differential is used (Figure 4.5), any value along the scale has a can only take the values of 1 or 0 for the probability strength and does not meet the criterion for the belief measure suggested by Fishbein and Ajzen (1975) above.

Figure 4.5 Semantic differential question (level of concern)

I believe that fresh fruit and vegetables grown using integrated pest management are									
safe	1	2	3	4	5	6	7	unsafe	
I believe that current conventional fresh fruit and vegetable supplies are									
safe	1	2	3	4	5	6	7	unsafe	

4.2 Reliability and validity

The reliability of a measure is the degree to which it is free from random error (Judd et al, 1991). Reliability can be measured by re-testing subjects, however this can be costly and is often not feasible. Moreover, familiarity with survey instruments can introduce a bias to respondents' answers and subsequent tests need to be carefully designed and evaluated.

An alternative measure of reliability is internal consistency. But this can only be measured on multi-scale (two or more) items and indicates the consistency between answers on what should be related aspects or dimensions of an object. Cronbach's α is a commonly used measure of internal consistency. The formula is

$$\alpha = \frac{(k) \text{cov/ var}}{1 + (k - 1) \text{cov/ var}}$$

where k is the number of items in the scale, cov is the average covariance between items and var is the average variance of the items (Marija J. Norusis/SPSS Inc., 1990, pB-191).

If the items' variance is standardised, the formula is

$$\alpha = \frac{kr}{1 + (k - 1)r}$$

where r is the average correlation between items, and α can be seen to be dependent on both k and r such that if k increases but r remains static Cronbach's α will increase.

Cronbach's α can take values between 0 and 1. Negative values occur when items are not positively correlated among themselves and the reliability model is violated (Marija J. Norusis/SPSS Inc., 1990).

For this study $cov = .1139$, $var = .8076$, $r = .1412$, and $k = 2$. Therefore, according to the first formula, α is .2472, and according to the second formula α is .2475. The SPSS/PC+™ statistical package reports these as *alpha* and *standardized item alpha* respectively. Taking the *standardized item alpha*, if k increased to 4 with no increase in r then the standardized item alpha increases from .2475 to .3967, illustrating the inflation in the measure that occurs with increasing k . The magnitude of the measure for the *belief1* and *belief2* variables shows that there is some reliability but not a great deal.

Validity refers to the match between the construct the researchers wishes to measure and that which she or he actually measured. Validity is assessed by one or more methods which investigate the extent to which other measures of the same construct corroborate the findings (convergent validity) and measures of different constructs do not (discriminant validity) (Judd et al, 1991). Many of the methods suggested by Judd et al (1991, p54) are complex and may involve third parties, such as face validity which "is evaluated by a group of judges, sometimes experts, who read or look at a measuring technique and whether in their opinion it measures what its name suggests".

The draft survey was assessed for question content and layout by two people who were not involved in the research, the first, a marketing researcher in the Department of Marketing at Massey University, Dr Mike Brennan, and the second, an orchard manager, Mr Shane Max, who

had trialed the use of integrated pest management. In addition, a group of ten people were asked for their feedback on the layout, design and ease of understanding of the survey. These people were non-experts, selected from a toastmasters group the researcher attends. One particular recommendation by Mr Max, the orchard manager, was that the term 'agrichemical' be used rather than 'pesticide' in the survey, as the term pesticide has negative connotations. Changes to question format recommended by the other parties were incorporated. Again, question 1 in the survey was not considered ambiguous and the same format had already been used by Dr Brennan, but in a face to face survey situation rather than a mail survey situation.

Convergent validity was tested in this survey by the use of an alternative measure of consumer concern about agrichemicals (Figure 4.6) and an alternative measure of consumer beliefs about agrichemical use (Figure 4.7). No suitable measures were included in the survey to test discriminant validity. The responses were summed over each question and the resulting variables correlated with the attitude and belief questions used in the analysis.

Figure 4. 6 Alternative measure of consumer concern about agrichemicals (*rank*)

How would you personally rate the health risk of eating fruit and vegetables grown with agrichemicals compared to eating food with saturated fat, sugar, salt or cholesterol? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE FOR EACH ITEM.

I believe that the health risk for eating food with...	much lower	somewhat lower	neither higher nor lower	somewhat higher	much higher
...saturated fat is...	1	2	3	4	5
...sugar is...	1	2	3	4	5
...salt is...	1	2	3	4	5
...cholesterol is..	1	2	3	4	5

...than eating fresh fruit and vegetables grown using agrichemicals.

Figure 4. 7 Alternative measure of consumer beliefs about agrichemicals (*use*)

Please indicate the extent to which you agree or disagree with the following statements about the use of agrichemicals on fresh fruit and vegetables. PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE FOR EACH STATEMENT.

Using agrichemicals...	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
a) ...improves the quality of fresh fruit and vegetables	1	2	3	4	5
b) ...reduces the price of fresh fruit and vegetables	1	2	3	4	5
c) ...increases the storage life of fresh fruit and vegetables	1	2	3	4	5
d) ...reduces natural poisons from pests and diseases	1	2	3	4	5

Convergent validity for the attitude variable, *level of concern* was tested with *rank*. A low score on *rank* would indicate that the respondent considered, overall, that the other food concerns presented a lower risk than agrichemicals on fresh produce, while a low value for *level of concern* indicates a low level of concern about the possible presence of agrichemical on fresh fruit and vegetables the respondent buys. An inverse relationship is expected and the correlation between the variables is negative. It is also significant but not particularly large, indicating perhaps that the concepts do not measure a great deal of the same underlying construct.

Correlation of *level of concern* (attitude) with *rank* -.2189 $p < .001$

The questions used to construct the *use* variable directly refer to conventional produce, and it would be expected that *belief2* would be correlated with *use*, because *belief2* asks whether the respondent agrees or disagrees that conventional fresh produce is safe. *Belief1*, on the other hand,

asks if the respondent agree or disagrees that IPM fresh produce is less safe than conventional. IPM fresh produce is not directly linked to the *use* concepts in the question asked.

A low score on use would indicate that respondents disagree with the statements made about the benefits of agrichemical use, while a low score on *belief2* indicates that the respondent agrees with the statement that "Current conventional fresh fruit and vegetable supplies are safe". An inverse relationship is expected and the correlation is negative. Again the correlation is significant but low.

Correlation of *use* with *belief2* -.2202 p<.001

The correlation of *belief1* with use is small and insignificant, and as discussed above, this was expected. There were no other suitable measures for testing convergent validity for *belief1*

Correlation of *use* with *belief1* .0176 p=.5

4.3 General issues in question design

Other general issues include whether to ask open-ended or closed-ended questions and how to set out the survey.

In general, closed-ended questions were used so that respondent answers would range over a given range of values. Categorising open-ended questions can lead to a large number of categories to incorporate the variety of responses. Yet constraining respondents to choose among researcher-specified categories may mean a loss of information if the categories do not include sufficient alternatives to cover the respondents' choices. Exploratory, or pilot surveys can be conducted to determine the range of values in areas of interest to the researcher. For example, in this research it would have been pertinent to conduct an initial survey asking respondents what characteristics come to mind when thinking about fresh fruit and vegetables, and asking them to weight or *rank* these characteristics. From here more specific questions would be developed to target the issues raised in the pilot survey. A pilot survey was conducted for this study but it was intended only to test the questionnaire design. Interestingly, in a random pilot survey of 50, with a response rate of 39, the first question (common to both surveys) was answered correctly by all 39

respondents, while of the 370 respondents in the final sample, only 257 or 69% answered the question in the format requested.

Where the information is easy for the consumer to furnish, an open-ended question may be preferable because it will obtain more information, for example, "Approximately how much does your household currently spend on fresh fruit and vegetables per week?"

Several open-ended questions were asked in this survey simply to find out the full range of respondents' opinions on an issue (Figure 4.8). In addition, for some of the closed-ended questions, an open-ended 'other' category was included.

Closed-ended questions were used for questions on demographic variables, as often respondents find it objectionable to be asked exactly how old they are, how educated they are, or what income they earn.

For the same reason, the layout of the survey was such that the demographic questions, which can seem personal, were at the end of the survey. An explanation was also given as to the purpose of collecting the demographic variables.

Figure 4. 8 Some open-ended questions in the survey

Are you concerned about agrichemical use on any specific kind of fresh fruit and vegetables?
PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Yes1
No2

IF YES PLEASE INDICATE WHICH KINDS IN THE SPACE BELOW.

Are you personally concerned about agrichemical use for any reason other than the possible presence of agrichemical residues on the fresh fruit and vegetables you eat?

Yes1
No2

IF YES, COULD YOU DESCRIBE YOUR REASONS BRIEFLY BELOW

Please could you indicate briefly why you would not buy and/or eat fresh fruit and vegetables grown using integrated pest management. PLEASE USE THE SPACE BELOW.

CHAPTER FIVE

DATA COLLECTION

5.1 Defining the population

The target population for the study consisted of all people in New Zealand over eighteen years of age. Eighteen was chosen as a lower age limit because it was expected that respondents eighteen and above were more likely to be making purchase decisions in some, if not all, aspects of their daily lives, including decisions about the purchase of food items.

To obtain the sample the 1992 electoral roll was used. Because the entire population of New Zealand was decided upon for the sample frame, a mail survey appeared to be the most expedient and cost-effective means of reaching the elements selected. One thousand surveys were sent and a response rate of 46 percent was obtained, excluding surveys returned as mis-addressed (15%). However, of the 391 completed surveys returned, only 370 were completed sufficiently and these constitute the sample used for the analyses in Chapter Six, taking the response rate down to 44%.

If the results are to be generalised to the New Zealand population, in theory every member of the New Zealand population over the age of eighteen had to have an equal chance of being selected in the sample. The most comprehensive list of people in New Zealand is the Census of Population and Dwellings, carried out every five years by the Department of Statistics. Respondents' names from the census are not, however, available to the general public. The next most comprehensive list, for people age 18 and above, is the electoral roll. The most recent electoral roll at the time of the survey (May 1993) was one collected in 1992 for the referendum on the New Zealand political structure, held on 19 September 1992. Fifty five percent of the electorate registered to vote in the referendum (1,217,284 people). By comparison 2,202,157 registered to vote in the 1990 general election, and 2,321,664 in the 1993 general election (Statistics New Zealand, 1994). Therefore, while the 1992 electoral roll was the most up to date list of potential respondents, it may not have been the most comprehensive when compared to the electoral rolls immediately before and after. Whether there are biases in the profile of those who registered for the 1992 electoral roll is not assessable from information available about the roll.

5.2 Sample size

Sudman (in Anderson et al (eds.), 1983) suggests two criteria or rules of thumb for deciding on sample size. How large sample sizes in similar studies are and choosing a sample size such that major categories of variables have approximately 100 cases and minor categories, a minimum of 20 cases. Certainly, where categorical data is used, cell frequencies can rapidly become very low as more variables are included in the analysis, decreasing the power of the research. In categorical models, Tabachnick and Fidell (1989, p240) recommend that all cell frequencies should be greater than one and no more than 20% should be less than five otherwise "power can be so drastically reduced with inadequately expected frequencies that the analysis is worthless".

Applying these 'rules' to this study, previous mail survey studies of similar topics include those by Ott et al (1991) and Preston et al (1991), and sample sizes for these were 580 and 2000, respectively. The principle categorical variables to be used as explanatory variables in a logistic regression had either four or five categories, for which, if a sample size of 1000 is chosen, a response rate of 50%, or 500 surveys, would give category frequencies of 125 to 100, respectively, assuming an equal distribution of respondents between categories.

One final consideration was the limitation of funds. In order to carry out a mail survey effectively, including a reminder letter and an incentive, 1000 surveys was the largest possible sample size. As this falls in between the sample sizes of two very similar studies, and satisfies the category frequencies for the major variables, a sample size of 1000 was therefore chosen.

5.3 Selecting respondents

Simple random samples are defined as samples in which every element of the defined population has an equal probability of selection and sampling is done in one stage, with elements selected independently of one another (Sudman; in Anderson et al (eds.), 1983).

To obtain a simple random sample from the electoral roll, each element would need to be numbered with a seven digit number ranging from 1 to 1,217,284. To select the sample a random number generator (such as a calculator) or a table of random numbers is used to generate seven digit numbers. Obviously this would cover numbers from 1 to 9,999,999. When a number

between 1 and 1,217,284 is generated, that element is selected and this process continues until the required number of elements is chosen (in this case, 1000),

The electoral roll is presented as a series of books, each of which covers an electorate. As the electoral roll was only available in this form, numbering each element would have involved photocopying the books and numbering each element by hand. This would have been unduly expensive and time consuming, so systematic sampling was used as an alternative.

To obtain a sample using systematic sampling, the number of pages in the entire electoral roll was obtained by summing the number of pages in each book. This number was divided by 1000 to ascertain how many x pages were to be turned before taking the name of the next respondent. A random number i was generated on the calculator and the i th name and address taken from every x page.

Systematic sampling appears to be a controversial technique. Sudman (in Anderson et al (eds.), 1983, p169) states that "systematic samples are really complex samples with unknown properties and... may be substantially different, sometimes better, sometimes worse, than simple random samples".

Judd et al (1991, p203) however believe that systematic sampling is a pitfall "that should be avoided". Although every element initially has an equal chance of selection, once the random start has been selected then selection decisions are no longer independent. For example, with a random start of six and a sampling interval of ten then "the sixteenth element must be chosen and the seventeenth cannot be".

Sudman (in Anderson et al (eds.), 1983) concurs with Judd et al (1991) on the point that when there are periodicities in the data to be sampled from, a systematically chosen sample may well be biased. However, Sudman concludes that, in the absence of such periodicities, "simple random samples and systematic samples will be about the same".

Judd et al (1991, p203) make one final comment that "[s]ince the correct procedure for drawing a simple random sample involves little additional effort..., it should be used in preference to systematic sampling". This conclusion certainly depends on how the data is presented, on a computer versus in print for example. As noted previously, for this study a systematic sample was far more easily obtained.

Systematic sampling was also used to obtain a sample of 50 people in the area covered by the Manawatu 1993 Telephone Directory, for the purpose of testing a pilot survey.

5.4 Carrying out the mail survey

A mail survey was chosen for this study as it was more cost-effective than either a telephone survey or face to face survey for the sample size chosen and geographical spread of respondents. Other advantages include allowing the respondent time to complete the survey at his or her convenience and to consult further information as necessary, and the elimination of interviewer bias (Brennan, 1992).

One major drawback of mail surveys has been the low response rate, although this is dismissed as a myth by Brennan (1992). Sudman (in Anderson et al (eds.), 1983) also comments that "biases in mail samples are towards respondents with more education and who are the most interested in the topic". The respondent profile drawn in Chapter Six indicates that respondents for this survey are actually likely to be only as educated, if not less educated, than the general population. The second bias, respondents are those who are most interested in the topic, may well be true, as many people made additional comments on issues and concerns about agrichemical use wherever possible.

In response to low response rates, whether imagined or actual, several techniques have been developed to improve response rates. Brennan (1992) investigated these and grouped them into three categories, effective techniques, ineffective techniques and possibly effective techniques, for improving the response rate to mail surveys. His findings under these categories, for surveys to the general public, are outlined in Table 5.1.

The survey for this study was mailed, with a covering letter, on 24 May 1993. The covering letter was personally addressed to the respondent (hand written) and each letter was signed by the researcher. The surveys were folded in half with the letter on top and placed in a plain white envelope, 24cm by 16.5cm. This envelope was also personally addressed to the respondent but using computer generated labels. The envelope was franked not stamped and did not have any logo indicating the research institution on it. This was because envelopes of this size were not available with the Massey University logo. A computer generated address label for the sender was placed on the back, top, left hand corner. A return envelope with a freepost number in the

top, right hand corner was included. This was smaller, 22.3cm by 11.3cm, and meant the respondent needed to fold the survey twice to get it in the envelope. However, a smaller envelope cut the cost of postage and, as the survey was being returned, presentation to the researcher was not important. This envelope had the Massey logo on the top, left hand, corner.

An incentive was given to complete the survey, the chance of winning an Ansett Mystery Weekend for two. The letter specified there were 2000 surveys sent nationwide. This was because there were two independent studies done in the same department at this time, which allowed the cost of the incentive to be spread between the two. The cover letter specified a date for the survey to be returned by, in order to be eligible for the draw. While confidentiality was specifically stated, the respondent needed to fill in a slip on the back of the questionnaire to enter the contest. This was actually outlined with a dotted line to indicate it would be removed from the survey and in fact only one of the 391 respondents commented on this as a breach of confidentiality and did not complete it. This does not indicate, however, whether or not there were any non-responses due to the anomaly the slip appeared to present in terms of confidentiality. Questionnaires were identified with a code number in order to be able to send out a reminder letter but of course this might also have been unacceptable to some potential respondents.

The reminder letter was mailed two weeks after the initial mailing and the cut-off date was 16 days after that. Only one reminder was sent. The envelope for the reminder letter was 22.3cm by 11.3cm with the Massey logo in the top left hand corner on the front. The reminder did not contain a second survey. The same personalised computer labels were used for the respondent's name and a sender's name and address. The reminder letter inside was not personally addressed to the respondent and the researcher's signature was photocopied.

Some of Brennan's (1992) findings (presented in Table 5.1) are particularly interesting. It has for example, long been common lore among researchers using survey instruments, that a more demanding survey, or a particularly long survey, is likely to turn respondents off, and thus decrease the response rate and yet Brennan's findings do not support this.

Of the effective and possibly effective techniques presented in Brennan's study, only two were not implemented for this study, 'enclosing a copy of the questionnaire with the reminder letter' and 'a covering letter is signed by a higher status, rather than lower status researcher'. The first exclusion illustrates the tradeoff that needed to be made between the sample size required to ensure adequate category frequencies and the cost of survey production and postage. While 1000

surveys was desirable to ensure adequate numbers of responses in major categories, producing a second survey and using the larger envelopes, which cost more to mail, exceeded the funds available. The second exclusion, only the graduate student signed the letter, arose from the fact that the supervisor was unavailable to answer queries at the time of the survey, and it was decided for congruency that the person who was able to answer the queries would list their name on the survey.

Table 5. 1 Evaluation of techniques developed to improve response rates to mail surveys

Effective techniques

using a personal rather than impersonal salutation²
 enclosing a copy of the questionnaire with the reminder letter
 offering an incentive (either a cash prize draw or a 50c in the mailing)

Ineffective techniques

whether the address is handwritten, typed or computer generated
 the envelope is white or brown, standard sized and white or A4 sized and manila
 the envelope is stamped or franked
 the covering letter is long or short
 the researcher's signature is typed or signed
 a summary of the results is offered or not
 the identification number on the questionnaire is explained or not
 the covering letter is on white or coloured paper
 the reminder is in the form of a letter or postcard
 a second reminder is accompanied by a questionnaire or not
 the tone of the second reminder is formal or informal
 the reply-paid envelope is stamped or franked
 a 20c incentive is used with the first or second mailout
 a \$1 incentive rather than a 50c incentive is used with the first mailout

Possibly effective techniques

address mail to a particular person rather than to "The Householder"²
 a covering letter is signed by a higher status, rather than lower status researcher
 a long questionnaire may be more effective, or at least as effective, as a short questionnaire
 people may be just as likely, or almost as likely, to respond to a demanding questionnaire as an easy questionnaire

Techniques not tested

use of at least two reminder letters
 use of a reply-paid return envelope

² These two techniques seem to test the same issue but no further detail is given by Brennan, 1992

CHAPTER SIX

DESCRIPTIVE RESULTS

6.1 Introduction

This chapter describes the treatment of missing values in the data, outlines the sample's demographic profile and compares this with the national demographic profile and summarises respondents' responses to the survey questions used in the analyses.

6.2 Treatment of missing values

There were initially 390 cases in the data set. Twenty of these had missing values on at least one of the five variables central to the analyses in Chapter Seven (questions 3, 14a, 14b, 16 and 17 in the survey, Appendix 1).

In order to provide consistency between the descriptive analyses in section 6.3 and the models presented in Chapter Seven, these 20 cases were dropped from the data set used for all sections. Before they were dropped however, t-tests comparing the means of each variable across the two groups were carried out to investigate whether there were any significant differences between the groups on any of the variables.

Three variables were significant at the 10% level, age (.056), children under 18 (.058) and whether respondents agreed or disagreed (or neither) with the statement "Current conventional fresh fruit and vegetable supplies are safe" (.031). The group of twenty respondents were older, more likely to have children older than 18 and only seven out of 20 of the respondents had answered the question on the safety of current, conventional fresh fruit and vegetables, although these people were more likely to agree with this statement.

As the age structure of the remaining 370 respondents also has a higher proportion of respondents in the older age groups, deleting the 20 respondents would not unduly distort the remaining sample on this variable. These 20 cases were therefore deleted.

While the 370 cases remaining in the analysis did not have any missing values on the five variables central to the analyses, they did have missing values on some of the remaining variables. These missing values were inspected case by case, and appeared to be distributed randomly. No one case had a large number of missing values. No one variable had a large number of missing values across cases, except that for Question 1, which 40% of the respondents did not complete according to the instructions. As the results for this question are only used for descriptive purposes, the number of missing values for this question does not present a problem.

In the descriptive analyses (section 6.3) missing values are simply indicated and excluded from calculations. In the discriminant analyses (Chapter Seven), which use demographic and information variables as discriminating variables, missing cases on these variables are replaced with the total sample means for the variables. As pointed out by Haslett (1996), using the total sample means to replace missing values diminishes the discriminating power of the explanatory variables used. However, to assign group means (means for the groups on the dependent variable), rather than the total sample means, would result in an upward bias in the discriminatory power of the variables used. Therefore total sample means are used.

6.3 Summary of survey responses

6.3.1 Sample Profile

A greater number of the respondents indicated they reside in a rural area than that of the general population (21% compared with 15%), the male to female ratio is the same for the sample as for the general population and the age distribution of the sample is slightly more dispersed, with a greater number of people in the younger and older categories than that of the general population. All ethnic groups except New Zealand Europeans, Europeans and Asians are under-represented. New Zealand Europeans and Europeans are over-represented, while the proportion of Asians in the survey sample is the same as the proportion in the general population (see Table 6.1).

Table 6. 1 Location, sex, ethnicity and age

Demographic characteristic	Category	Sample (%)	General population ³ (%)
Location	Urban	79	85
	Rural	21	15
Sex	Male	48	49
	Female	52	51
Ethnicity	NZ Maori	6	10
	NZ European	83	75
	Polynesian	1	4
	Asian	1	1
	European	8	5
	Other	1	5
Age	under 20	3.5	3.5 ⁴
	20 to 29	20	27
	30 to 39	24	24
	40 to 49	17	18
	50 to 59	16	14
	60 to 69	11	18
	70 or over	9	11

missing cases: location, 1; sex, 3; ethnicity, 1; age, 0.

The income categories used by Statistics New Zealand in their Household Expenditure and Income Survey differ slightly from those used for this survey, but are similar enough to provide for some comparison. The income figures in the 1991 Census of Population and Dwellings use the same categories as this survey but are for individuals rather than households and are thus not comparable. The household income distribution of the sample approximates that of the general population (see Table 6.2).

The 1991 Census of Population and Dwellings was again used to provide the education figures. Respondents for the census answered a question on what educational or job qualifications they had obtained since leaving school. This was compared with the results of the survey question "Which of the following best describes your highest level of education?".

³ 1991 Census of Population and Dwellings (Statistics New Zealand, 1992).

⁴ A proxy, using the figure from the sample, as no figure for the 18 to 19 age bracket is available.

Table 6. 2 Income

Demographic Characteristic	Categories used in survey	Sample (%)	Categories used by Statistics New Zealand	General population ⁵ (%)
Income	less than \$10000	4	less than \$12000	11
	\$10000 to \$19999	16	\$12000 to \$19999	19
	\$20000 to \$29999	18	\$20000 to \$31999	19
	\$30000 to \$39999	14	\$32000 to \$39999	11
	\$40000 to \$49999	13	\$40000 to \$47999	10
	\$50000 to \$59999	14	\$48000 to \$57999	10
	\$60000 to \$69999	8	\$58000 to \$75999	10
	more than \$69999	13	more than \$76000	10

missing cases: 8.

To enable comparison with the survey results, the categories for this question in the census were grouped into two categories 'no qualifications since leaving school' (60%) and 'a qualification since leaving school' (40%), which contained those who indicated one of the various qualifications listed. These two categories are compared with two categories formed from the survey. The first category is all respondents who indicate their level of education in one of the categories from 'primary school' through to 'some tertiary' (73%) and the second category is 'tertiary graduate (course completed)' (27%). These results would appear to indicate that the survey respondents are less educated than the general population. The results, in the format set out in the survey, are presented in Table 6.3.

Table 6. 3 Survey results for education

Demographic Characteristic	Categories used in survey	Sample (%)
Education ⁶	Primary	3
	High School up to 3 years	24
	High School 4 years or more	22
	Some tertiary	24
	Tertiary complete	27

missing cases: 2.

⁵ Household Expenditure and Income Survey 1992 (Statistics New Zealand, 1993).

⁶ 1991 Census of Population and Dwellings (Statistics New Zealand, 1992).

6.3.2 How do respondents rank food issues?

If a simple weighting is used and the numbers are simply added across categories (sum in Table 6.4), the respondents concur with scientific estimates which estimate that food poisoning from microorganisms presents the greatest health risk in our food supply. These respondents indicate that chemical food additives are their next greatest concern and that foods grown using agrichemicals are their third greatest food concern. Note however that only 60% of respondents completed the question as requested.

A ranking technique (following Ott et al, 1991) can be used to combine these concerns into a single measure in order to rank them. The concerns are weighted by 3, 2 and 1 from the greatest concern to the third greatest concern respectively. The percentage of respondents multiplied by the weighting and summed from the greatest concern to third greatest concern gives the ranking or overall score for the issue (Score is Table 6.4). This results in a switching of concerns to food poisoning, foods grown using agrichemicals and foods high in saturated fats, as greatest to third greatest concern respectively.

Table 6. 4 Respondent ranking of food issues

Major food concerns	Greatest concern # of respondents	Second Greatest Concern # of respondents	Third Greatest Concern # of respondents	Sum	Score
food poisoning (botulism, salmonella)	111	25	13	149	1.54
foods grown using agrichemicals	33	35	34	102	0.79
foods high in saturated fat	30	41	20	91	0.75
chemical food additives	20	41	45	106	0.73
chemical food preservatives	16	34	38	88	0.60
food prices too high	18	15	20	53	0.40
foods high in cholesterol	9	22	26	57	0.38
foods too low in nutritional value	5	21	28	54	0.33
foods high in salt	9	16	22	47	0.32
foods high in sugar	6	7	11	24	0.17

missing cases: greatest concern, second greatest concern and third greatest concern, 113.

Respondents were also asked to rate the health risk of eating fruit and vegetables grown with agrichemicals, compared with eating food with saturated fat, sugar, salt or cholesterol. The respondents' scores on these variables were added together to give an overall score of the health risk of these other components of foods. This score was correlated with the respondent's level of

concern to assess convergent validity for that measure (Chapter Four). This variable more closely resembles a belief variable than an attitude variable and may not be entirely suitable for assessing convergent validity with level of concern, which is considered a measure of attitude, but was the best available in the survey.

The responses to this question could also be combined to compare how respondents ranked these risks compared with the previous question about their concerns. Again following Ott et al (1991), the categories were given a value of -2, -1 0, 1 and 2 across the categories, from much lower through to much higher. These values were weighted by the percentage of respondents in each category and the issue given a score. Respondents consider that sugar presents less of a health risk than food grown using agrichemicals, but salt, saturated fat and cholesterol present higher risks. Saturated fat and cholesterol are considered to be higher health risks than fresh produce grown using agrichemicals, salt is neither higher nor lower and sugar is a lower health risk than fresh produce grown using agrichemicals (Table 6.5).

Table 6. 5 Respondents ranking of other health risks compared with eating fresh fruit and vegetables grown with agrichemicals

The health risk of eating foods with...	much lower (%)	somewhat lower (%)	neither higher nor lower (%)	somewhat higher (%)	much higher (%)	score (standard error)
saturated fat is..	6	16	22	38	18	0.46 (1.15)
sugar is..	15	26	32	22	5	-0.24 (1.11)
salt is..	11	19	30	30	10	0.09 (1.16)
cholesterol is..	8	15	25	34	18	0.39 (1.18)

than eating fresh fruit and vegetables grown using agrichemicals.

Missing cases: saturated fat, 6; sugar, 8; salt, 9; cholesterol, 8.

6.3.3 Respondents' level of concern about agrichemical use

Respondents were asked how they personally would rate their level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables they eat. Seven percent said they were not at all concerned, 41% said they were moderately concerned, 31% that they were quite concerned and 21% that they were very concerned. The responses to this question provide one of the three independent variables in the logistic regressions in Chapter Seven.

Respondents were then asked if they were personally concerned about agrichemical use for any reason other than the possible presence of agrichemical residues on the fresh fruit and vegetables they ate. This was an open ended question. Fifty-four percent indicated 'yes' and their responses were grouped into several categories. The most frequent reason for concern was that of long lasting effects on the environment and the next most frequent concern that of the effects on the food chain and other beneficial species (Table 6.6).

Table 6. 6 Concerns other than food safety

Concerned about...	(%)
the effects on people who work with agrichemicals	9
long lasting effects on the environment	26
agrichemical contamination of groundwater	8
spraydrift	8
food chain effects, effects on other beneficial species	15
effects on long term health of people in general	12
effects on the health of children e.g. asthma, rashes	5
effects on the unborn child	4
overseas markets	13

missing cases: 0.

Respondents were also asked if they were concerned about agrichemical use on any specific kind of fresh fruit and vegetables. Forty seven percent indicated 'yes'. Apples were the fruit or vegetable that were most often indicated as a single, named fruit or vegetable. Respondents were most concerned about fruit and/or vegetables they did not wash or peel, and almost one third of these respondents indicated all fresh fruit and vegetables (Table 6.7).

Table 6. 7 Concerns about specific fruit and vegetables

Response	(%)
apples	5
one type of fruit or vegetable, other than apples	3
fruit that I do not always wash or peel	32
fruit, two or more varieties	11
vegetables, two or more varieties	5
mixed fruit and vegetables, less than five varieties	7
mixed fruit and vegetables, five or more varieties	7
all	30

missing cases: 0.

6.3.4 Respondents' beliefs about agrichemical use

Respondents were asked to indicate whether they agreed with several statements about the use of agrichemicals on fresh fruit and vegetables (see Table 6.8). The responses were summed over the four statements. The resulting variable was correlated with the belief statements about the relative safety of integrated pest management fresh produce compared with conventional fresh produce, and the safety of conventional fresh produce, to test convergent validity of these measures. The results were presented in Chapter Four.

Table 6. 8 Beliefs about the use of agrichemicals on fresh fruit and vegetables

Using agrichemicals...	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree	score (standard error)
	(%)	(%)	(%)	(%)	(%)	
improves the quality of fresh fruit and vegetables	23	26	18	29	4	-.336 (1.23)
reduces the price fresh of fruit and vegetables	15	30	30	20	5	-.304 (1.09)
increases the storage life of fresh fruit and vegetables	8	25	27	34	6	.038 (1.06)
reduces natural poisons from pests and diseases	12	23	28	32	5	-.054 (1.11)

missing cases: quality, 4; price, 2; storage life, 3; reduces poisons, 6.

These responses were tested using the same method as the health risks, that is, the categories were given a value of -2, -1 0, 1 and 2 across the categories, from strongly agree through to strongly disagree. These values were weighted by the percentage of respondents in each category and the issue given a score. This indicated whether, overall, respondents agreed or disagreed with the statement. Respondents disagreed with the first two statements but neither agreed nor disagreed with the second two.

Respondents were asked to indicate whether they agreed or disagreed with several statements about conventional and IPM fresh produce (see Table 6.9). This question provides the remaining two independent variables used in the logistic regression. A majority of respondents disagree that fresh fruit and vegetables grown using integrated pest management will be less safe, but respondents were only slightly more inclined to disagree than agree that current conventional fresh fruit and vegetables are safe.

Table 6. 9 Responses to statements about the safety of conventional and IPM fresh produce

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
	(%)	(%)	(%)	(%)	(%)
Fresh fruit and vegetables grown using integrated pest management will be less safe than conventional produce.	3	6	20	53	18
Current conventional fresh fruit and vegetable supplies are safe.	1	23	41	30	5

missing cases: 0.

6.3.5 Will respondents consider buying fresh produce grown using integrated pest management and how much will they pay?

The majority of respondents were willing to consider buying produce grown using integrated pest management (88%). Of the 327 respondents who were willing to consider buying such produce, 46.1% were not willing to pay more for it, 48% were willing to pay up to 20% more, 5% were willing to pay up to 40% more and 1% were willing to pay up to 60% more. The responses to these two questions provide the dependent variables used in the two logistic regression models presented in sections 6.4 and 6.6.

Respondents were also asked to indicate why they would not buy fresh fruit and vegetables grown using integrated pest management. It was intended that only those respondents who would not consider buying fresh produce grown using IPM would answer the question. However, the survey did not make this clear enough, as 139 of the 327 respondents who were willing to consider buying IPM fresh produce also volunteered an opinion as to why they would not.

The most frequent reason not to purchase such produce, for those who would consider buying it in the first instance, was "if it cost more". This is the same as if the respondent had answered no to the question about paying more for IPM produce. More interestingly, disregarding the cost issue, even though these respondents would consider buying IPM fresh produce they were most concerned about the lack of information and certainty about what they are getting, and the fact that there is no guarantee that residues will be reduced or non-existent. Their next reason would be that they would prefer organic to IPM and IPM to conventional fresh produce. For respondents who answered that they would not consider buying IPM fresh produce, their major

reason was also the lack of information and certainty. They were also more likely to indicate that they grow their own produce (see Table 6.10).

When asked if they thought that fresh fruit and vegetables grown using integrated pest management should be labeled, the majority (81%) strongly agreed or agreed. Twenty-eight percent of respondents strongly agree, 53% of respondents agree, 11% neither agree nor disagree, 5% disagree and 3% strongly disagree.

Table 6. 10 Why respondents would not buy fresh produce grown using IPM

Reason	Buy IPM	
	Yes	No
	# respondents	
if it costs more (than prices currently pay)	71	
not enough information to indicate this produce is different from conventional	33	17
indifferent between IPM and conventional produce	1	5
if quality is lower/quality will be lower	5	1
if the produce adversely affects health/IPM produce will adversely affect health	4	3
grow our own	4	6
would rather buy organic	16	2
insecticides (sic) shouldn't be used		2
time factor looking for produce	2	1
other comments:		
"if remove skin anyway"	1	
"over 80, so at my age it is not important"	1	
"they are all theories anyway"	1	

missing cases: 0.

6.3.6 Responses to information questions

Respondents were asked if they could personally recall hearing or reading any information about agrichemical use and/or levels of agrichemical residues on fresh produce in the previous six months. Forty-one percent said yes. The sources of information were also requested. Television was the most frequently reported source (72% of the respondents indicating yes also indicated that at least one source was television). The remaining sources were newspapers (67%), magazines (61%), radio (33%), health professionals (24%), and other sources (20%). The number of sources that a respondent had seen or heard, was used as a proxy for increasing exposure to information (Table 6.11) rather than the number of times the respondent had seen or heard information in the past six months, as this may be difficult to recall.

Respondents were asked if their fresh fruit and vegetable buying habits had changed because of the information they had seen or heard in the last six months. Of the 41% who had seen or heard information, 5% indicated that they now bought more fresh fruit and vegetables, 80% indicated that they had made no change, while 15% indicated that they now bought less fruit and vegetables.

Table 6. 11 Number of sources of information

Number of sources	Respondents indicate they have seen or heard information from this number of sources (%)
1	21
2	10
3	8
4	2
5	.5
6	.3

missing cases: 0.

Respondents were also asked if they believed that, as a consumer, they had enough information on agrichemical use on fresh fruit and vegetables. Only 8% responded yes.

To investigate what channels of communication were considered the most reliable and who respondents thought should be responsible for providing consumer information, two questions were asked about these issues. The respondents considered that government research agencies (30%), the Department (now Ministry) of Health (28%) and producer groups (12%) should be responsible for providing information. However public interest groups (30%) and the Department of Health (28%) were considered the most reliable, with government research agencies third (16%) (Table 6.12).

While producer groups (12%) and agrichemical companies (9%) were more likely to be deemed responsible for providing the information, they were not considered reliable (1% each). This was frequently an added comment by respondents, indicating that respondents thought that these agents, and individual growers, should pay for but not provide the information. Another comment often attached when multiple agents were indicated, was that multiple agents should be responsible, because information from more than one source had greater integrity than that from a single source.

Table 6. 12 Who should be responsible for information and who is a reliable source of information

	Responsible (%)	Reliable (%)
Environmental groups e.g. Greenpeace	0	5
Department of Health e.g. pamphlets, public health nurses	28	28
University scientists e.g. plant health scientists	2	9
News media, e.g. television, radio, magazines	4	6
Government Research Agencies e.g. the Horticulture and Food Institute	30	16
Public Interest Groups e.g. Consumers' Institute	8	30
Producer groups, co-operatives e.g. Apple and Pear Marketing Board	12	1
Agrichemical companies	9	1
Multiple	7	4

missing cases: responsible, 2; reliable, 6.

6.3.7 Responses to other questions

As an indicator of familiarity with agrichemicals, and perhaps a positive attitude towards agrichemicals, respondents were asked if they or anyone in their households uses any form of chemical to control weeds, pests and diseases around the outside of their property. Sixty four percent indicated yes.

To find out what respondents thought of the GROWSAFE initiative, in terms of the fresh fruit and vegetables they buy, they were presented with the following information (Figure 6.1) and asked the extent to which they agreed or disagreed with the statement "I would prefer to buy fresh fruit and vegetables grown by a certified GROWSAFE grower rather than the fresh fruit and vegetables I currently buy". Thirty-three percent of respondents strongly agree, 38% of respondents agree, 22% neither agree nor disagree, 5% disagree and 3% strongly disagree.

Figure 6. 1 Information about GROWSAFE

GROWSAFE

The GROWSAFE Training Programme has been set up by the New Zealand Agrichemical Education Trust. In order to use the GROWSAFE logo, the Trust's registered mark, growers must undertake and satisfy the requirements of an assessment of their knowledge of and practice in using agrichemicals. A certificate is then issued to such growers and they may use the GROWSAFE logo for the fresh fruit and vegetables they grow.

CHAPTER SEVEN

MODEL FORMULATION AND RESULTS

7.1 Introduction

This chapter presents a model in which attitude and belief variables are explanatory variables for consumer choice, investigates the relationship between respondent demographics and information levels and respondent attitudes and beliefs, models how much respondents might be willing to pay for fresh produce grown using integrated pest management as a function of the belief and attitude variables, and looks at the relationship between consumer demographics and information levels related to their willingness to pay for IPM produce.

7.2 A model of consumer choice

It is proposed that a consumer's belief about a characteristic of a good is his or her subjective evaluation of that characteristic's presence and quantity in a good. It is also proposed that a consumer has a preference for, or evaluative attitude towards, the characteristic, and that in combination these variables are related to a consumer's self reported intention to purchase or not to purchase the good under study (fresh fruit and vegetables grown using integrated pest management methods).

Potential consumers of fresh fruit and vegetables grown using integrated pest management (IPM) were asked about their beliefs regarding the safety of such produce, compared with the safety of fresh fruit and vegetables grown using conventional management practices, and their beliefs about the safety of fresh fruit and vegetables grown using conventional management practices. These variables can take a value from one to five depending on the extent to which a respondent agrees or disagrees with the statement given (see Figure 4.4, Chapter Four). Respondents were also asked about their level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables they eat. This variable can take a value from one to four (Figure 4.2, Chapter Four). These three variables are used as explanatory variables in several model formulations used to explain why consumers, as represented by the respondents to the survey, would or would not buy fresh produce grown using IPM.

Survey respondents were therefore also asked the question: "If fresh fruit and vegetables grown using integrated pest management are available would you consider buying them?". This response is a scalar which can take only two values, conventionally assigned the values 0 and 1, and defined here as

$Y_i = 1$ if respondent answered "yes"

$Y_i = 0$ if respondent answered "no".

The natural approach to such data is to regard Y_i as a discrete random variable, and to make the probability of $Y_i = 1$, (not the value of Y_i itself), a suitable function of the regressors X , (Cramer, 1991). The probability that $Y_i = 0$ is then given by $1 - P(Y_i = 1)$.

The information from the survey questions is used to form a probability model

$$P_i = P(Y_i = 1) = f(X_i, \beta)$$

where

X_{1i} is the i th respondent's answer to the belief statement "Fresh fruit and vegetables grown using integrated pest management will be LESS SAFE than conventional produce".

X_{2i} is the i th respondent's answer to the belief statement "Current conventional fresh fruit and vegetable supplies are safe".

X_{3i} is the i th respondent's answer to the question about evaluative attitude "How would you personally rate your level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables you eat?".

For a single regressor X , the simplest model for a dichotomous choice dependent variable is

$$P(Y|X)$$

or

$$P(X) = \beta_0 + \beta_1 X$$

which is the linear probability model. With the addition of an error term, we have

$$Y_i = P(Y_i | X_i) + e_i$$

or

$$Y_i = \beta_0 + \beta_1 X_i + e_i$$

and hence, with a correction for heteroscedasticity, the estimation of β_0 and β_1 by linear regression methods. The principal objection to the linear probability model is that the estimated probabilities are not constrained to the limited range from 0 to 1 which is imposed on probabilities (Cramer, 1991). Where it is required that the estimated probability vary monotonically with X and yet remain within these bounds, an S-shaped or sigmoid curve is needed, which flattens out at either end so as to respect these natural limits. The two most common curves satisfying these conditions encountered in the literature are the logistic function (yielding the logit model) and the cumulative normal function (yielding the probit model).

By judicious adjustment of linear transformations of the regressors, the logit and probit probability functions can be made to coincide over a fairly wide range, thus logit and probit functions fitted to the same data are virtually indistinguishable, and it is impossible to choose between them on empirical grounds (Cramer, 1991).

The logit model is reviewed in depth by Cramer (1991). The logistic cumulative probability function is

$$P(Z) = \frac{1}{1 + e^{-Z}} \quad -\infty < Z < \infty$$

and the variable Z is known as the logit. The logit, in turn, is written as a function of the regressors (or their transformed values), commonly

$$Z_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_k X_{ik}$$

and the corresponding probability that $Y_i = 1$ is

$$P_i = P(Z_i) = P(X_i; \beta)$$

where P is the logistic function. The probability that $Y_i = 0$ is $Q_i = 1 - P_i$.

Since sample observations are independent, the probability density of any given ordering of observed outcomes, say

$$1, 0, 1, 1, \dots$$

is the product

$$P_1 \cdot Q_2 \cdot P_3 \cdot P_4 \cdot \dots$$

This product is the likelihood function L of the sample, and depends on the vector of coefficients β in the logit model. Since L is a product, the loglikelihood function, $\log L$ is a sum, and the maximum likelihood estimate of β is $\hat{\beta}$, which maximises the likelihood or its logarithm. The predicted outcomes from a probability model are probabilities which lie between zero and one. Hence $\log L(\hat{\beta})$ is always negative, and the closer to zero it is, the better the fit. The value of the loglikelihood function can be used to test restrictions on the parameter vector, β . Provided the restricted model is nested within the general or unrestricted model, the restriction can be tested by the loglikelihood ratio (LR) test. The test statistic is

$$LR = 2(\log L(\hat{\beta}_u) - \log L(\hat{\beta}_r))$$

with u and r denoting unrestricted and restricted models respectively. Under the null hypothesis that the restriction holds, the LR statistic is asymptotically distributed as chi-square with degrees of freedom equal to the number of restrictions on the parameter vector (Cramer, 1991).

Since this is the most common test of nested hypotheses, computer programmes routinely give the value for $-2 \log L(\hat{\beta})$ corresponding to the model fitted. The smaller this value, the better is the model fit.

Where the probability model is estimated from individual data (as is the case in this study), the simplest logit model

$$Z_i = \beta_0 + e_i$$

yields maximum likelihood probability estimates

$$\hat{P}_i = n_1/n = f$$

$$\hat{Q}_i = n - n_1/n = 1 - f$$

where n is the sample size and n_1 is the number of observations for which $Y_i = 1$ (Cramer, 1991).

The corresponding value for $\log L(\hat{\beta}_0)$ is therefore

$$\log L(\hat{\beta}_0) = n_1 \log f + (n - n_1) \log(1 - f)$$

This can be regarded as the most restricted version of any logit model, and hence results in the largest value of $-2 \log L$.

For the analysis reported here, the logistic regression procedure in the SPSS/PC+™ computer package has been used. This procedure allows continuous as well as categorical independent variables. The probability reported is for the highest number coded for the dichotomous choice variable, so for the purpose of this analysis, as the 'yes' responses are coded '1' and the 'no' responses are coded '0', hence the probability that a consumer will consider buying produce grown using integrated pest management is reported.

The independent variables for this analysis, the respondents' beliefs and attitude, can be represented as purely categorical variables or as cardinal variables. Each respondent is characterised by the vector

$$(X_1, X_2, X_3)$$

where $X_1 = 1, 2, 3, 4, \text{ or } 5$ (belief 1)
 $X_2 = 1, 2, 3, 4, \text{ or } 5$ (belief 2)
 $X_3 = 1, 2, 3, \text{ or } 4$ (evaluative attitude)

and a value for the state variable $Y_i = 0$ or 1.

If X_1, X_2, X_3 are considered categorical variables then each respondent can have one of 100 possible combinations on these three variables. However only 58 combinations actually resulted.

The combinations and the frequency of respondents for each combination are shown in Figure 7.1.

Figure 7.1 Numbers of respondents by X_1, X_2, X_3 categories

X_1 by $X_2, X_3 = 1$

		X_2				
		1	2	3	4	5
X_1	1			2		
	2		2	1	1	
	3		6	2	1	
	4	1	5	3	2	
	5					

X_1 by $X_2, X_3 = 2$

		X_2				
		1	2	3	4	5
X_1	1		1			
	2		2	2	1	
	3		10	15	4	
	4		29	47	14	
	5		5	14	5	

X_1 by $X_2, X_3 = 3$

		X_2				
		1	2	3	4	5
X_1	1		2		1	
	2		3	3	5	
	3		6	10	8	
	4	1	8	23	24	
	5		1	11	8	2

X_1 by $X_2, X_3 = 4$

		X_2				
		1	2	3	4	5
X_1	1	1			3	1
	2	1		1	2	
	3		2	5	4	2
	4		3	5	21	8
	5			7	6	6

A probability model consisting of a dummy variable for each of the 58 (X_1, X_2, X_3) cells (or an intercept plus 57 dummies) produces predicted \hat{P}_{ijk} values equal to the observed relative frequency of the response in the (ijk)th cell. This is a fully saturated model and gives the best possible fit to the observed sample data, and hence gives the smallest possible value for $-2 \log L$. By definition, this is the most complex or unrestricted probability model that could be used for the sample data. At the other extreme, the simplest or most restricted (baseline) model is the intercept only logit model, and this produces the largest value for $-2 \log L$.

Since the fully saturated (58 cell model) gives predicted probabilities equal to the relative frequencies of the state variable Y in each cell, cells containing only one observation or observations in a cell that belong to one state, give predicted probabilities equal to one and hence a loglikelihood value of zero for each observation. The value for $-2 \log L$ might therefore be artificially reduced by using a grouping resulting in too many categories with no variation in the value of the state variable Y . In the limit, where each observation is considered as a category, the fully saturated model does result in $-2 \log L = 0$, the usual lower limit of $-2 \log L$ for probability models fitted to individual observations. A more representative model, where there are more actual and hence predicted observations for each state, is obtained when the belief variables are grouped.

Intuitively the semantics of the question and answer wording for the belief variables might be considered so that answers 'agree' and 'strongly agree' might be grouped together, neutral answers 'neither agree nor disagree' might be kept as a group and the answers 'disagree' and 'strongly disagree' might be kept together, leaving the four categories for level of concern. This would give a nine cell model, based on the belief variables (Figure 7.2).

Figure 7. 2 Cell frequencies in the nine cell model

		X_2				
		1	2	3	4	5
X_1	1	12		9		14
	2					
	3	24		32		19
	4					
	5	54		110		96

At each of the nine belief combinations (X_1, X_2) there are one of four possible attitude values (X_3). The resulting probability model (model 1) consists of a dummy variable for each of the 36 combinations (or an intercept plus 35 dummies)

$$Z_{ij} = \beta_{ij} \quad \text{Model 1}$$

$$i=1, \dots, 9$$

$$j=1, \dots, 4$$

$$df=36$$

Rather than the 58 cell model, then, this is considered the fully saturated model and the objective is to find a simple (restricted) model that is not significantly inferior to this 36 cell, fully saturated model, but which shows significant improvement over the intercept only model. As discussed above, these tests are conducted using the LR test.

To obtain a more parsimonious model, the first restriction implemented is that of the attitude variable, X_3 , to a cardinal variable (model 2). This reflects the theoretical model based on Lancaster (1966) and Fishbein and Ajzen (1975) in which, given a respondent's belief about a characteristic, it is their evaluative attitude which is linearly related to their behavioral intention and hence probability of action. Again the location on the belief variables will be coded as an intercept or dummy variable (0,1) while the corresponding values for X_3 are cardinal.

$$Z_i = \beta_{0i} + \beta_i X_3 \quad \text{Model 2}$$

$$i = 1, \dots, 9.$$

$$df=18$$

From the nine cell model the next possible restriction on the belief variables is to combine the neutral answers with either the 'disagree' or 'agree' answers. This was done by coding the neutral group to fall into one of the two other groups for each belief variable. This meant there were four possible 'four belief cell' models (Figure 7.3).

Figure 7.3 Possible four cell models

	1	2	3	4	5
1					
2					
3					
4					
5					

	1	2	3	4	5
1					
2					
3					
4					
5					

	1	2	3	4	5
1					
2					
3					
4					
5					

	1	2	3	4	5
1					
2					
3					
4					
5					

These models were assessed on their goodness of fit. The best explanatory model has four cells divided as in Figure 7.4. The neutral group for X_1 and X_2 has been included with the 'agree' and 'strongly agree' answers for both belief variables. The cells are now labeled from one to four. Cell one is the top-left cell, cell two is the bottom-left cell, cell three is the top-right cell and cell four, the remaining bottom-right cell.

Figure 7.4 Cell frequencies in the four cell model

		X_2				
		1	2	3	4	5
X_1	1					
	2	77			33	
	3					
	4					
	5	164			96	

The location by belief (coded into the four cells) and attitude, will be coded as a dummy variable model (15 variables plus the intercept).

$$Z_{ij} = \beta_{ij} \quad \text{Model 3}$$

$$i=1, \dots, 4$$

$$j=1, \dots, 4$$

$$df=16$$

The next model (model 4), following the same reasoning, is a four cell model in which the four cells are defined as before and attitude is modeled as a cardinal variable.

$$Z_i = \beta_{0i} + \beta_{1i} X_3$$

$$i = 1, \dots, 4.$$

$$df=8$$

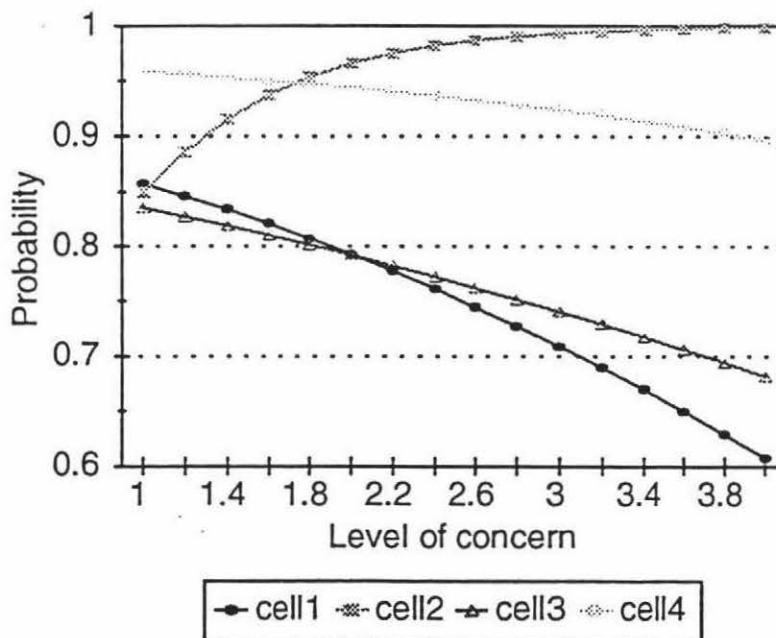
The parameters for this model are presented in Table 7.1 and the probability function for each cell is graphed against the level of concern in Figure 7.5.

Table 7. 1 Parameter results for four cell model

Parameter	Parameter Estimate	SL ^a : H ₀ : $\beta = 0$
β_{01}	2.2466	.0058
β_{02}	.1248	.9381
β_{03}	1.9121	.2073
β_{04}	3.4722	.0393
β_{11}	-.4528	.1278
β_{12}	1.6040	.0565
β_{13}	-.3879	.3990
β_{14}	-.3279	.5025

^a Significance Level

Figure 7. 5 Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern (Model 4)



From here there is no further intuitive grouping of the cells. Looking at the parameters of the model 4 (Table 7.1), the next choice would be to reduce to three cells. Cells one and three (in the four cell model) have intercept similar in magnitude and cells one, three and four have coefficients on the X_3 variable similar in magnitude. The restricted model (model 5) restricts cells one and three to the same intercept and slope, cell two has a unique intercept and slope, and cell four has a unique intercept but has the same coefficient on X_3 (or slope) as cells one and three.

In the three cell model, cell one is the top cell, cell two is the bottom-left cell and cell three is the bottom-right cell (Figure 7.6).

Figure 7. 6 Frequencies in the three cell model

		X_2				
		1	2	3	4	5
X_1	1	110				
	2					
	3					
	4	164		96		
	5					

The logits for each cell are

$$\text{Cell 1 and 3} \quad Z_1 = \beta_{01} + \beta_{1(134)} X_3$$

$$\text{Cell 2} \quad Z_2 = \beta_{02} + \beta_{1(2)} X_3 \quad \text{Model 5}$$

$$\text{Cell 4} \quad Z_3 = \beta_{03} + \beta_{1(134)} X_3$$

The parameters for this model are presented in Table 7.2 and the probability function for each cell is graphed against the level of concern in Figure 7.7. No further reduction is carried out from here. As described previously, each successive model was compared with the previous model using the likelihood ratio statistic. These results are presented in Table 7.3.

Table 7. 2 Parameter results for Model 5

Parameter	Parameter Estimate	SL: $H_0: \beta = 0$
β_{01}	2.1495	.0007
β_{02}	.1248	.9381
β_{03}	3.8284	.0000
$\beta_{1(134)}$	-.4332	.0427
$\beta_{1(2)}$	1.6040	.0565

Figure 7. 7 Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern (Model 5)

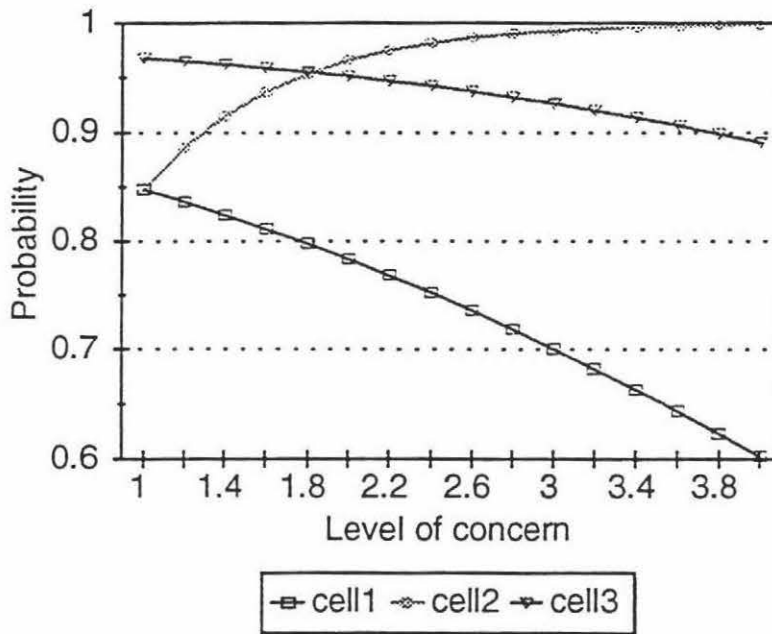


Table 7. 3 Loglikelihood ratio between successive models

Model	$-2 \log L$	DF ^a	LR ^b	DF ^c	p
1 36 Cells	195.01	36			
2 9 Cells, X_3 restricted	211.92	18	16.91	18	.5293
3 16 Cells	214.45	16	2.53	2	.2822
4 4 Cells, X_3 restricted	219.96	8	5.51	8	.7019
5 3 Cells, X_3 restricted	220.11	5	.15	3	.9852

^a Model degrees of freedom^b Likelihood ratio statistic^c Likelihood ratio degrees of freedom

It is desirable, in the sequence of models presented, that not only is every successive model not significantly different from the previous model, that is, it explains a similar amount of the variation in the cell frequencies with less parameters, but also that it should not be significantly different from *all* models previous. To examine this, likelihood ratios were constructed to compare at each step the current model with previous models. The results are presented in Table 7.4, where the likelihood ratio, its degrees of freedom and the probability level for each combination are tabled. Thus, for example, the data in column 1, row 5, compares Model 5 with Model 1. The significance level of the likelihood ratio is 0.7632 and it can be concluded that Model 5 is not significantly different in explanatory power from Model 1.

Table 7. 4 Likelihood ratio statistic for all models

Model	1	2	3	4	5
1	*	*	*	*	*
2	16.91, 18 .5293	*	*	*	*
3	19.44, 20 .4934	2.53, 2 .2822	*	*	*
4	24.95, 28 .6306	8.04, 10 .6249	5.51, 8 .7019	*	*
5	25.10, 31 .7632	8.19, 13 .8310	5.66, 11 .8951	.15, 3 .9852	*

Several other models were explored. These included; a Fishbein index for the belief and attitude variables; a simple categorical model for each of the belief and attitude variables, and a restricted model for each; and linear, log-linear and quadratic models containing all three explanatory variables. The models, $-2 \log L(\hat{\beta})$ and the degrees of freedom are presented in Table 7.5.

Examination of $-2 \log L(\hat{\beta})$ values in comparison with Model 5, shows that all of the alternative models result in a loss of explanatory power. Two of the models in Table 7.5 have the same degrees of freedom as Model 5, but since their $-2 \log L$ statistic is larger than that of Model 5, they do not represent an improvement over Model 5. The last model in Table 7.5 is not significantly different from Model 5, however, in this study the choice was made to use Model 5 as a framework for exploring the relationship between beliefs and demographic and information variables (Section 7.3). The remaining models result in a significant loss in explanatory power compared with Model 5.

Table 7. 5 Loglikelihood ratio for alternative models compared with Model 5

Model	$-2 \log L$	DF ^a	LR ^b	DF ^c	p
$Z = \beta_0 + \beta_1(X_1 \times X_3)$	239.72	2	19.61	3	.0002
$Z = \beta_0 + \beta_1(X_2 \times X_3)$	265.82	2	45.71	3	.0000
$Z = \beta_0 + \beta_1(X_1 \times X_3) + \beta_2(X_2 \times X_3)$	238.21	3	18.10	2	.0001
$Z = \beta_0 + \beta_1 X_{11} + \beta_2 X_{12} + \beta_3 X_{13} + \beta_4 X_{14}$	228.78	5			
$Z = \beta_0 + \beta_1 X_1$	235.32	2	15.21	3	.0016
$Z = \beta_0 + \beta_1 X_{21} + \beta_2 X_{22} + \beta_3 X_{23} + \beta_4 X_{24}$	257.09	5			
$Z = \beta_0 + \beta_1 X_2$	265.90	2	45.79	3	.0000
$Z = \beta_0 + \beta_1 X_{31} + \beta_2 X_{32} + \beta_3 X_{33}$	257.33	4	37.22	1	.0000
$Z = \beta_0 + \beta_1 X_3$	263.53	2	43.42	3	.0000
$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$	232.83	4	12.72	1	.0004
$Z = \beta_0 + \beta_1(\ln X_1) + \beta_2(\ln X_2) + \beta_3(\ln X_3)$	240.07	4	19.96	1	.0000
$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_1^2 + \beta_5 X_2^2 + \beta_6 X_3^2 + \beta_7 X_1 X_2 + \beta_8 X_1 X_3 + \beta_9 X_2 X_3$	222.29	10	2.18	5	.8237

^a Degrees of freedom for the model

^b Likelihood ratio statistic

^c Degrees of freedom for the likelihood ratio statistic

The results of the logit analysis indicate that the respondents fall into one of three groups (previously called cells). Respondents in group 1 (cell one) believe that IPM produce is less safe than conventional produce but whether they think conventional produce is safe or not does not affect their decision to buy IPM fresh produce. The people in this group are less likely to consider buying fresh produce grown using integrated pest management than anyone else and the probability declines as respondent level of concern increases (Figure 7.7).

Respondents in group 2 (cell two) believe that IPM fresh produce is at least as safe as conventional produce and agree that conventional produce is safe. As their level of concern about agrichemical use increases they are more likely to consider buying IPM fresh produce.

Respondents in group 3 (cell three) believe that IPM fresh produce is at least as safe as conventional fresh produce. However they disagree that current conventional produce is safe and as their level of concern increases, are less likely to consider buying IPM fresh produce.

7.3 Explaining consumer choice

From the analysis carried out in section 7.2, respondents fall into one of three groups. These groups reflect their beliefs about the safety of conventional fresh produce and the safety of IPM fresh produce, compared with the safety of conventional fresh produce.

Multiple discriminant analysis (MDA) is used to characterise these groups. MDA is a special case of canonical correlation analysis which takes two sets of variables and finds the linear composite of each set of variables such that the linear composites have the maximum correlation (Takeuchi et al, 1982).

In MDA, one set of the variables takes the form of a set of k dummy variables, and is considered the set of dependent variables. This formulation can alternatively be seen as a single categorical variable with k categories or groups. The objective of MDA is to maximise the between groups variance over the within groups variance. The β_j 's which achieve this explain the differences between the group centroids in X_j space. MDA does not provide any statistical criterion to determine whether one subject belongs to one group or not, in view of the scores of the explanatory variables. However, if the explanatory variables follow a p -dimensional multivariate normal distribution (where p is the number of explanatory variables), then this can be done.

If the explanatory variables, which explain the differences between the group centroids, do not follow a multivariate normal distribution, classification using the normal parametric methods is not appropriate. There are non-parametric methods available to construct classification functions which use non-normal explanatory variables (SAS Institute Inc., 1988). However, as the goal of this analysis is to characterise the groups not to classify cases, classification using non-parametric methods is not explored.

A stepwise discriminant analysis was performed as a screening procedure, using the SAS[®] STEPDISC procedure, in which all the information and demographic variables were used as discriminating variables (questions 7 to 10 and 19 to 29 in the survey, Appendix 1, and see Table 7.6). The criterion for entry used for the variables was "the squared partial correlation for predicting the variable under consideration from the [dependent] variable, controlling for the effects of the variables already selected for the model" (SAS Institute Inc., p910, 1988), which follows an F-distribution. The prior probability of being in a group was set equal to the actual probability.

Table 7. 6 Explanatory variables used in the analysis

Variable	Description
locat	dichotomous variable, urban and rural, coded 1 if urban, 0 is rural
sex	dichotomous variable, male and female, coded 1 if male, 0 if female
educ	five category variable, categories reflect increasing levels of education, so considered a discrete cardinal variable in the analysis
members	discrete cardinal variable indicating number of members in household
nochild	dichotomous variable indicating whether respondent has children or not (coded 1 if yes)
child	dichotomous variable indicating whether respondent's youngest child is under 18, coded 1, otherwise coded 0
age	seven category variable, where age is indicated as being in one of seven age brackets, considered a discrete cardinal variable in the analysis
income	eight category variable, where income is indicated as being in one of eight income brackets, considered a discrete cardinal variable in the analysis
emp	dichotomous variable, coded 1 if respondent is employed, 0 otherwise
ret	dichotomous variable, coded 1 if respondent is retired, 0 otherwise
home	dichotomous variable, coded 1 if respondent is homemaker, 0 otherwise
notwork	dichotomous variable, coded 1 if respondent is not working, 0 otherwise
Maori	dichotomous variable, coded 1 if respondent is Maori, 0 otherwise
NZEuro	dichotomous variable, coded 1 if respondent is New Zealand European, 0 otherwise
Poly	dichotomous variable, coded 1 if respondent is Polynesian, 0 otherwise
Asian	dichotomous variable, coded 1 if respondent is Asian, 0 otherwise
Euro	dichotomous variable, coded 1 if respondent is European, 0 otherwise
envmem	dichotomous variable, coded 1 if respondent is a member of an environmental organisation, 0 otherwise
recalinf	dichotomous variable, coded 1 if respondent can recall information, 0 otherwise
suminfo	discrete cardinal variable, which indicates number of sources of information respondent recalls in last six months
suffinfo	dichotomous variable, coded 1 if respondent has enough information, 0 otherwise
pestcont	dichotomous variable, coded 1 if chemicals used around house, 0 otherwise
spend	a continuous variable measuring how much the household currently spends on fresh fruit and vegetables per week

Rencher and Larson (1980; cited in SAS Institute Inc., 1988, p910) have shown “that the order of selecting the variables for entry at each step [can depend] on the data” with the possibility that for each subsequent variable for entry determined by the F-statistic criterion, the F-statistic for entry is biased. This means that the results may not be stable and different variables may be entered if the analysis is run again. To investigate this and to find stable results, forward selection, which enters variables based on the F-statistic for entry, and backward selection which

enters all variables and then takes variables out based on the F-statistic to stay, as well as stepwise, which allows variable entry and exit, were undertaken.

The significance level was also decreased with subsequent analyses, based on the discussion in the SAS/STAT™ User's Guide Release 6.03 (SAS Institute Inc., 1988) which points out that "[i]f you want to include only variables with significant contributions to the discriminatory power of the models rather than to maximise the probability of correct classification, you should specify a small significance level" although no guide as to what is a small significance level was indicated.

Decreasing the significance level decreased the number of variables entered, as would be expected. The method of entry also changed some of the variables in the analysis, although a core set persisted throughout. The results are presented in Table 7.7.

Table 7.7 Variables in each analysis

Significance level	Stepwise selection		Forward selection	Backward elimination
	Var. in	Var. out	Var. in	Var. remaining
.15	income Maori recalinf emp pestcont		income Maori recalinf emp pestcont	emp recalinf pestcont income Maori
.10	<i>income</i> Maori recalinf emp pestcont		income Maori recalinf emp pestcont	emp recalinf pestcont Maori
		<i>income</i>		
.0900	<i>income</i> Maori recalinf emp pestcont		income Maori recalinf emp	emp recalinf pestcont Maori
		<i>income</i>		
.075	<i>income</i> Maori recalinf emp		income Maori recalinf emp	emp recalinf Maori
		<i>income</i>		
.05	income Maori recalinf		income Maori recalinf	emp recalinf Maori

At a significance level of 15%, all three analyses, stepwise, forward selection and backward elimination, contain the same five variables, income, Maori, recalinf, emp and pestcont.

At a significance level of 10%, income is dropped from the stepwise selection and backward elimination analyses, while all five variables remain in the forward selection analysis.

At a significance level of 9%, again income is dropped in the stepwise selection and backward elimination analyses but the order in which variables are entered and removed in the stepwise selection changes. Income is removed after pestcont is entered at a significance level of 10%, but after emp at a significance level of 9%. In the forward selection both emp and income remain but pestcont is removed.

When the significance level is dropped to 7.5% Maori, emp and recalinf are included in the stepwise selection and backward elimination analyses, while those variables and income are included in the forward selection.

At the final significance level tested. 5%, income, Maori and recalinf are selected in the stepwise and forward selection analyses while emp, recalinf and Maori are included in the backward elimination analysis. As emp and income have the highest correlation, 0.42 in the total sample, this may explain the changing around between income and employment in some of the analyses. No other total sample correlations are above 0.18.

From these results, two models were chosen to put through a SAS[®] DISCRIM procedure which provides additional output to the STEPDISC procedure. The models were chosen on the basis of the changes between the 10% and 9% significance levels. The high correlation between emp and income led to a decision to include only one or the other of these two variables in the models to be compared (Figure 7.8).

Figure 7. 8 Models to be compared

$$\text{Model A } D = f(\text{emp}, \text{Maori}, \text{recalinf}, \text{pestcont})$$

$$\text{Model B } D = f(\text{income}, \text{Maori}, \text{recalinf}, \text{pestcont})$$

The univariate F-statistics⁷ for the variables included in each model are presented in Table 7.8.

Table 7. 8 Univariate F statistics for explanatory variables included in the models

Variable	F	Pr>F
Maori	7.6175	.0006
income	8.0962	.0004
recalinf	4.9402	.0076
pestcont	2.7784	.0634
emp	7.8214	.0005

Because there are three groups in the dependent variable, there can be a maximum of two orthogonal discriminant functions. The proportion of variance explained by the second function is (1 - proportion of variance explained by the first). Function 1 in Model A explains the greatest amount of variance between groups (Table 7.9).

Table 7. 9 Statistics for model comparison

Model	Proportion of between groups variability explained by function 1
A	.8418
B	.7884

Tests are available to test the significance of the overall relationship between groups and explanatory variables. One such test is Wilks' Lambda which is calculated as

$$\Lambda = \frac{|S_{wg}|}{|S_{bg} + S_{wg}|}$$

and for which an F ratio can be calculated (Tabachnick and Fidell, 1989, p514).

Such a statistic would have provided a further criterion for deciding between models, as not only the amount of variance that a function explains but also the reliability of the relationship could be tested. If one model provided two functions, both explaining 50% of the between groups variability and both significant, this might be considered preferable to a second model with two functions, the first with a high proportion of variance, say .75, and a second function, with remaining variance .25, but which is not statistically significant.

⁷ From a discriminant analysis for Model A and Model B, not the stepwise procedure.

However, it may be dubious to interpret the significance levels of statistics such as Wilks' Lambda when the explanatory variables are not multivariate normal variables (Ganesalingam, 1995) and, in this study, the set of explanatory variables which maximises the between groups variability over the within groups variability is a set of dichotomous variables.

Tabachnick and Fidell (1989) suggest using Pillai's criterion, rather than Wilks' Lambda, to test multivariate significance in the event of unequal group sizes and heterogeneity of variance-covariance matrices but do not comment on the appropriateness of this criterion for the case when the explanatory variables are not normally distributed.

In the absence of any statistical criteria, Model A is chosen. This is because the first function explains the largest proportion of between groups variability and, intuitively, with no test of the remaining function, we would like at least one function to explain as much as possible. The remainder of the discussion in this section relates to Model A.

The correlation of the variables with the functions (pooled within canonical structure) is presented in Table 7.10. This is also called the matrix of loadings and is the pooled within-group correlation matrix for the explanatory variables, multiplied by the matrix of standardised discriminant function coefficients. Therefore the relationship between any one explanatory variable and the function is not a partial one and the loadings reveal patterns between the explanatory variables for a discriminant function. Tabachnick and Fidell (1989, p539) note that by convention loadings greater than 0.30 are considered eligible for interpretation, although the loading of an explanatory variable "depends... on the correlation of the variables in the population and the homogeneity of scores in the sample taken from it" and will be reduced if sample values for the explanatory variable are unusually homogeneous. In this situation, the criteria for eligibility can be lowered.

The variables Maori, emp and recalinf have high correlations with canonical function 1, -0.6432, 0.6236, and 0.4951 respectively, while pestcont has a low correlation with this function, .0606. Pestcont has a high correlation with canonical function 2 (but note the function only explains 16% of between groups variability), emp and recalinf have correlations of 0.4282 and -0.3515 respectively, while Maori has a correlation of -.0327.

Table 7. 10 Pooled within canonical structure

Variable	Canonical Function 1	Canonical Function 2
Maori	-0.6432	-0.0327
emp	0.6236	0.4282
recalinf	0.4951	-0.3515
pestcont	0.0606	0.8853

The contribution of the variable to the discriminant scores is presented in Table 7.11. The total-sample canonical coefficients are used to calculate the canonical function scores, plotted in Figure 7.10. The canonical function score for a respondent is the sum of the total sample correlation coefficients multiplied by the standardised value for each variable.

The total sample correlation coefficients measure the partial relationship of the variable to the function. Were the sign to change or the magnitude to markedly decrease compared with the pooled within canonical structure results, this would indicate that the correlation of the variable with the function had been affected by its relationship with the other variables in the function. The magnitude and sign of pestcont changed, for example, from 0.0606 to -0.1038 for canonical function 1 (Tables 7.10 and 7.11 respectively). The pooled within-group canonical coefficients are presented for comparison in Table 7.12.

Table 7. 11 Total sample correlation coefficients

Variable	Canonical function 1	Canonical function 2
Maori	-0.6446	0.1371
emp	0.5733	0.3331
recalinf	0.5057	-0.3430
pestcont	-0.1038	0.8419

Table 7. 12 Pooled within-group standardized canonical coefficients

Variable	Canonical function 1	Canonical function 2
Maori	-0.6333	0.1347
emp	0.5630	0.3271
recalinf	0.5004	-0.3393
pestcont	-0.1033	0.8379

A plot of canonical function 1 scores against canonical function 2 scores is presented in Figure 7.9. On average, respondents in group 3 have higher discriminant scores on the first canonical function because the variables *recalinf* and *emp* are relatively large in magnitude and are positive. Respondents in group 3 are more likely to have indicated yes to the questions which ascertained information about these two variables.

The scores of respondents in group 2 are pulled to the left because they have lower levels of employment, are less likely to recall information than group 3 respondents, are more likely to use pest control and some respondents indicate they are Maori. The variables *Maori* and *pestcont* (use of pest control) pull the discriminant scores in the opposite direction from the variables, *emp* (employment) and *recalinf* (recall of information).

Scores for respondents in group 1, however, range widely on canonical function 1. Canonical function 2 does not pull the groups clearly apart and since it explains only 16% of the variance between groups this might be expected.

The group means on the discriminant functions are also indicated on Figure 7.9 and are presented in Table 7.13. Plots of centroids indicate how groups are separated in terms of a discriminant function. So, considering function 1, the centroids range from -0.4438 (group 1) to 0.3858 (group 3).

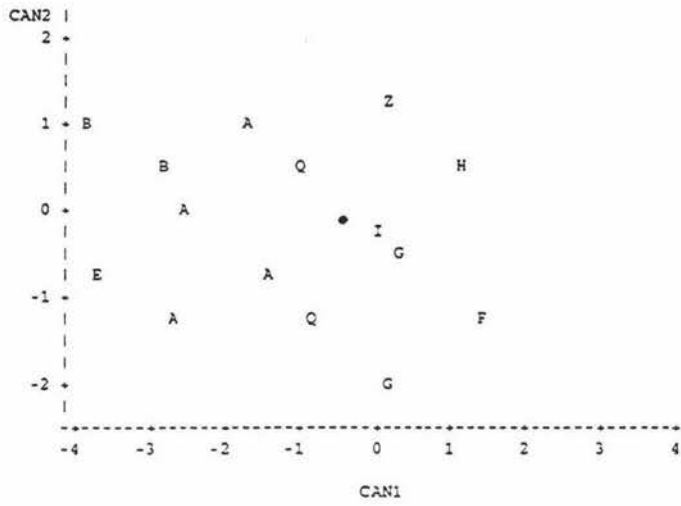
Table 7. 13 Group means

Group	Canonical Function 1	Canonical Function 2
1	-0.4438	-0.0847
2	0.0718	0.1501
3	0.3858	-0.1593

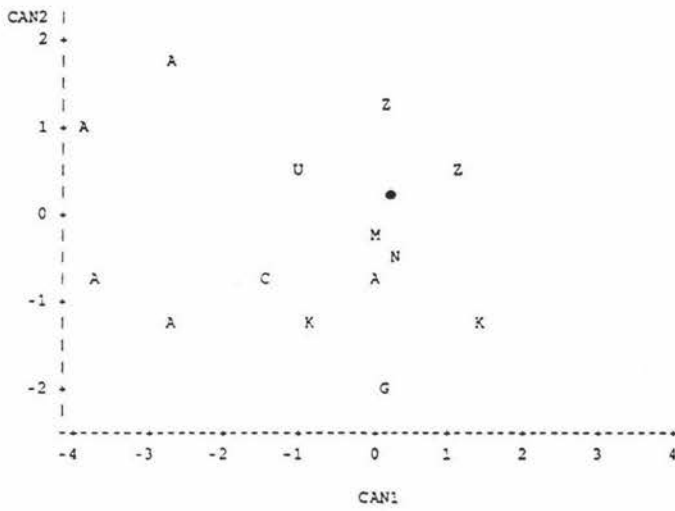
Groups can also be described by their means on the explanatory variables (Table 7.14). Group 1 has the greatest proportion of Maori respondents, the lowest proportion of employed people, respondents are least likely to recall hearing or reading any information about agrichemical use and/or about agrichemical residues in the last six months and are less likely than respondents in group 2 to use chemical pest control around the outside of the home, and almost as unlikely to do so as respondents in group 3.

Figure 7.9 Plot of canonical function 1 by canonical function 2 by group

Group 1

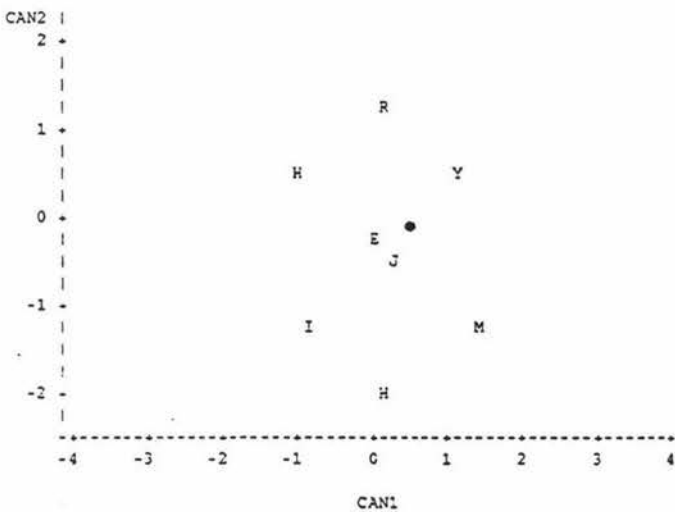


Group 2



NOTE: 27 obs hidden.

Group 3



Legend: A = 1 observation, B = 2 observations, etc. * indicates a group centroid.

Group 2 has a lower proportion of Maori respondents than group 1. The proportion in the group who are employed is greater than that of group 1 and closer to the level of group 3. Respondents in this group are more likely to recall information than respondents in group 1, but not as likely as group 3, and are most likely to use chemical control for pests and diseases around the outside of the home.

Group 3 does not have any Maori respondents. They are more likely to be employed than respondents in the other two groups, are most likely to recall information and are least likely to control pests and diseases outside the house by using chemicals.

Table 7. 14 Ranking of group means

	Highest			Lowest		
	Mean	Group	Mean	Group	Mean	Group
Maori	.11818	1	.04268	2	0	3
emp	.68750	3	.65854	2	.45455	1
recalinf	.53125	3	.40244	2	.31818	1
pestcont	.70951	2	.59091	1	.58333	3

A more detailed presentation of the sample statistics by total sample and group is presented in Table 7.15.

Table 7. 15 Sample statistics for the predictors

Total Sample

Variable	N	Sum	Mean	Variance	Std dev
Maori	370	20	0.05405	0.05127	0.22643
Emp	370	224	0.60541	0.23954	0.48943
Recalinf	370	152	0.41081	0.24270	0.49265
Pestcont	370	237.36	0.64151	0.23052	0.48159

Group 1

Variable	N	Sum	Mean	Variance	Std dev
Maori	110	13	0.11818	0.10517	0.32430
Emp	110	50	0.45455	0.25021	0.50021
Recalinf	110	35	0.31818	0.21893	0.46790
Pestcont	110	65	0.59091	0.24395	0.49392

Table 7.15 cont.

Group 2

Variable	N	Sum	Mean	Variance	Std dev
Maori	164	7	0.04268	0.04111	0.20276
Emp	164	108	0.65854	0.22625	0.47565
Recalinf	164	66	0.40244	0.24196	0.49189
Pestcont	164	116	0.70951	0.21038	0.45867

Group 3

Variable	N	Sum	Mean	Variance	Std dev
Maori	96	0	0	0	0
Emp	96	66	0.68750	0.21711	0.46595
Recalinf	96	51	0.53125	0.25164	0.50164
Pestcont	96	56	0.58333	0.24561	0.49559

7.4 Are respondents willing to pay more for IPM produce?

If respondents replied that they would consider buying fresh fruit and vegetables grown using integrated pest management, they were then asked:

If all fresh fruit and vegetables you currently buy could be bought as produce grown using IPM, how much would you be willing to pay for IPM produce above the prices you currently pay?

0%	.....not willing to spend more.....	1
20%	.....adds \$2 for every \$10 you currently spend on fresh produce.....	2
40%	.....adds \$4 for every \$10 you currently spend on fresh produce.....	3
60%	.....adds \$6 for every \$10 you currently spend on fresh produce.....	4

The frequency of responses to this question is presented in Table 7.16. While the answers are mutually exclusive in that respondents only circled one answer, an indication that the consumer was willing to pay more (20% and above) was taken to mean that the respondent would also purchase IPM fresh produce at all the lower price levels.

Table 7. 16 Respondents' willingness to pay to buy IPM produce

How much respondent is willing to pay above conventional fresh produce prices	Number of respondents
Willing to pay 0% more	153
Willing to pay 20% more	154
Willing to pay 40% more	17
Willing to pay 60% more	3

The responses to this question represent a variable with four possible values, which can be considered discrete, cardinal values. Analysis of the relationship of the attitude and belief variables to this variable could be carried out using an ordered multinomial probability model or using discriminant analysis. However the number of respondents indicating that they are willing to pay 40% and 60% more are extremely low and accordingly the respondents are grouped into two groups, not willing to pay any more (153 respondents) and willing to pay at least 20% more (174 respondents). Note that respondents not willing to buy IPM fresh produce are not included in this analysis.

A logistic regression model was run in which the dependent variable is coded 0 if respondents are not willing to pay any more for IPM fresh produce and 1 if respondents are willing to pay at least 20% more. Again the objective is to group these respondents according to their attitudes and beliefs and exactly the same process, as described earlier in this chapter, is carried out. Models 1 to 4 from section 7.2 are carried out for the dependent variable indicating how much respondents are willing to pay for IPM fresh produce. The likelihood ratio was used to test successive models (Tables 7.17 and 7.18).

Table 7. 17 Loglikelihood ratio between successive models

Model	$-2 \log L(\hat{\beta})$	DF ^a	LR ^b	DF ^c	p
1 36 Cells	390.73	36			
2 9 Cells, X ₃ restricted	413.27	18	22.53	18	0.2092
3 16 Cells	424.05	16	33.32	20	0.0311
4 4 Cells, X ₃ restricted	431.27	8	40.54	28	0.0592

^a Degrees of freedom for the model

^b Likelihood ratio statistic

^c Degrees of freedom for the likelihood ratio statistic

Table 7. 18 Likelihood ratio statistic between all models

Model	1	2	3	4
1	*	*	*	*
2	22.54, 18 .2088	*	*	*
3	33.32, 20 .0311	10.78, 2 0.0046	*	*
4	40.54, 28 0.0591	18.00, 10 .0550	7.22, 8 .5131	*

As can be seen from the results, the change in $-2 \log L$ from the nine cell restricted model onwards is significant, which means that the move to a more restricted model has led to a significant decrease in the explanatory power of the model. This suggests a discriminant analysis on the nine groups, but this would give cell frequencies as low as 7, which would seriously impair the power of the model. Therefore the four cell split, with attitude modelled as a cardinal variable, as for the previous analysis, was used (Figure 7.10). Of the four possible alternatives

for incorporating the neutral groups, discussed previously, the same division gave the best results, as measured by the smallest chi-square value (Model 4 in Table 7.17).

Figure 7. 10 Cell frequencies in the four cell model

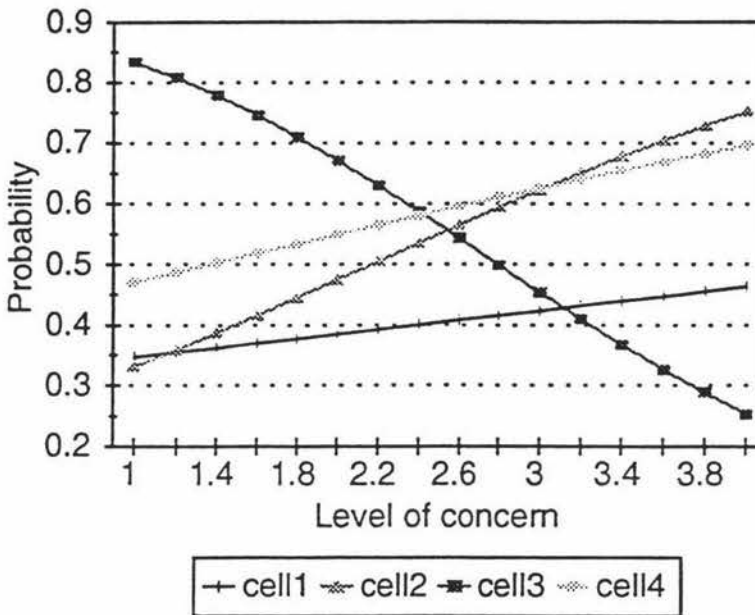
		Respondents in the analysis					Respondents not in the analysis				
		X_2					X_2				
		1	2	3	4	5	1	2	3	4	5
X_1	1	58			22		19			11	
	2										
	3	159			88		5			8	
	4										
	5										

In this model the cells are labeled from one to four. Cell one is the top-left cell, cell two is the bottom-left cell, cell three is the top-right cell and cell four, the remaining bottom, right cell. The parameters for this model are presented in Table 7.19 and the graph of the probability a respondent will pay at least 20% more for IPM fresh produce by respondent level of concern is presented in Figure 7.11.

Table 7. 19 Parameters for the four cell model

Parameter	Parameter Estimate	SL: $H_0: \beta = 0$
β_{01}	-.7932	.2827
β_{02}	-1.3062	.0266
β_{03}	2.5120	.1342
β_{04}	-.4346	.6146
β_{11}	.1607	.5851
β_{12}	.6027	.0115
β_{13}	-.8994	.0924
β_{14}	.3163	.2368

Figure 7. 11 Probability that respondents in each group will pay at least 20% more for IPM fresh produce, as a function of their level of concern (Model 4)



The results of the logit analysis indicate that the respondents fall into one of four groups. Respondents in group 1 believe that IPM produce is less safe than conventional produce and consider that conventional produce is safe. The probability that they would be willing to pay at least 20% more apparently increases as their level of concern increases. The relationship is not significant however and it could be considered that there is no change in the probability that they would be willing to pay at least 20% more as their level of concern increases.

Respondents in group 2 believe that IPM fresh produce is at least as safe as conventional produce and agree that conventional produce is safe. As their level of concern about agricultural use increases the probability that they are willing to pay at least 20% more increases.

Respondents in group 3 disagree with the statement "Current conventional fresh fruit and vegetable supplies are safe" and with the statement "Fresh fruit and vegetables grown using integrated pest management will be less safe than conventional produce". Respondents in this group are far more likely than respondents in any other group to pay at least 20% more at low levels of concern, but as their concern increases, the probability that they will pay at least 20% more for IPM fresh produce falls steeply.

Respondents in group 4 believe that IPM fresh produce is at least as safe as conventional fresh produce. However they disagree that current conventional produce is safe and as their level of concern increases, are more likely to pay at least 20% more for IPM fresh produce.

7.5 Explaining willingness to pay

Following the previous analysis, it is proposed that respondents can be similarly grouped on the belief variables, with attitude modelled as a cardinal relationship to the probability of paying at least 20% more for IPM fresh produce. Groups one and three (or cells) now remain separate. The focus of the remaining analysis is to describe these groups using the demographic and information variables. The results of a stepwise discriminant analysis are presented in Table 7.20.

Table 7. 20 Variables in each analysis

Significance level	Stepwise selection		Forward selection	Backward elimination
	Var. in	Var. out	Variables in	Variables remaining
.1500	Maori recalinf emp suminfo members		Maori recalinf emp suminfo members	emp recalinf suminfo members Maori
.1000, .0900, .0750 and .0500	Maori recalinf emp suminfo		Maori recalinf emp suminfo	emp recalinf suminfo Maori

The results were stable from a significance level of 10% to 5% and the variables included in the analysis were Maori, recalinf, emp and suminfo. However, recalinf and suminfo are highly correlated (0.89), which would be expected given their relationship in the survey. No other total sample correlations were above 0.17. Two models were formulated, in which either suminfo or recalinf was included (Figure 7.12).

Figure 7. 12 Models to be compared

$$\text{Model A } D = f(\text{emp}, \text{Maori}, \text{suminfo})$$

$$\text{Model B } D = f(\text{emp}, \text{Maori}, \text{recalinf})$$

Recalinf has a higher univariate F^8 than suminfo and produces a better result in a discriminant analysis as evaluated by the proportion of variance explained by the first function (Tables 7.21 and 7.22).

Suminfo was also removed from the list of variables entered in the stepwise analysis to see if any other variables enter at the various significance levels. No further variables were entered or removed with a significance level set from 0.10 down to 0.05.

Table 7. 21 Univariate F-statistics of variables included in the models

Variable	F	Pr>F
Maori	7.3247	.0001
emp	4.2904	.0055
recalinf	0.0303	.0303
suminfo	1.7769	.1514

Table 7. 22 Percent of between groups variability explained by function 1

Model	Percent of between groups variability canonical function 1
A	.8242
B	.8946

The final model chosen from the models compared (Figure 7.12) is Model B.

Since in this MDA there are four groups, three orthogonal canonical functions fully explain the between group centroid variance. The proportion of between groups variability explained by canonical functions 2 and 3, in Model B, respectively is .0694 and .0360. Again Wilks' Lambda, as a statistical test of the functions, may not be reliable, due to the nature of the explanatory variables included in the model, which are all dichotomous.

The parameters for the explanatory variables change a little in magnitude between their simple correlations with each canonical function (Table 7.23) and their partial contribution to the same (Table 7.24 and Table 7.25) but there are no sign changes.

⁸ From a discriminant analysis for Model A and Model B, not the stepwise procedure.

All three variables make a large contribution to canonical function 1 and canonical function 2. The variable indicating whether the respondent is Maori or not does not however make a large contribution to canonical function 3. There are no changes in the signs of the coefficients from the correlations to the standardised total sample and pooled within-group canonical coefficients. The standardised total sample and pooled within-group canonical coefficients increase in magnitude from the simple correlation with canonical function 3 for the variable indicating whether the respondent is Maori or not.

Table 7. 23 Pooled within canonical structure

Variable	Canonical Function 1	Canonical Function 2	Canonical Function 3
Maori	-0.7262	.6804	.0985
emp	0.5444	.3795	.7480
recalinf	0.4265	.6723	-.6051

Table 7. 24 Total sample canonical coefficients

Variable	Canonical function 1	Canonical Function 2	Canonical Function 3
Maori	-0.7586	.6716	.2114
emp	0.4884	.4061	.7954
recalinf	0.4792	.6064	-.6564

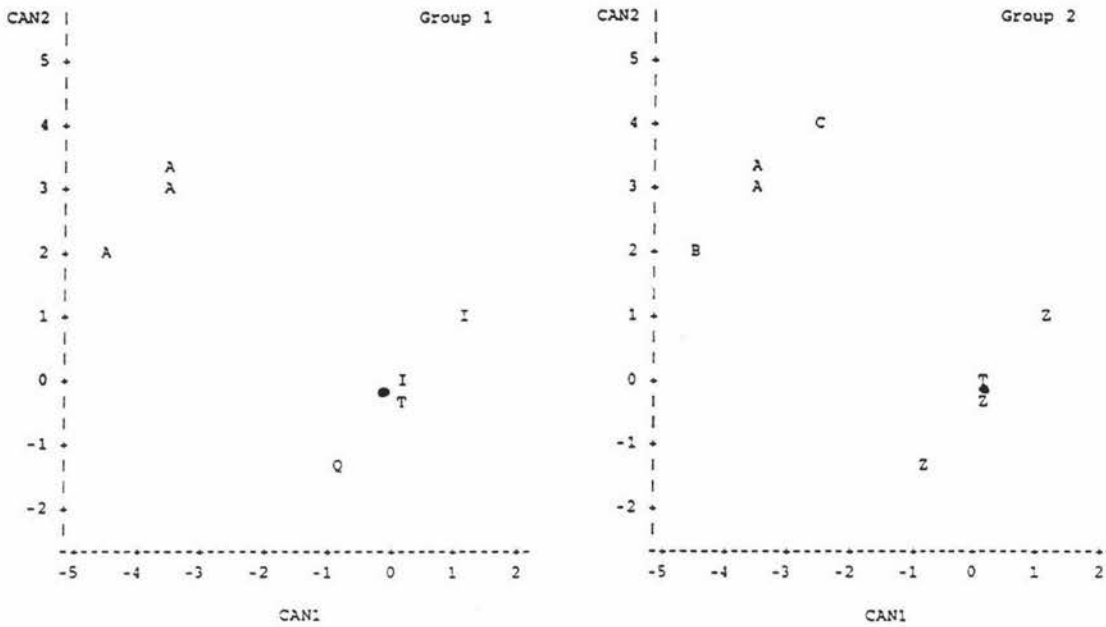
Table 7. 25 Pooled within-group standardized canonical coefficients

Variable	Canonical function 1	Canonical Function 2	Canonical Function 3
Maori	-0.7375	.6529	.2055
emp	0.4812	.4001	.7836
recalinf	0.4748	.6009	-.6504

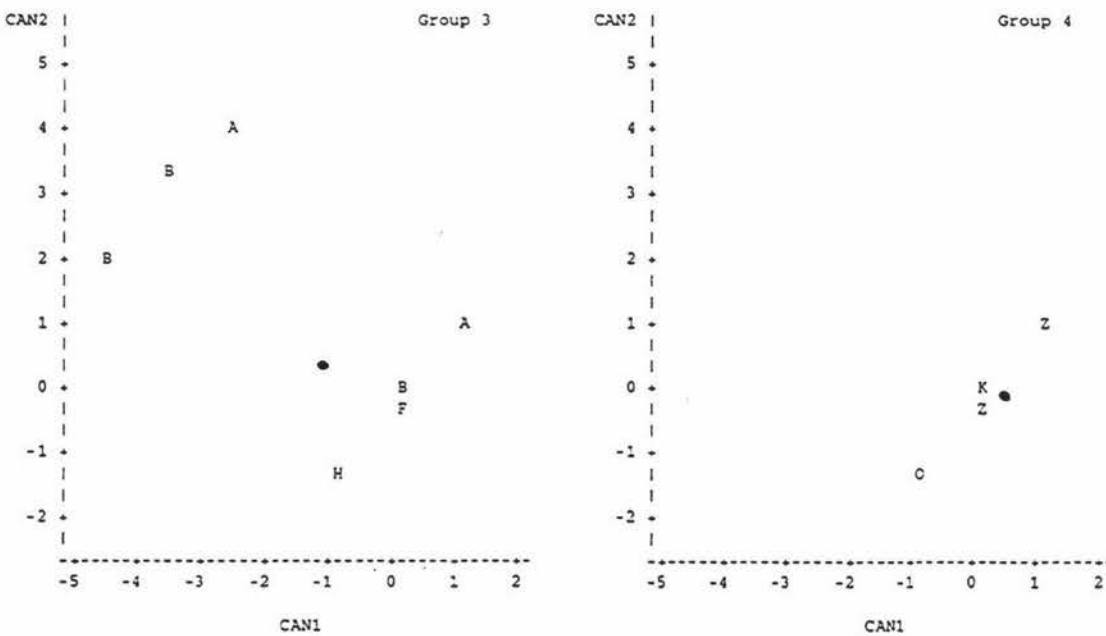
The similarity of the results to the discriminant analysis performed for the three groups based on respondents' willingness to consider buying IPM fresh produce might be expected. Two factors are likely to contribute to this. The groups are divided on the belief variables on a similar basis, except that groups one and three remain separate and only 43 respondents are left out of the analysis. However, it should be noted that the 43 respondents left out of the analysis are distributed differently among the groups than the 327 respondents remaining in the analysis (refer to Figure 7.10).

Respondent scores on canonical function 1 and canonical function 2 and the group centroids for these two functions are plotted in Figure 7.13. Group centroids are also presented in Table 7.26.

Figure 7. 13 Plot of canonical function 1 by canonical function 2 by group



NOTE: 54 obs hidden.



NOTE: 10 obs hidden.

Legend: A = 1 observation, B = 2 observations, etc. • indicates a group centroid.

The distribution of scores is extremely limited due to the nature of the variables. There are only eight possible combinations that a respondent can take. Respondents in Group 4 are limited to four of those values.

Table 7. 26 Group centroids

Group	Canonical Function 1	Canonical Function 2	Canonical Function 3
1	-0.2175	-0.1817	-0.0568
2	0.0274	0.0057	0.0709
3	-1.0612	0.1848	-0.0589
4	0.3591	0.0632	-0.0760

The group means on the explanatory variables also illustrate the differences between groups. These group means can be ranked (Table 7.27).

Table 7. 27 Ranking of group means

	Highest				Lowest			
	Mean	Group	Mean	Group	Mean	Group	Mean	Group
Maori	.22727	3	.05172	1	.04403	2	0	4
emp	.70455	4	.66038	2	.51724	1	.66038	3
recalinf	.53409	4	.40252	2	.32759	1	.27273	3

Groups 3 and 4 provide the greatest contrast. Group 4 has no Maori respondents and the highest levels of employment and highest probability of recall of information from the previous six months. Group 3 has the highest proportion of Maori respondents and the lowest employment and recall of information.

A more detailed presentation of the sample statistics by total sample and group is presented in Table 7.28.

Table 7. 28 Sample statistics for the predictors

Total Sample

Variable	N	Sum	Mean	Variance	Std dev
Maori	327	15	.04587	.04390	.20953
emp	327	205	.62691	.23461	.48437
recalinf	327	136	.41590	.24367	.49363

Group 1

Variable	N	Sum	Mean	Variance	Std dev
Maori	58	3	.05172	.04991	.22430
emp	58	30	.51724	.25408	.50407
recalinf	58	19	.32759	.22414	.47343

Group 2

Variable	N	Sum	Mean	Variance	Std dev
Maori	159	7	.04403	.04235	.20580
emp	159	105	.66038	.22570	.47508
recalinf	159	64	.40252	.24202	.49195

Group 3

Variable	N	Sum	Mean	Variance	Std dev
Maori	22	5	.22727	.18398	.42893
emp	22	8	.36364	.24242	.49237
recalinf	22	6	.27273	.20779	.45584

Group 4

Variable	N	Sum	Mean	Variance	Std dev
Maori	88	0	0	0	0
emp	88	62	.70455	.21055	.45886
recalinf	88	47	.53409	.25170	.50170

CHAPTER EIGHT

DISCUSSION

8.1 Introduction

There have been numerous studies of consumer concerns carried out in recent years, with a large proportion noticeably from the United States (US). Many of the questions used in this study have deliberately requested the same information as those asked of US consumers in papers by Weaver et al (1992), Ott (1990), Ott et al (1991), Byrne et al (1991) and Huang (1993). This is to provide for comparative analysis since few studies of consumer concerns, with a particular emphasis on agrichemical issues and concerns, have been carried out in New Zealand to date. In fact, in the process of the literature search for this study, none were found. Discussion of the results, in light of results from US studies, will be carried out in the same order as presented in sections 6.3.2 to 6.3.7 and 7.2 to 7.5.

Note that the terms pesticides and agrichemicals will be used interchangeably here as the studies discussed use the term pesticide.

8.2 Consumer ranking of food issues

Two questions were used to rank consumer concerns. These were of an identical format to two questions asked in a survey of consumers carried out by Ott et al (1991).

While US consumers rank foods grown with pesticides as their top concern, food poisoning second, and foods high in cholesterol third, New Zealand respondents rank food poisoning, then food grown using agrichemicals, and saturated fat, as their first, second and third greatest food concerns respectively.

Ott et al (1991) asked a second question to confirm the ranking of the first. They asked respondents to rank the health risk presented by cholesterol, saturated fats, salt and sugar compared with that presented by fresh produce grown with pesticides. They observed that, while the respondents to their survey are most concerned about pesticides, as indicated in the previous

question, they ranked the health risks of cholesterol, saturated fats, salt and sugar as higher than those of eating foods with pesticides.

While New Zealand consumers ranked fresh produce grown using agrichemicals as their second highest food concern, above saturated fat, cholesterol, salt and sugar, this ranking changes when an alternative question is posed. Respondents were asked how they rank the relative health risks of eating foods with saturated fat, cholesterol, sugar and salt compared with eating fresh produce grown with agrichemicals. Saturated fat and cholesterol were ranked as higher health risks than fresh produce grown using agrichemicals, salt was not a significantly higher or lower risk, and sugar was considered a significantly lower risk.

The change in ranking may not be that controversial. In the first question, saturated fat is rated as the third greatest concern at 0.75, compared with agrichemicals at 0.79 (Table 8.1), and the scores are quite close. Similarly, the intervening concerns between cholesterol and fresh produce grown using agrichemicals are either chemical issues, chemical food additives and chemical food preservatives, or food prices, an issue which was not tested in the second question. If all the chemical issues were collapsed into one category (agrichemicals, chemical additives and chemical preservatives), and the issue of food prices temporarily disregarded, these results suggest that foods with chemicals, foods high in saturated fat, and foods high in cholesterol may be concerns of a similar magnitude. The size of the original scores is a function of the number of responses people can make. Once they have ranked three concerns they cannot rank a fourth, so that if chemical food additives and chemical food preservatives were collapsed with agrichemicals, and price were not included, cholesterol would have a higher score.

Table 8. 1 Comparison between food concern rankings for different questions in the study

Food concerns	Ranking	Relative health risk	Ranking
food poisoning	1.54	saturated fat	0.46
foods grown using agrichemicals	0.79	cholesterol	0.39
foods high in saturated fat	0.75	salt	0.09
chemical food additives	0.73	food grown using agrichemicals	0
chemical food preservatives	0.60	sugar	-0.24
food prices too high	0.40		
foods high in cholesterol	0.38		
foods too low in nutritional value	0.33		
foods high salt	0.32		
foods high in sugar	0.17		

Ott et al (1991) consider that the inconsistent ranking by US consumers may stem from the belief that the benefits of eating fresh fruit and vegetables outweigh the risks, despite their concerns about agrichemicals. A second reason Ott et al (1991) suggest may be the lack of control over the risk agrichemicals present as opposed to being able to choose foods low in cholesterol, saturated fat, salt or sugar.

8.3 Consumers' level of concern

In a second study Ott (1990) phrased a question about respondents' level of concern in which he asked respondents to indicate which opinion was closest to their own (Table 8.2).

Table 8. 2 Respondent level of concern

Statements about pesticide use used by Ott (1990)	%	Level of concern about possible presence of agrichemicals on fresh fruit and vegetables (this study)	%
All pesticides should be banned.	13	Very concerned	21
Some pesticides should be banned with greater restrictions on remaining pesticides.	37	Quite concerned	31
Pesticides can be used safely, but there should be greater testing.	44	Moderately concerned	41
Current pesticides are safe and consumer fears are unwarranted.	6	Not at all concerned	7

The categories or statements used by Ott (1990) cannot be directly compared with the question used to ascertain respondents' level of concern in this study because of the difference in wording, but some general comparisons can be made.

Ott considered, for example, that responses to the first two statements "All pesticides should be banned" and "Some pesticides should be banned with greater restrictions on remaining pesticides" indicated that these respondents were concerned, while responses to the remaining two questions, "Pesticides can be used safely, but there should be greater testing" and "Current pesticides are safe and consumer fears are unwarranted" indicated that these respondents were unconcerned. If, instead, the statement "Pesticides can be used safely, but there should be greater testing" is considered to indicate at least some level of concern about the status quo, then there is an interesting similarity in the pattern of responses to the two questions.

Ott (1990, p596) phrased his question in this manner to avoid capturing respondent general concern because, as he comments, “[p]eople can worry about the safety of many things, but still feel items are safe to use”. For comparison he cites a study by Zind (1987) in which more than 75% of respondents indicated they were extremely or very concerned about pesticide use, and a study by Sacks et al (1987) in which almost 75% of respondents indicated a great deal or some concern about pesticides. But certainly the proportion of respondents in the study by Ott (1990) and this study, reported as indicating a positive level of concern, depends on the interpretation of the categories, with possibly as many as 94% and 93%, in the study by Ott and this study respectively, indicating a positive level of concern.

8.4 Other concerns

Respondents in this study were asked if they had any concerns other than the possible presence of agrichemicals on the fresh fruit and vegetables they ate. This was an open-ended question allowing multiple responses, to which 54% of respondents indicated yes. These concerns were categorised and are presented in Table 8.3.

Weaver et al (1992) asked a question in which respondents were asked whether they agreed or disagreed with five statements about pesticide use on fresh produce. These responses have been converted to a rank as for the previous questions, by multiplying the percentage of respondents in each category from strongly disagree to strongly agree by -2 to 2 respectively if the statement was about the harmful effects of pesticides. Statements about the benefits of pesticides were scored from 2 to -2 for strongly disagree through to strongly agree. The results provide a ranking of US consumer concerns (Table 8.3).

Environmental issues are the greatest concern for US consumers, as they are for New Zealand respondents. Agrichemical contamination of groundwater is ranked sixth by New Zealand respondents compared with first by US respondents to the study by Weaver et al (1992). This may be an artifact of the question in each study, as the statements were given to the US respondents rather than requested as an open-ended question.

Table 8. 3 Respondent concerns about the use of agrichemicals

Study by Weaver et al 1992		This study	
concern	score	concern	%
contaminates groundwater	1.06	long lasting effects on the environment	26
harm wildlife	1.05	food chain effects, effects on other beneficial species	15
does not harm environment	1.01	overseas markets	13
personal health	0.96	effects on long term health of people in general	12
does not harm farmworkers	0.89	effects on people who work with agrichemicals	9
		agrichemical contamination of groundwater	8
		spraydrift	8
		effects on the health of children e.g. asthma, rashes	5
		effects on the unborn child	4

8.5 Respondent beliefs about the benefits of agrichemicals

Weaver et al (1992) asked respondents about their beliefs regarding the benefits of agrichemical use. Respondents answered yes or no to statements about such uses. A similar question was asked in this study, although respondents were asked whether they agreed or disagreed (including strongly agree and strongly disagree) with statements about agrichemical use. Their answers are condensed into agree and strongly agree, which equates with yes in the study by Weaver et al, and disagree and strongly disagree, which equates with no. There is also a don't know category (Table 8.4).

Table 8. 4 Respondent beliefs about the benefits of agrichemicals

Using agrichemicals...	Study by Weaver et al (1992)			This study		
	Yes	No	Don't know	Yes	No	Don't know
increases storage life	54.5 ^a	27	18.6	40	33	27
reduces natural poisons	11.9	57	31.1	37	35	28
reduces prices	49.6	36.6	13.8	25	45	30
improves the quality	46.9	44.3	8.8	33	49	18

^a figures are to one decimal place as given by Weaver et al (1992).

US respondents are more likely to agree that using agrichemicals increases storage life, reduces prices, and improves the quality of fresh fruit and vegetables. New Zealand consumers are more likely to disagree that using agrichemicals reduces prices and improves quality, are divided evenly on whether they reduce natural poisons, and tend to agree that they increase storage life.

8.6 Reasons for not buying IPM fresh produce

Weaver et al (1992) asked respondents why they would not change their buying habits to buy certified pesticide residue free produce. When the results are compared with this study, the most interesting result is that a lack of information is an issue for a large proportion of the respondents in both studies (Table 8.5 and 8.6).

This finding is supported by the indication of respondents that IPM fresh produce should be labeled (81% agreed or strongly agreed). Seventy-one percent of respondents also indicated that they agreed or strongly agreed that they would prefer to buy fresh fruit and vegetables grown by a certified GROWSAFE grower rather than the fresh fruit and vegetables they currently buy. Certification provides some information to the consumer about the grower of the produce.

Table 8. 5 Reasons for not buying certified pesticide residue free produce (Weaver et al, 1992)

Reason	%
No concern	32
No information available	22
No organic or chemical free produce available	7
Price too high	5
Organic or chemical free quality is poor	2

Table 8. 6 Why respondents would not buy fresh produce grown using IPM

Reason	%
if it costs more (than prices currently pay)	40
not enough information to indicate this produce is different from conventional	28
would rather buy organic	10
grow our own	6
if the produce adversely affects health/IPM produce will adversely affect health	4
indifferent between IPM and conventional produce	3
if quality is lower/quality will be lower	3
miscellaneous (<i>detailed in Chapter Six</i>)	6

Only 8% of respondents consider they have enough information on agrichemical use on fresh fruit and vegetables. A study by Byrne et al (1991) found that respondents in their study were most likely to believe information provided by university scientists, public health officials, and environmental groups (highest to lowest probability respectively). Respondents in this study were

most likely to consider that government research agencies (30%), the Department⁹ (now Ministry) of Health (28%) and producer groups (12%) should be responsible for providing information but public interest groups (30%) and the Department of Health (28%) were considered the most reliable, with government research agencies third (16%).

8.7 Will respondents consider buying IPM fresh produce?

The model results indicate that respondents can be identified as belonging in one of three groups of consumers based on whether they would consider buying IPM fresh produce or not.

Considering Figure 8.1, respondents in group 3 (who believe conventional produce is not safe and IPM fresh produce is at least as safe) have the highest probability of purchasing IPM fresh produce if they are not at all concerned about agrichemical residues on the fresh fruit and vegetables they eat. Groups 1 and 2 have the same probability. However, if all the respondents consider themselves moderately concerned (they have a value of 2 on the x axis, Figure 8.1) then the probability of purchase for respondents in group 2 is the highest, followed closely by group 3, and group 1 has a lower probability of purchase. As the respondent level of concern rises, this same order prevails but the probability of purchase for respondents in group 1 declines rapidly, for group 3 declines slowly, and for group 2 increases but at a declining rate until there is little change in the probability that they will buy IPM produce.

Research into attitude and beliefs has shown that changing beliefs is generally easier than changing attitudes. This implies that a producer wishing to increase the probability of a consumer considering adopting IPM produce would wish to change consumer beliefs if they report a moderate or greater level of concern. Considering the probability functions for the three groups, such a producer would wish to change the belief structure of groups 1 and 3 to that of group 2. Assuming that the best way to do this might be through the provision of information, respondents in group 1 are most likely to consider the Department of Health, followed by public interest groups and government research agencies to be the most reliable sources of information, while respondents in group 3 are most likely to consider public interest groups, followed by the Department of Health and university scientists, to be the most reliable sources of information

⁹ The Department of Health description is maintained, as respondent perceptions of this government department/ministry may have changed with the recent changes in the structure of health provision and the current functions of the Ministry of Health

(Table 8.7). Respondents in all three groups were most likely to obtain information from television, newspapers and magazines (Table 8.8).

Figure 8. 1 Probability that respondents in each group will consider buying IPM produce, as a function of their level of concern

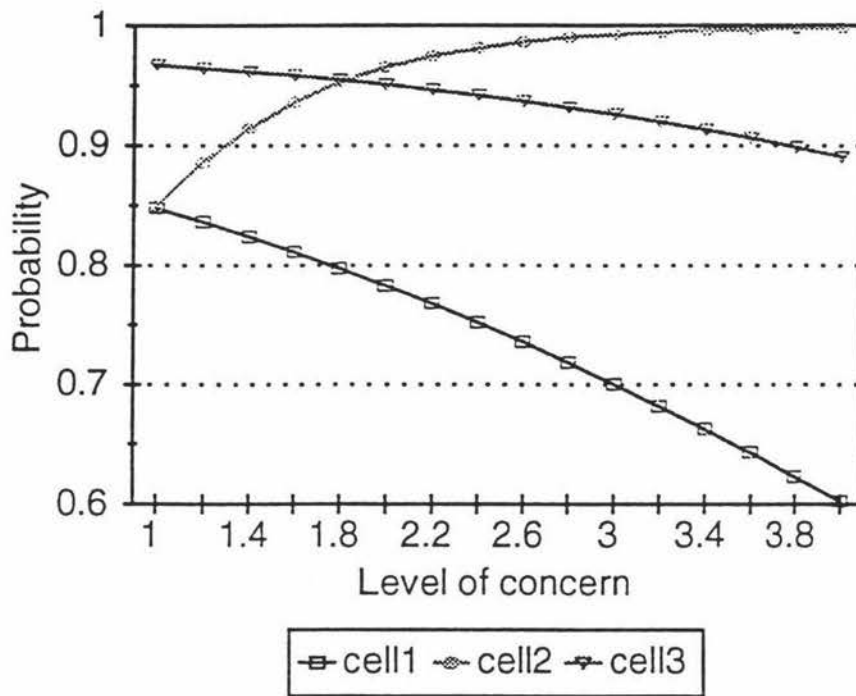


Table 8. 7 Sources of information considered reliable

Information sources considered reliable by group	Group		
	1	2	3
	%	%	%
Environmental groups e.g. Greenpeace	5	3	9
Department of Health e.g. pamphlets, public health nurses	28	30	22
University scientists e.g. plant health scientists	8	7	15
News media, e.g. television, radio, magazines	6	6	4
Government Research Agencies e.g. the Horticulture and Food Institute	17	20	10
Public Interest Groups e.g. Consumers' Institute	27	30	34
Producer groups, co-operatives e.g. Apple and Pear Marketing Board	1	1	1
Agrichemical companies	2	0	1
Multiple	6	4	4

Table 8. 8 Media channels recalled

Source	Group 1	Group 2	Group 3
Total	32	40	53
Television	46	44	53
Radio	14	21	27
Magazine	37	44	37
Newspaper	46	48	37
Health professional	14	18	14
Other	10	5	21
Reason indicated in other:	<ul style="list-style-type: none"> • friends • agricultural department • farmer and teacher • book • sickness in area from agrichemical use, leading to general awareness (Whakatane) 	<ul style="list-style-type: none"> • orchardist • seminar • conversation 	<ul style="list-style-type: none"> • university talk • organic grower • organic gardener • books • family member uses agrichemicals at work • use agrichemicals at work • biologist • Foodtown supermarkets • qualified speaker on soils • conversation • DSIR information book

Respondents have been identified as belonging in a group based on their beliefs and the group can be characterised in turn, by the respondent demographic variables, recall of information and familiarity with agrichemicals.

The variables which distinguish between the groups are ethnic origin (Maori or other), whether the respondent is employed or not, whether the respondent recalls information in the past six months or not, and whether the respondent (or anyone in the respondent's household) uses chemicals around the outside of their home to control pests and diseases.

Huang (1993) found that the following variables were significant in explaining risk perception, which corresponds to the belief variables in this study, whether the respondent uses pesticides in the home, whether the respondent is employed or not, the sex of the respondent, marital status and the presence of children in the household (Figure 8.2).

If the respondent uses pesticides around the home, and if the respondent is employed, are also significant explanatory relationships in this study. In the study by Huang, the use of pesticides by the respondent decreases their risk perception of pesticides, while if the respondent is employed, he or she is more likely to consider the risk from pesticides to be greater. In this study, group 2 has the lowest risk perception of agrichemicals (they consider current conventional fresh fruit and vegetables to be safe, and consider IPM fresh produce to be at least as safe) and the highest use of agrichemicals around the outside of the home, but the level of employment is lower for group 2 than for group 3 (although not by a great deal) and higher than for group 1.

Older, black less educated respondents from smaller households are more likely to have a favourable attitude towards the use of pesticides in the study by Huang (1993). This result is not directly comparable, since the attitude variable in this study is not tested directly.

Figure 8. 2 Results of the model by Huang (1993)

Risk Perception	<i>USPEST</i> **	<i>FEMALE</i> *	<i>EMPLOYED</i> **	<i>HSTATUS</i> **
	-0.357	0.246	0.368	0.503
Attitude	<i>AGE</i> ***	<i>BLACK</i> **	<i>HSIZE</i> **	<i>EDUC</i> *
	0.498	0.450	-0.133	-0.029
Willingness to pay	<i>TEST</i> ***	<i>FEMALE</i> *	<i>INCOME</i> **	
	0.565	0.184	0.006	

***, **, * asymptotic t-ratio, significant at 0.01, 0.05 and 0.10 levels respectively.

8.8 An alternative approach

An alternative approach to using only the attitude and belief variables in the initial logistic regression would be to include all the variables, both the set of attitudes and beliefs and the demographic and information variables (Nayga, 1993). This has been carried out to illustrate the effect on the parameters of the belief and attitude variables (Model C, Table 8.9). Recall that the attitude and belief variables are also already restricted from the investigation carried out in this study. A second comparison is made between the logistic regression with only the belief and attitude variables (Model A, Table 8.9) and a model with both attitude and beliefs and the restricted set of demographics significant in the discriminant analysis (Model B, Table 8.9). The

likelihood statistics for the models are presented in Table 8.10 and the likelihood ratios between models are presented in Table 8.11. The full models are presented in Appendix 2.

In Model C, with the belief and attitude variables and the complete set of demographic variables, none of the attitude and belief parameters are significant. In addition there is some change in the parameter values. In Model B, with the attitude and belief variables and the restricted set of demographic variables, three of the parameters remain significant at the 5% level, but there is also some change in the parameter values. When the relevant likelihood ratios and associated significance levels are calculated, Model A, the most restricted model, does not result in a significant loss of explanatory power relative to Models B and C and Model B does not result in a significant loss of explanatory power relative to Model C.

The conclusion made from these results is that inclusion of (at least) the full set of demographic and information variables in the initial logistic regression would have obscured the underlying structure of factors influencing consumer choice, as hypothesized in Chapter Three, Figure 3.11.

Table 8.9 Belief and attitude parameter results

Parameter	Model A ^a		Model B ^a		Model C ^a	
	Parameter Estimate	SL: $H_0: \beta = 0$	Parameter Estimate	SL: $H_0: \beta = 0$	Parameter Estimate	SL: $H_0: \beta = 0$
β_{01}	2.1495	.0007	2.8265	.0104	1.3088	.6059
β_{02}	.1248	.9381	.6405	.7223	.0987	.9718
β_{03}	3.8284	.0000	4.3750	.0003	2.8296	.2837
$\beta_{1(134)}$	-.4332	.0427	-.3433	.1262	-.3409	.1903
$\beta_{1(2)}$	1.6040	.0565	1.7248	.0440	1.3110	.1178

^aThe full models are presented in Appendix B.

Table 8.10 - 2 log L statistic for models

Model	- 2 log L	DF
C	202.935	26
B	216.193	9
A	220.111	5

Table 8. 11 Likelihood ratio statistic between models

Model	C	B	A
C	*	*	*
B	13.258, 17 .7188	*	*
A	17.176, 21 .7004	3.918, 4 .4172	*

8.9 Will respondents pay more for IPM fresh produce?

Respondents in group 3 are most likely to pay at least 20% more for IPM fresh produce if they are not at all concerned or moderately concerned. However, once respondents indicate they are quite concerned or very concerned, the probability that a respondent will pay at least 20% more is highest for respondents in group 2, closely followed by respondents in group 4 and then respondents in groups 1 and 3 (Figure 8.3).

As groups 2 and 4, defined in this model, remain the same as groups 2 and 3, defined in the probability model for whether respondents would consider buying IPM fresh produce, information sources remain the same for these two groups. Considering only groups 1 and 3, both groups consider the Department of Health and public interest groups the most reliable sources of information (Table 8.12). Respondents in group 1 were most likely to obtain information from newspapers, while respondents in group 3 were most likely to obtain information from television (Table 8.13).

Figure 8. 3 Probability that respondents in each group will consider paying at least 20% more for IPM produce, as a function of their level of concern

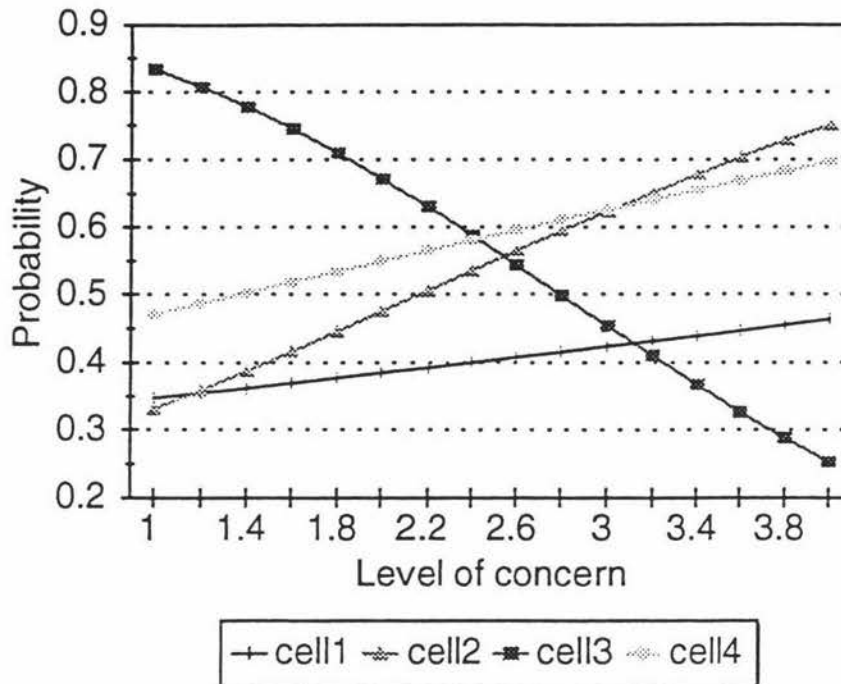


Table 8. 12 Sources of information considered reliable

Information sources considered reliable by group	Group	
	1 %	3 %
Environmental groups e.g. Greenpeace	5	3
Department of Health e.g. pamphlets, public health nurses	29	27
University scientists e.g. plant health scientists	7	12
News media, e.g. television, radio, magazines	4	12
Government Research Agencies e.g. the Horticulture and Food Institute	20	12
Public Interest Groups e.g. Consumers' Institute	25	30
Producer groups, co-operatives e.g. Apple and Pear Marketing Board	1	0
Agrichemical companies	3	0
Multiple	7	1

Table 8. 13 Media channels recalled

Source	Group 1	Group 3
Total	30	36
Television	39	58
Radio	13	16
Magazine	39	33
Newspaper	43	5
Health professional	17	8
Other	7	33

The same explanatory variables characterise these groups, developed on how much respondents were willing to pay for IPM fresh produce, as the groups developed on whether the respondents would consider buying IPM fresh produce.

8.10 Will consumers change behaviour based on information?

Of the 54% of respondents who indicated that they could recall seeing or hearing information in the previous six months on the use of agrichemicals or agrichemical residues on fresh fruit and vegetables, 80% indicated that they had made no change in their buying habits, with regard to fresh fruit and vegetable purchases.

Weaver et al (1992) found that 43% of the respondents in their study had made changes in their buying habits. Forty-one percent indicated that they bought more organic or certified pesticide residue free fresh produce, 22% buy less fresh produce, 28% stopped buying produce cited in the media as dangerous due to chemical (sic) residues and 5% now grew their own.

Comparatively, within the restricted framework of the question, 5% of respondents in this study indicated they now bought more fresh produce, while 15% indicated they now bought less. Unfortunately, the type of produce the respondents bought less or more of was not ascertained.

Considering the grouping for respondents according to whether they would consider buying IPM fresh produce (3 groups), the differences with respect to changes in buying habits are presented in Table 8.14. Respondents in groups 1 and 3 have made the most changes and since it is their behaviour that a producer of IPM produce is most likely to want to change, this might be considered encouraging.

Table 8. 14 Changes in purchase habits for fresh fruit and vegetables, as a result of information seen or heard in previous six months

	Group 1	Group 2	Group 3	Overall
Yes, I buy more fresh fruit and vegetables	10	1	5	5
No, I have made no changes	68	95	70	80
Yes, I buy less fresh fruit and vegetables	22	4	25	15

8.11 Conclusion

Consumer demand in this study is assumed to be for the characteristics of a good rather than the good per se (Lancaster, 1966). In addition it is assumed that consumers do not have perfect information. If a new good is introduced which differs on only one characteristic from other goods in the market, consumer choice for that good will be based on consumer perception of that characteristic.

Perception, overall attitude and concerns are considered synonymous terms for a consumer's subjective evaluation of the characteristic. This subjective evaluation may be more or less close to the objective reality of the characteristic (Earl, 1995). Perception of a characteristic will be based on the consumer's information or knowledge about the characteristic and on their personal characteristics, such as ethnic origin, education and income. Such a model provides for education, advertising and branding as means for changing consumer beliefs, and hence, as shown in this study, influencing the probability of consumer choice.

Following Lancaster (1966, p154), there is some justification in concluding that the model explored in this study "is a model very many times richer in heuristic explanatory and predictive power than the conventional model of consumer behaviour".

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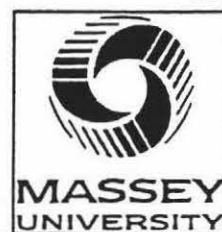
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APPENDIX 1

SURVEY INSTRUMENT



Ruth Wilson-Salt
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PALMERSTON NORTH

Office number (06) 356 9099 extn 8706
Facsimile number (06) 359 5642

WIN AN ANSETT MYSTERY WEEKEND FOR TWO

24 May 1993

Dear *[Respondent's Name]*

How do you feel about agrichemical (insecticide, fungicide and herbicide) use on the fresh fruit and vegetables you eat?

The following questionnaire has been sent out as part of a study at Massey University to find out how consumers feel about agrichemical use on fresh fruit and vegetables.

All responses given are treated confidentially and used only for the purposes of this study. A code number, not your name, will identify the completed questionnaire.

To show our appreciation for your participation in this survey we have organised for all participants to enter a draw for an **ANSETT MYSTERY WEEKEND FOR TWO**, with a value of \$458, which can be taken any time in the next year from 23 June 1993. There have been only 2000 surveys sent nationwide and there is one weekend to be won.

To be eligible for the draw all you have to do is complete the survey and the entry slip at the end of the survey and return it to us by Wednesday 23 June 1993 in the reply paid envelope enclosed. No stamp is required. The winner will be drawn and notified by post or telephone and the result published in the Dominion Sunday Times on Sunday 27 June 1993.

Your assistance with this research effort is greatly appreciated.

Yours sincerely

Ruth Wilson-Salt



**SURVEY OF CONSUMER VIEWS OF AGRICHEMICAL USE ON FRESH FRUIT
AND VEGETABLES**

The following questionnaire has been distributed as part of a study at Massey University to find out how consumers feel about agrichemical use on fresh fruit and vegetables.

Agrichemicals used on fresh fruit and vegetables are commonly called pesticides and include insecticides, fungicides, and herbicides. The name agrichemical does not include chemical fertilisers. For the purpose of this survey we are interested in your opinion of insecticide, fungicide and herbicide use on fresh fruit and vegetables.

All responses given are treated confidentially and used only for the purposes of this study. A code number, not your name, will identify the completed questionnaire. Please answer all of the questions.

For further information or any enquiries you may have please contact:

Ruth Wilson-Salt
Department of Agricultural Economics and Business
Massey University
Private Bag
Palmerston North
New Zealand
Office number (06) 356 9099 extn 8706
Facsimile number (06) 350 5642

INSTRUCTIONS - PLEASE ANSWER THE FOLLOWING QUESTIONS BY CIRCLING THE APPROPRIATE ANSWER, TICKING THE APPROPRIATE BOX OR BY WRITING IN THE SPACE PROVIDED.

1. Which of the following are your three major food concerns.

Please indicate (A) your greatest concern
(B) your second greatest concern
and (C) your third greatest concern

BY TICKING THE BOX OF ONE ITEM ONLY FOR EACH COLUMN ACCORDING TO YOUR CHOICES.

	(A) Greatest Concern	(B) Second Greatest Concern	(C) Third Greatest Concern
foods high in salt	[].....	[].....	[].....
foods high in saturated fats	[].....	[].....	[].....
foods grown using agrichemicals	[].....	[].....	[].....
foods high in sugar	[].....	[].....	[].....
foods high in cholesterol	[].....	[].....	[].....
food poisoning (botulism, salmonella)	[].....	[].....	[].....
chemical food preservatives	[].....	[].....	[].....
chemical food additives	[].....	[].....	[].....
foods too low in nutritional value	[].....	[].....	[].....
food prices too high	[].....	[].....	[].....

2. How would you personally rate the health risk of eating fruit and vegetables grown with agrichemicals compared to eating food with saturated fat, sugar, salt or cholesterol? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE FOR EACH ITEM.

I believe that the health risk for eating food with...	much lower	somewhat lower	neither higher nor lower	somewhat higher	much higher
...saturated fat is...	1	2	3	4	5
...sugar is...	1	2	3	4	5
...salt is...	1	2	3	4	5
...cholesterol is..	1	2	3	4	5

...than eating fresh fruit and vegetables grown using agrichemicals.

3. How would you personally rate your level of concern about the possible presence of agrichemical residues on the fresh fruit and vegetables you eat? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Not at all concerned	.....	1
Moderately concerned	.....	2
Quite concerned	.....	3
Very concerned	.....	4

4. Are you concerned about agrichemical use on any specific kind of fresh fruit and vegetables? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Yes1
 No2

IF YES, PLEASE INDICATE WHICH KINDS IN THE SPACE BELOW.

5. Are you personally concerned about agrichemical use for any reason other than the possible presence of agrichemical residues on the fresh fruit and vegetables you eat?

Yes1
 No2

IF YES, COULD YOU DESCRIBE YOUR REASONS BRIEFLY BELOW

6. Please indicate the extent to which you agree or disagree with the following statements about the use of agrichemicals on fresh fruit and vegetables. PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE FOR EACH STATEMENT.

Using agrichemicals...	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
a) ...improves the quality of fresh fruit and vegetables	1	2	3	4	5
b) ...reduces the price of fresh fruit and vegetables	1	2	3	4	5
c) ...increases the storage life of fresh fruit and vegetables	1	2	3	4	5
d) ...reduces natural poisons from pests and diseases	1	2	3	4	5

7. Do you personally recall hearing or reading any information about agrichemical use and/or levels of agrichemical residues on fresh fruit and vegetables within the last six months? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

- Yes1
- No2

IF YES, what was the source of this information? PLEASE SPECIFY AND CONTINUE TO QUESTION 8.

- television1
- radio2
- magazine3
- newspaper4
- health professional, e.g. doctor, nurse, homeopath5
- other (please specify) _____6

IF NO, PLEASE CONTINUE TO QUESTION 9.

8. Have your fresh fruit and vegetable buying habits changed because of this recent information about agrichemical use and/or levels of agrichemical residues on fresh fruit and vegetables? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

- Yes, I buy more fresh fruit and vegetables1
- No, I have made no changes2
- Yes, I buy less fresh fruit and vegetables3

9. Do you believe that you, as a consumer, have enough information on agricultural chemical use on fresh fruit and vegetables? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

- Yes1
- No2

10. Do you or does anyone in your household use any form of chemical to control weeds, pests and diseases around the outside of your property? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

- Yes1
- No2

11. Which ONE of the following organisations do you think should be RESPONSIBLE in terms of money and time for providing consumer information? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

- Environmental groups e.g. Greenpeace1
- Department of health e.g. pamphlets, public health nurses2
- University scientists e.g. plant health scientists3
- News media, e.g. television, radio, magazines4
- Government Research Agencies e.g. the Horticulture and Food Institute5
- Public Interest Groups e.g. Consumers' Institute6
- Producer groups, cooperatives e.g. the Apple and Pear Marketing Bd7
- Agrichemical companies8
- Other (please specify) _____9

12. Of the following sources of information, which ONE do you personally consider the MOST reliable on food safety issues? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Environmental groups e.g. Greenpeace	1
Department of health e.g. pamphlets, public health nurses	2
University scientists e.g. plant health scientists	3
News media, e.g. television, radio, magazines	4
Government Research Agencies e.g. the Horticulture and Food Institute	5
Public Interest Groups e.g. Consumers' Institute	6
Producer groups, cooperatives e.g. the Apple and Pear Marketing Bd	7
Agrichemical companies	8
Other (please specify)	9

PLEASE READ THE FOLLOWING INFORMATION

GROWSAFE

The GROWSAFE Training Programme has been set up by the New Zealand Agrichemical Education Trust. In order to use the GROWSAFE logo, the Trust's registered mark, growers must undertake and satisfy the requirements of an assessment of their knowledge of and practice in using agrichemicals. A certificate is then issued to such growers and they may use the GROWSAFE logo for the fresh fruit and vegetables they grow.

13. Please indicate if you agree or disagree with the following statement.

I would prefer to buy fresh fruit and vegetables grown by a certified GROWSAFE grower rather than the fresh fruit and vegetables I currently buy.

PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Strongly agree.....	1
Agree.....	2
Neither Agree nor Disagree.....	3
Disagree.....	4
Strongly Disagree.....	5

PLEASE READ THE FOLLOWING INFORMATION

INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) is a management process used to grow fresh fruit and vegetables. Growers use various monitoring methods to determine the number of pests in the area where the produce is grown and also take into account weather conditions which affect pest numbers. Agrichemical sprays are not used until pest numbers reach a preset threshold level. Growers also encourage the natural predators of the pests that attack their produce by careful selection and timing of spray applications.

Use of an integrated pest management programme means the number of spray applications **MAY** be reduced compared with a **conventional** (non-IPM, non-organic) programme which uses a programme of sprays on a regular basis to prevent the build up of pests.

The IPM programme produces fresh fruit and vegetables which are of the same quality and size as those produced using a conventional spray programme.

Fresh fruit and vegetables grown using integrated pest management are **NOT** the same as organic fresh fruit and vegetables which are grown without the use of conventional agrichemicals.

14. Given the information above [*about fresh produce grown using integrated pest management*] please indicate the extent to which each of the following statements describes your opinion by **CIRCLING THE NUMBER OF YOUR RESPONSE TO EACH STATEMENT.**

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
a) Fresh fruit and vegetables grown using integrated pest management will be LESS SAFE than conventional produce	1	2	3	4	5
b) Current conventional fresh fruit and vegetable supplies are safe	1	2	3	4	5
c) Fresh fruit and vegetables grown using IPM should be labelled	1	2	3	4	5

15. Approximately how much does your household currently spend on fresh fruit and vegetables per week?

PLEASE WRITE YOUR ANSWER HERE \$ _____

16. If fresh fruit and vegetables grown using integrated pest management are available would you consider buying them? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Yes1
 No2

IF YOU ANSWERED YES, PLEASE CONTINUE TO QUESTION 17.
 IF YOU ANSWERED NO, PLEASE CONTINUE TO QUESTION 18.

17. If all fresh fruit and vegetables you currently buy could be bought as produce grown using IPM, how much would you be willing to pay for IPM produce above the prices you currently pay? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

0%not willing to spend more1
 20%adds \$2 for every \$10 you currently spend on fresh produce2
 40%adds \$4 for every \$10 you currently spend on fresh produce3
 60%adds \$6 for every \$10 you currently spend on fresh produce4

18. Please could you indicate briefly why you would not buy and/or eat fresh fruit and vegetables grown using integrated pest management. PLEASE USE THE SPACE BELOW.

The amount of any food that the members of a household buy depends on various personal, social and economic factors. To help us analyse your answers above, please answer the following questions about yourself and your household. PLEASE REMEMBER THAT THE SURVEYS ARE COMPLETELY ANONYMOUS AND THAT YOUR RESPONSES CANNOT BE IDENTIFIED.

19. How would you classify where you live? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE

City1
 Town2
 Rural3

20. PLEASE INDICATE YOUR SEX

Male1
 Female2

21. What is your ethnic background? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

New Zealander/Maori1
 New Zealander/European2
 Polynesian3
 Asian4
 European5
 Other (please specify) _____6

22. Which of the following best describes your highest level of education? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

Primary school1
 High school for up to 3 years2
 Secondary school for 4 years or more3
 Some tertiary education (polytechnic, trade, university)4
 Tertiary graduate (course completed)5

23. Including yourself, family members, boarders and flatmates how many people are there altogether in this household?

PLEASE WRITE THE NUMBER HERE _____

24. And how many of these are 18 years of age or older?

PLEASE WRITE THE NUMBER HERE _____

25. Which of these categories best describes you at the moment? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.

No children1
 Youngest child under 182
 Youngest child over 183

26. What is your age? PLEASE CIRCLE THE NUMBER OF YOUR RESPONSE.
- | | | |
|------------|-------|---|
| under 20 | ..... | 1 |
| 20 - 29 | ..... | 2 |
| 30 - 39 | ..... | 3 |
| 40 - 49 | ..... | 4 |
| 50 - 59 | ..... | 5 |
| 60 - 69 | ..... | 6 |
| 70 or over | ..... | 7 |
27. Approximately what is the annual income of your household before taxes?
- | | | |
|-----------------------------|-------|---|
| less than \$10000 | ..... | 1 |
| between \$10000 and \$19999 | ..... | 2 |
| between \$20000 and \$29999 | ..... | 3 |
| between \$30000 and \$39999 | ..... | 4 |
| between \$40000 and \$49999 | ..... | 5 |
| between \$50000 and \$59999 | ..... | 6 |
| between \$60000 and \$69999 | ..... | 7 |
| more than \$69999 | ..... | 8 |
28. Are you presently...
- | | | |
|----------------------|-------|---|
| Employed with pay | ..... | 1 |
| Employed without pay | ..... | 2 |
| Retired | ..... | 3 |
| Homemaker | ..... | 4 |
| Unemployed | ..... | 5 |
| Student | ..... | 6 |
| Unable to work | ..... | 7 |
| Not working | ..... | 8 |
29. Do you belong to an environmental organisation such as Greenpeace, Maruia Society, Royal Forest and Bird Society?
- | | | |
|-----|-------|---|
| Yes | ..... | 1 |
| No | ..... | 2 |

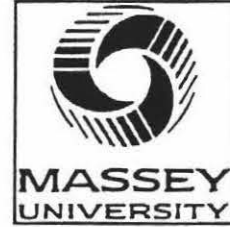
THANKYOU FOR YOUR TIME AND ASSISTANCE WITH THIS RESEARCH EFFORT.

PLEASE COMPLETE THIS SECTION IF YOU WISH TO ENTER THE DRAW FOR THE
ANSETT MYSTERY WEEKEND FOR TWO

NAME _____

DAYTIME PHONE NUMBER _____ HOME PHONE NUMBER _____

POSTAL ADDRESS _____



Ruth Wilson-Salt
Department of Agricultural
Economics and Business
Massey University
Private Bag
PALMERSTON NORTH

Office number (06) 356 9099 extn 8706
Facsimile number (06) 359 5642

7 June 1993

Dear Respondent

Your name was chosen at random from a list of respondents and a questionnaire sent to you on 26 May 1993 as part of a study at Massey University to find out how consumers feel about agrichemical use on fresh fruit and vegetables.

To enable us to get a representative result it would be of great help if you could complete the survey sent and post it to us before 23 June 1993. As indicated in the previous letter we have organised for all respondents to enter a draw for an ANSETT MYSTERY WEEKEND FOR TWO, to be taken any time within a year from 23 June 1993.

If you have completed and returned your survey already please disregard this letter and thank you for your time and effort in doing so.

Yours sincerely

Ruth Wilson-Salt

APPENDIX 2

MODELS COMPARED IN SECTION 8.9

MODEL A

LOGISTIC REGRESSION /VARIABLES buyipm WITH
var13 var2 var4 var134b var2b /origin.

Total number of cases: 370 (Unweighted)
Number of selected cases: 370
Number of unselected cases: 0

Dependent Variable.. BUYIPM

Initial Log Likelihood Function

-2 Log Likelihood 512.92891

	Chi-Square	df	Significance
-2 Log Likelihood	220.111	365	1.000
Model Chi-Square	292.817	5	.0000
Improvement	292.817	5	.0000
Goodness of Fit	417.642	365	.0296

Classification Table for BUYIPM

Observed		Predicted		Percent Correct
		0	1	
0	0	3	43	.00%
1	1	3	327	100.00%
Overall				88.38%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
VAR13	2.1495	.6336	11.5090	1	.0007	.1362	8.5802
VAR2	.1248	1.6066	.0060	1	.9391	.0000	1.1329
VAR4	3.8284	.8177	21.9214	1	.0000	.1971	45.9903
VAR134B	-.4332	.2137	4.1083	1	.0427	-.0641	.6485
VAR2B	1.6040	.8410	3.6377	1	.0565	.0565	4.9729

MODEL B

LOGISTIC REGRESSION /VARIABLES buyipm WITH var13 var2 var4 var134b var2b
EMP maori recalinf pestcont /origin.

Total number of cases: 370 (Unweighted)
Number of selected cases: 370
Number of unselected cases: 0

Dependent Variable.. BUYIPM

Initial Log Likelihood Function

-2 Log Likelihood 512.92891

	Chi-Square	df	Significance
-2 Log Likelihood	216.193	361	1.000
Model Chi-Square	296.736	9	.0000
Improvement	296.736	9	.0000
Goodness of Fit	374.377	361	.3027

Classification Table for BUYIPM

		Predicted		Percent Correct
		0	1	
Observed	0	3	42	2.33%
	1	3	327	100.00%
Overall				88.65%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
VAR13	2.8265	1.1024	6.5732	1	.0104	.0944	16.8859
VAR2	.6405	1.8019	.1263	1	.7223	.0000	1.8974
VAR4	4.3750	1.2165	12.9344	1	.0003	.1460	79.4429
VAR134B	-.3433	.2245	2.3385	1	.1262	-.0257	.7094
VAR2B	1.7248	.8565	4.0554	1	.0440	.0633	5.6115
EMP	.2632	.3689	.5092	1	.4755	.0000	1.3011
MAORI	-.1416	.6112	.0537	1	.8168	.0000	.8680
RECALINF	-.0860	.3747	.0527	1	.8185	.0000	.9176
PESTCONT	-.5981	.3701	2.6116	1	.1061	-.0345	.5499

MODEL C

LOGISTIC REGRESSION /VARIABLES buyipm WITH var13 var2 var4 var134b var2b
 locat sex educ members nochild child age income EMP RET HOME NETWORK maori
 nzeuro poly asian euro envmem recalinf suffinfo pestcont /origin.

Total number of cases: 370 (Unweighted)
 Number of selected cases: 370
 Number of unselected cases: 0

Dependent Variable.. BUYIPM

Initial Log Likelihood Function

-2 Log Likelihood 512.92891

	Chi-Square	df	Significance
-2 Log Likelihood	202.935	344	1.000
Model Chi-Square	309.994	26	.0000
Improvement	309.994	26	.0000
Goodness of Fit	327.239	344	.7337

Classification Table for BUYIPM

Observed		Predicted		Percent Correct
		0	1	
0	0	5	38	11.63%
1	1	8	319	97.55%
Overall				87.57%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
VAR13	1.3088	2.5369	.2661	1	.6059	.0000	3.7016
VAR2	.0987	2.7887	.0013	1	.9718	.0000	1.1037
VAR4	2.8296	2.6395	1.1492	1	.2837	.0000	16.9393
VAR134B	-.3409	.2603	1.7150	1	.1903	.0000	.7111
VAR2B	1.3110	.8382	2.4462	1	.1178	.0295	3.7099
LOCAT	.1238	.4858	.0649	1	.7989	.0000	1.1318
SEX	-.4236	.4075	1.0807	1	.2985	.0000	.6547
EDUC	-.0610	.1777	.1178	1	.7315	.0000	.9408
MEMBERS	.0339	.1763	.0369	1	.8477	.0000	1.0345
NOCHILD	-.6206	.5916	1.1005	1	.2942	.0000	.5376
CHILD	-.9508	.6165	2.3780	1	.1231	-.0271	.3864
AGE	.2023	.1682	1.4459	1	.2292	.0000	1.2242
INCOME	-.0022	.1134	.0004	1	.9846	.0000	.9978
EMP	.0129	.8286	.0002	1	.9876	.0000	1.0130
RET	-.9209	1.0955	.7067	1	.4005	.0000	.3981
HOME	.1493	1.0216	.0214	1	.8838	.0000	1.1610
NETWORK	.2211	1.0592	.0436	1	.8345	.0000	1.2475
MAORI	.2262	1.4174	.0255	1	.8732	.0000	1.2538
NZEURO	.7165	1.2706	.3179	1	.5728	.0000	2.0472
POLY	5.6353	20.4595	.0759	1	.7830	.0000	280.1291
ASIAN	5.3403	19.3593	.0761	1	.7827	.0000	208.5774
EURO	.1811	1.3570	.0178	1	.8938	.0000	1.1986
ENVMEM	.8710	.5454	2.5508	1	.1102	.0328	2.3894
RECALINF	-.0296	.4108	.0052	1	.9426	.0000	.9709
SUFFINFO	.7105	.6490	1.1985	1	.2736	.0000	2.0350
PESTCONT	-.6636	.4120	2.5937	1	.1073	-.0340	.5150