Changing Patterns of Tastes and Preferences for Food in Great Britain

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by

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Abstract

Recently the importance of underlying, non-economic factors in the determination of food choice has been increasing. It is hypothesised that changes in these underlying factors, sometimes known as food preferences, are a function of fundamental changes in consumers' attitudes. Attitudes, defined as the *belief* about an object, the *emotions* associated with it and the *readiness* to behave in a certain way, can in turn, it is contended, be determined by socio-economic and demographic measures.

The precise nature of food preference changes in Great Britain is measured, and it is shown that *post hoc* variables are better than *a-priori* variables at segmenting consumers with respect to their consumption of foods. Moreover, these *post hoc* variables are statistically significant determinants of the consumption of those foods which have undergone the most marked preference changes in recent years.

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This thesis is dedicated to my mum, Hilary Hutchins.

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List of Abbreviations

B.C.S.	British Cardiac Society
B.N.F.	British Nutrition Foundation
C.C.C.	Cubic Clustering Criterion
C.H.D.	Coronary Heart Disease
C.O.M.A.	Committee on Medical Aspects of Food Policy
C.S.O.	Central Statistical Office
D.H.S.S.	Department of Health and Social Security
D.O.E.	Department of Employment
F.E.S.	Family Expenditure Survey
F.A.O.	Food and Agriculture Organization of the United Nations
H.E.C.	Health Education Council of England
H.M.S.O.	Her Majesty's Stationery Office
I.H.D.	Ischaemic Heart Disease
K.K.P.	Key Kitchen Person
M.A.F.F.	Ministry of Agriculture, Fisheries and Food
N.A.C.N.E.	National Advisory Committee on Nutrition Education
N.F.S.	National Food Survey
O.P.C.S.	Office of Population Censuses and Surveys
R.C.P.	Royal College of Physicians of London
S.P.S.S.	Statistical Package for the Social Sciences
U.K.	United Kingdom
W.H.O.	World Health Organization

Chapter One

Scope and Plan of Thesis

It goes without saying that food is important, not least because it is generally regarded that, "you are what you eat." (Murcott, 1986). In fact this belief has been deterministic in the shaping of food consumption patterns throughout recorded history. Russell (1961) said of the Cathari, a persecuted thirteenth century heretical sect, representing popular belief in Southern France:

> "They regarded matter as essentially evil, and believed that for the virtuous there is no resurrection of the body. The wicked, however, will suffer transmigration into the bodies of animals. On this ground they were vegetarians, abstaining even from eggs, cheese, and milk."

A belief or attitude, however misguided, acted to determine the nature of food consumption. Almost two thousand years earlier, around 500 B.C., Pythagoras founded a religion, ultimately taking control of parts of the State. Five of the rules of his order were related to food consumption and preparation, primary among them to 'abstain from beans'.

> "But the unregenerate hankered after beans, and sooner or later rebelled." (Russell, *op cit*)

Obviously a change of attitude led to a change in consumption and it is this relationship between changes in attitudes and food choice which is the subject of this thesis. This discussion is popular still. According to Lesser, Hughes and Marshall (1986):

> "There is always someone somewhere who wants to know what she ('man, or more accurately woman') eats, when, where and in what combinations, where and when she buys the food, and, especially, why she chooses one foodstuff or one brand rather than another."

The principal objective is to contribute to the understanding of why food preferences, i.e., underlying, non-economic factors, have changed. The significance of preferences in the determination of food choice has recently been increasing relative to other factors. Thus, it is of increasing importance to improve our understanding of those factors which determine food preferences, not least since food is the primary demand on income.

It is postulated that changes in food preferences are determined by fundamental changes in consumers' attitudes, where attitudes are defined by three factors; the cognitive element, or belief about an object (food); an affect or feeling element, and; a connative element, or readiness to behave in a certain way. Furthermore, it is hypothesised that attitudes are a function of a series of demographic and 'household' variables.

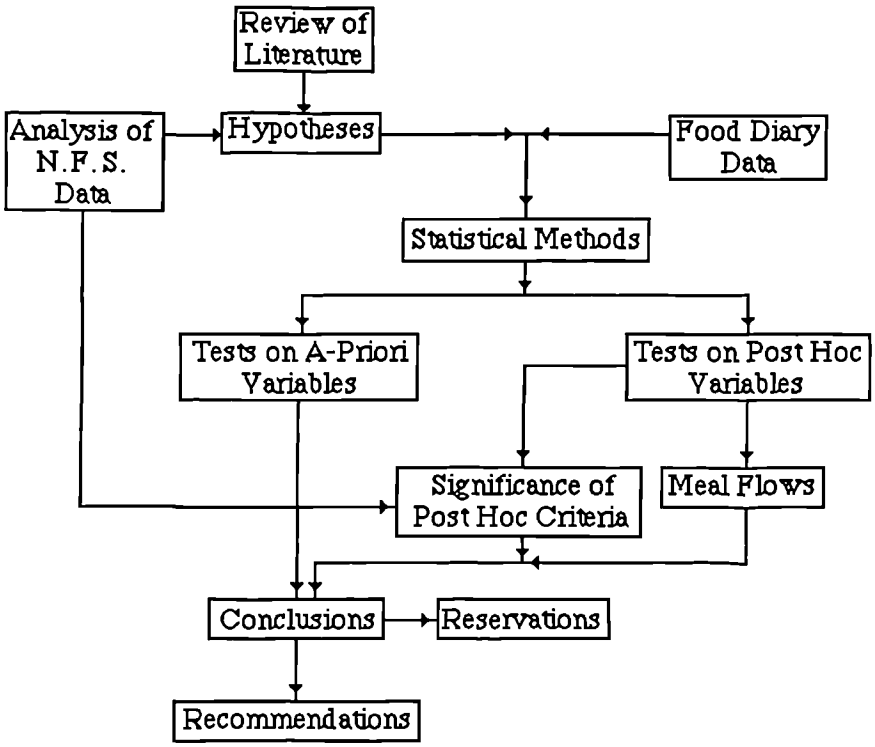
The research process, illustrated in figure 1.1, is focused on four principal components; hypothesising why preferences have changed; defining a set of variables which can be used to differentiate consumers according to what they consume; measuring preference changes, and; testing whether or not the defined variables differentiate between consumers with respect to their food preferences.

The hypotheses are drawn from a review of literature, supported by an analysis of secondary data, published by the Ministry of Agriculture, Fisheries and Food (M.A.F.F.) in the *Annual Report of The National Food Survey Committee* (N.F.S.). The variables used to differentiate consumers are drawn from a second set of secondary data, the Newcastle Food Diaries. Two types of variables are identified; *a-priori* and

post hoc. The former are defined as socio-economic variables such as age and social class and are always, as far as this thesis is concerned, treated in isolation, i.e., dealt with one-at-a-time. The latter are derived from the former by means of a grouping of consumers using various statistical methods. In other words, they are a simultaneous consideration of all the socio-economic, or *a-priori*, variables. They are therefore considered by many authors (see Wind, 1978 and Plasser, 1988) as definitions of *lifestyles*.

The usefulness of these variables is then defined, resulting in tests on their ability to define consumers' food preferences.

Figure 1.1 Schematic Representation of the Research Process Adopted



Chapter Two

Economic and Non-Economic Theories of Consumer Behaviour

2.1 Introduction

This chapter considers two approaches, one economic and one non-economic, which can be used in developing an understanding of how consumers behave. The economic theory builds on the assumption that the rational consumer will attempt to maximise satisfaction derived from goods and services. Non-economic theory examines models of consumer behaviour used in the definition of preference formation. Both approaches are limited to fundamental ideas and elements as a basis upon which the thesis is built.

2.2 Economic Theory of Consumer Behaviour

2.2.1 The Concept of Utility

The logic of consumer choice (Arnold, 1992) is that consumers will attempt to maximise the utility, or benefit, which they derive from consumption. If it is further assumed that utility can be measured, and that the unit of measurement be known as a util, consumers will tend to attempt to consume up to the point where the number of utils derived is a maximum. This is known as total utility maximisation.

Suppose that a consumer derives ten utils of utility from the consumption of good X, and that from the consumption of a second unit of X, a further eight utils are derived (table 2.1). Five utils might be gained from the consumption of the third unit of X and one from the fourth. Consumption of the fifth unit of X, it can be assumed, would render the consumer a disutility of, say, one util. Total utility has therefore been maximised at the point where four units of X are consumed, giving a total of twenty-four utils. The consumption of an additional unit does not increase utility, rather decreases it by one util. The rational consumer will therefore consume four units of X, *ceteris paribus.*

Table 2.1 Hypothetical Example of Total and Marginal Utility

Units of X	Total Utility	Marginal Utility
1	10	-
2	18	8
3	23	5
4	24	1
5	23	-1
6	20	-3

It is generally accepted that the total utility derived from the consumption of two units of a good will tend to be less than or equal to twice the utility derived from the consumption of one unit of the same good, *ceteris paribus*. Hence, in the example above, total utility is ten utils when one unit is consumed, increasing by eight utils when the second unit is consumed. This is the law of diminishing marginal utility, which states that the increase in utility derived from each equal increase in the number of units consumed (marginal utility) will tend to decrease.

Perhaps the most interesting aspect of these phenomena is that each consumer will tend to be different. Therefore, although the principals will be the same for each, the practice will be different. Utility is an immeasurable, subjective notion, making it therefore impossible to compare consumers in absolute terms. However, it is an acceptable starting point for gaining an understanding of how consumers behave.

2.2.2 Utility Maximisation and Bundles of Goods

Total utility is a function of the utilities derived from all goods which are consumed, i.e.:

$$U = u(q_1, q_2, \ldots, q_n)$$

where q_i = consumption of commodity i where $i = 1,2,\ldots,n$

that is, the sum of the utilities of all goods consumed, i.e.:

$$U = u_1(q_1) + u_2(q_2) + \ldots + u_n(q_n)$$

In order to maximise utility it is not necessary for the units of measurement to be cardinal. In other words, the consumer does not have to be able to assign a value (in utils) to each good. The consumer merely has to be able to order the goods in terms of the utility they will yield. The unit of measurement, therefore, need only be ordinal.

Utility is therefore a central concept in the relationship between goods, or bundles of goods, as far as preferences are concerned, and the rational consumer will attempt to maximise satisfaction given a number of constraints, namely income, prices and preferences.

2.2.3 Axioms of Preference

Five axioms must be applied in order to develop the theory. The first, known as the axiom of *comparability*, assumes that the consumer is able to rank a bundle of goods in order of preference (ordinal as opposed to cardinal utility) such that:

q_1 **p** q_2 **p** q_3 where **p** = preferred

The second axiom, that of *antisymmetry*, states that if:

$$q_1 \ \mathbf{p} \ q_2$$

then it is not simultaneously possible that:

$$q_2 \ \mathbf{p} \ q_1$$

The third axiom, that of *transitivity*, assumes that ranking is undertaken consistently, such that if:

$$q_1 \ \mathbf{p} \ q_2 \text{ and } q_2 \ \mathbf{p} \ q_3 \text{ then } q_1 \ \mathbf{p} \ q_3$$

Fourthly, there is the axiom of *monotoneity*, or non-satiation, which assumes that utility will increase in successive bundles as long as these bundles contain more of all, or at least more of one and not less than other, commodities. In other words, more is always preferred to less.

The final axiom is that of *convexity*. The assumption is that if two goods, say q_1 and q_2, belong to the same set, then a weighted average of these two goods will also belong to the set, i.e.:

$$t.q_1+(t-1).q_2 \text{ where } 0<t<1 \text{ belongs to the same set as } q_1 \text{ and } q_2$$

2.2.4 The Budget Constraint

The concept of demand assumes that the consumer will maximise utility, according to these axioms, but subject to his or her budget constraint. Therefore, the consumer can spend any amount of income less than or equal to his or her budget, i.e.:

$$Y \geq p_1q_1 + p_2q_2 + ,\ldots, + p_nq_n$$

where: Y = income

q_i = consumption of commodity i where $i=1,2,\ldots,n$

p_i = price of commodity i where $i=1,2,\ldots,n$

If we assume that the budget is exhausted, then:

$$Y = \sum_{i=1}^{n} p_iq_i$$

If the utility function is specified as:

$$U = u(q_1, q_2, \ldots, q_n)$$

then the consumer will attempt to choose q_i in order to maximise utility, subject to the budget constraint such that:

$$U(q_1, q_2, \ldots, q_n) + \lambda(Y - p_1q_1 - p_2q_2 - , \ldots, - p_nq_n)$$

The solution of the consumer maximisation problem yields the n derived demand equations where quantity purchased of each commodity is a function of $(n+1)$ variables, the commodity's own price, the price of all other commodities and income, i.e.:

$q_j = q_j(p_1, p_2, \ldots, p_n, Y)$ where $j=1,2,\ldots,n$

2.2.5 Demand Restrictions

As a result of the process of utility maximisation, these demand equations have a number of properties, or restrictions, since n equations are used to estimate $(n+1)$ variables.

The first restriction, known as *homogeneity*, states that the demand equations are homogeneous of degree zero in incomes and prices, i.e., that quantity demanded will remain unchanged if prices and incomes change in the same proportion.

Secondly, the sum of income elasticities, weighted by their respective shares, will sum to unity. Known as *Engel aggregation*, it implies that increases in income must be completely allocated across all goods. Taking the budget constraint and assuming all income is disposed of:

$$p_1q_1 + p_2q_2 + ,\ldots, + p_nq_n = Y$$

and differentiating with respect to Y gives:

$$p_1\frac{\partial q_1}{\partial Y} + p_2\frac{\partial q_2}{\partial Y} + ,\ldots, p_n\frac{\partial q_n}{\partial Y} = 1$$

multiplying through by $\frac{q_j}{Y}.\frac{Y}{q_j}$ gives:

$$\frac{p_1q_1}{Y}.\frac{Y}{q_1}.\frac{\partial q_1}{\partial Y} + \frac{p_2q_2}{Y}.\frac{Y}{q_2}.\frac{\partial q_2}{\partial Y} + ,\ldots, + \frac{p_nq_n}{Y}.\frac{Y}{q_n}.\frac{\partial q_n}{\partial Y}$$

where $\frac{p_jq_j}{Y}$ is $j's$ share of income

and $\frac{Y}{q_j}.\frac{\partial q_j}{Y}$ is the income elasticity

The condition therefore becomes:

$$w_1 e_{1y} + w_1 e_{1y} +, \ldots, + w_n e_{ny} = 1$$

where w_j is the share of income allocated to j and e_{jy} is the income elasticity of demand for commodity j.

Thirdly, *Cournot aggregation* is concerned with the effect of a change in the price of a commodity, assuming all other prices remain constant, that is, the cross price elasticity of demand for good i given a change in the price of good j. The condition is expressed as follows:

$$w_1 e_{1j} + w_2 e_{2j} +, \ldots, + w_n e_{nj} = -w_j$$

where w_i is the share of income allocated to i and e_{ij} is the cross price elasticity of demand for commodity i with respect to a change in the price of j.

Finally, the *Slutsky condition* concerns the effect of a change in the price of one good, or any other, on the quantity demanded of the good. This effect can be decomposed into both an income and a substitution effect, the former resulting from the fact that a price change will have an effect on the real income of the consumer; the latter arises as a result of the price change affecting the demand for that and all other goods (if the income effect is ignored).

The observed response of the consumer will be the result of a simultaneous working of the income and substitution effects, the analysis of the effect being based on compensating the consumer for a price change. The two bases for compensation are:

1. to enable the consumer to purchase the same goods as were purchased before the price change, and;
2. to enable the consumer to enjoy the same level of utility as before.

2.2.6 Empirical Analysis

There are essentially two approaches to empirical testing of economic theory of demand - cross-sectional and time series.

Cross section analysis involves the collection of data for a given period in time and, since relative prices are given, the analysis tends to focus on income effects and the effects of other variables (demographics for example) and the estimation of elasticities for the whole population and sub-groups within a population.

Time series models assume that prices and incomes are given, with all income being disposed of (zero savings). Typically they will be used to estimate market demand by means of aggregating individuals' demand.

It is possible, though, to combine the approaches in an attempt to overcome the problems of one model by complementing it with the other.

2.3 Removal of the Effects of Price and Income Changes

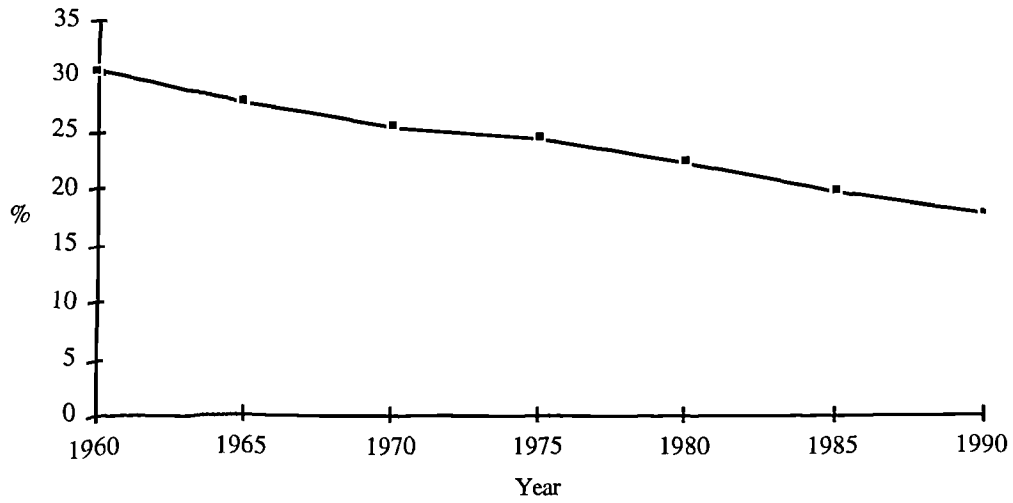
> "The poorer a family is, the greater the proportion of total expenditures (income) which it must use to procure food" (Burk, 1968).

This is one interpretation of Engel's Law, an examination of the relationship between consumers' expenditures on food and consumers' incomes, which has undoubtedly been one of the most popular areas of economic research since Engel published his initial findings in 1857 (Senauer, Asp and Kinsey 1991). Knowledge of this

relationship is critical in the initial stages of this research since one of the primary aims of this thesis is to examine food consumption changes in the absence of an income constraint. In order to do so, the effects of income changes on food consumption must first be removed (Appendix 2.I)

The proportion of income spent on food is declining (figure 2.1) and therefore the relative importance of underlying elements must, by definition, be increasing (Wheelock, 1986). It is therefore becoming increasingly necessary for policy makers, farmers, primary processors, manufacturers, distributors, wholesalers and retailers to focus on these elements of the demand function. However the composition and relative importance of these underlying elements have yet to be effectively and conclusively defined, although there is certainly no shortage of hypotheses. Without clear definition, the relative importance of underlying factors cannot be quantified.

Figure 2.1 U.K. Food Expenditure as a Percentage of Total Expenditure 1960 to 1990



Source: D.O.E. (1990)

Measurement of the residual element in the demand function is dealt with in Chapter Four. However, there are alternative, non-economic approaches to the analysis of consumers' preferences, some of which are now discussed.

2.4 Models of Consumer Behaviour

A number of non-economic models have been put forward, particularly by sociologists, as being capable of explaining consumer behaviour. Many are specific to food choice and each seeks to add to the explanatory power of previous models. Each of the models, with the exception of Yudkin (1956), integrates deterministic factors (Shepherd, 1989) and builds into a system of food preference or acceptance determination. Similarities exist between many of the models, particularly in the hypothesis that food preferences are determined by two or three key factors related to the food itself, the person to whom a stimulus is presented and the environment in which this takes place (Pilgrim, 1957) (Booth and Shepherd, 1988) (Khan, 1981) (Figures 2.2 to 2.4), the difference between them being that Pilgrim (*op cit*) viewed the situation as being dynamic, with food acceptance changing over time as, say, the individual characteristic of hunger changes over time, and Khan (*op cit*) hypothesised that deterministic factors are interrelated, whereas Booth and Shepherd (*op cit*) perceived the system as simply the sum of food and individual characteristics.

Figure 2.2 Pilgrim's (1957) Model

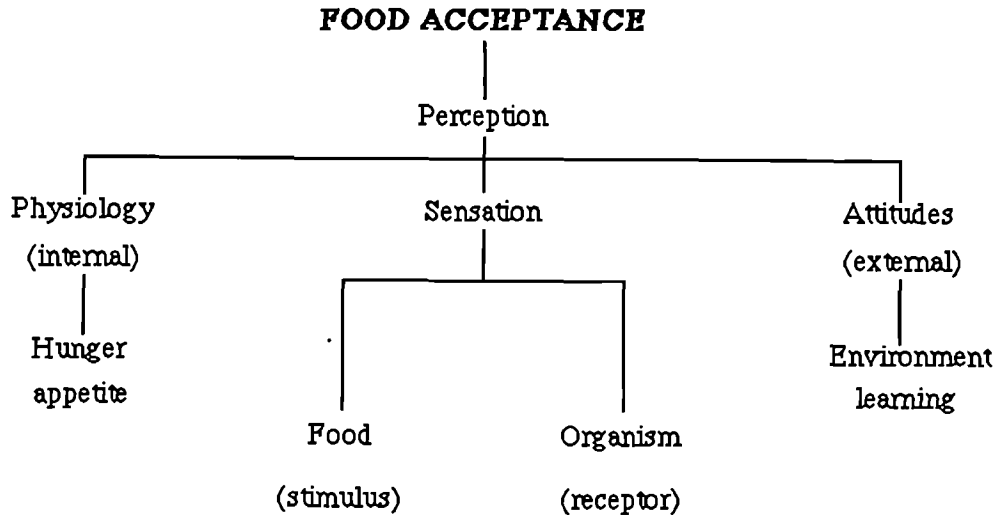


Figure 2.3 Booth and Shepherd's (1988) Model

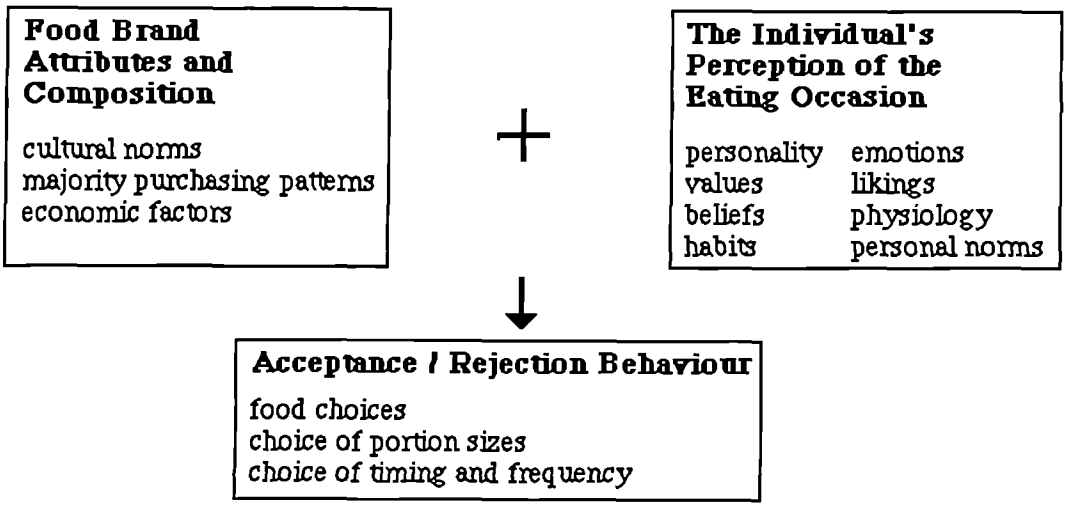
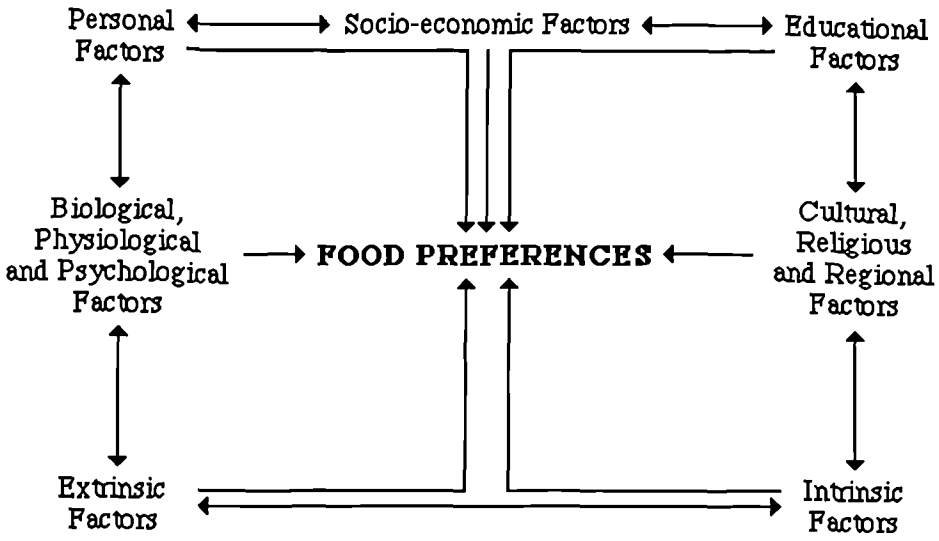
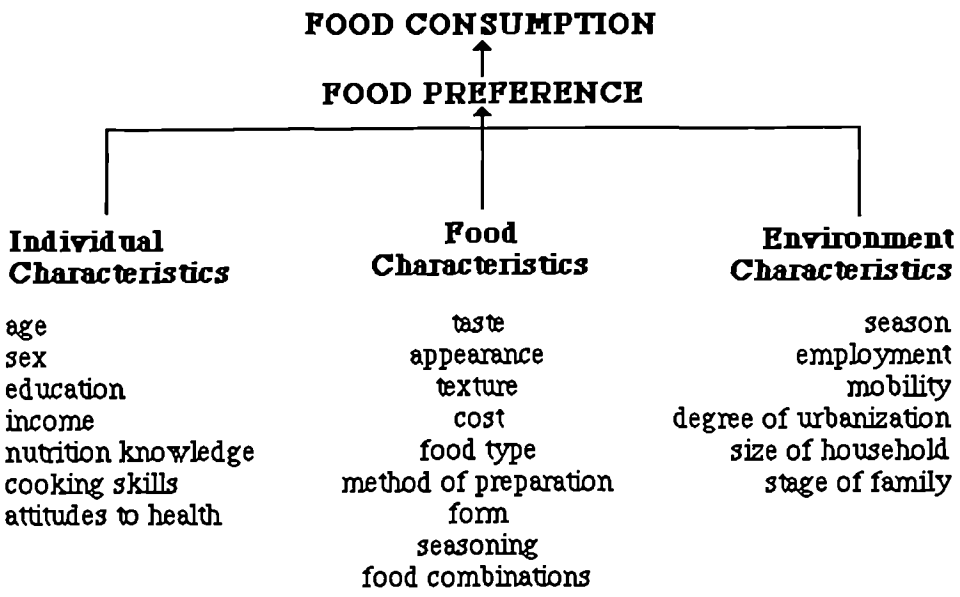


Figure 2.4 Khan's (1981) Model



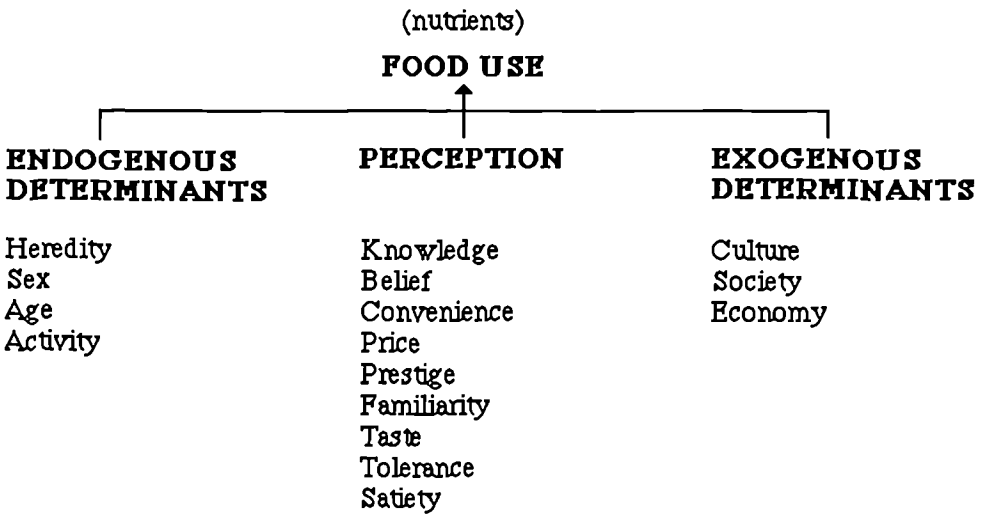
Khan (*op cit*) and Randall and Sanjur (1981) (Figure 2.5) postulated that food preferences influence food selection, the latter being an additional example of the recognisable model of preferences being determined by individual, food and environmental characteristics, although it was an attempt to explain the relative importance of each of these factors. Their conclusion, after empirical analysis on a sample of 120 New York women with regard to preferences and consumption of some twenty vegetables, was that the hypothesised determinant of food consumption, being food preferences, worked both ways in that preferences determine consumption and *vice versa*.

Figure 2.5 Randall and Sanjur's (1981) Model



Katz (1989) included a discussion of the influence of culture and Shepherd (1985) considered religion as a determinant. However, Krondl and Lau (1978, 1982) (Figure 2.6) went further to look at the relative importance of factors such as individuals' perceptions of price and convenience, endogenous factors such as sex and age, and exogenous factors such as culture and society. The interrelationships of these variables provided a first measure of relative importance (calculated as a function of a variable's correlation coefficient, assuming each factor to be an independent variable determining food use). When tested, the model, being an extension of Randall and Sanjur (*op cit*) in that foods can only be analysed in isolation, merely seemed to cast doubt on the validity of this approach, although critically it did give an insight into the predictability of hypotheses such as health beliefs and their relevance as food choice determinants.

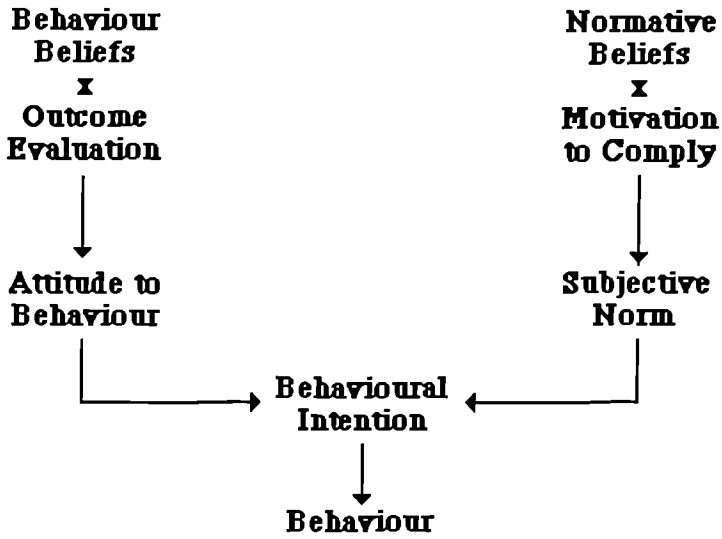
Figure 2.6 Krondl and Lau's (1982) Model



Perhaps the most notable inclusion of beliefs and attitudes, as determinants of food choice within a prediction framework, is presented originally by Fishbein and Ajzen (1975) (figure 2.7). Beliefs can be viewed as a cognitive component of attitudes, where attitudes are composed of information, feelings and behavioural tendencies (Krech and Crutchfield, 1948) or as separate from, but related to, attitudes (Shepherd, *op cit*). The model assumes firstly that a behaviour is best predicted by an intention to perform the said behaviour, and secondly that the consumer acts rationally. The behavioural intention is defined as a function of both the attitude towards the behaviour and the subjective norm.

The attitude towards the behaviour is the consumer's evaluation of the benefits, disbenefits or other feelings regarding the behaviour, and is determined by the behaviour belief and an assessment of the expected outcome. However the subjective norm, as the label implies, is determined by the product of an evaluation of what the consumer believes other people, namely those in a position to exert an influence on the said consumer, would wish the consumer to do with regard to the behaviour, and how willing the consumer is to accept this.

Figure 2.7 Schematic Representation of Fishbein and Ajzen's (1975) Model



Source: adapted from Shepherd (*op cit*).

Initially, much of the empirical testing of the model involved consumers responding to questions regarding food, but Tuorila-Ollikainen, Lahteenmaki and Salovaara (1986) managed to demonstrate an improvement in its power by presenting consumers with the added stimulus of actually tasting the food in question. This conflicted with Tuorila (1987), who found that hedonic responses did not add to the predictive power of the model. Shepherd (*op cit*) suggests that this may be a result of the types of foods being examined in that attitudes towards familiar foods may not be altered by tasting the food, and *vice versa*.

Katz (1985) examined the mediating effects of behavioural intentions in a sample of New York State probation officers. Fishbein and Ajzen's (*op cit*) contention that behavioural intentions mediate the effects of attitude and normative beliefs was not borne out. The proximity of the measurement of behavioural intentions and behaviour is important, as is the proximity of the actual behaviour to the measurement. The

reason for the difference to Fishbein and Ajzen's (*op cit*) contention may be that the other independent variables also affect behaviour directly.

Shepherd (*op cit*) argues that it is necessary to investigate whether or not there are factors which act independently of the Fishbein and Ajzen (*op cit*) model and how, if proven, these factors might operate through the model. Factors not accounted for include measures of past behaviour (Bentler and Speckart, 1979), social determinants, expectations, the effects of education, advertising, other forms of promotion and finally the impact of changes in behaviour.

Grube, Morgan and McGree (1986) tested three modifications of the Fishbein and Ajzen (*op cit*) model. They concluded that the model should be modified to take account of the effects of behavioural norms (perceived behaviour of others is distinct from the subjective norm), interactions between attitude and normative beliefs, and finally multidimensional (as opposed to unidimensional) normative beliefs.

The models discussed thus far are concerned with the individual consumer. Subsequently, more detailed models, as discussed by Schiffman and Kanuk (1991), have been designed and tested empirically to include other influential factors. Sheth (1974) views the family as the decision making unit. The Sheth-Newman-Gross model is designed to have three uses; prediction, description and explanation of consumption behaviour for a multiplicity of product types.

Shepherd (*op cit*) summarises the essence of the linkages between *a-priori* and *post hoc* variables and models of the type so far discussed:

> "Differences in age, sex, social class, region of residence, degree of urbanisation will all lead to differences in food consumption. These may operate through some of the other variables described above (i.e., through the models). Many of the variables will be interrelated and their effects difficult to distinguish. Also food choice is not a constant phenomenon but will change with differing circumstances and with experiences of the individual. ... Food choice is affected by a large number of factors. These can be investigated in isolation but few would argue that any singular influence will be all important."

The Fishbein and Ajzen (*op cit*) model is universally accepted as being capable of predicting food consumption behaviour, but the model does not address all factors which can be hypothesised as determining food choice. These factors, social class for example, may act independently of, or through, the model (Shepherd, *op cit*). So, although models of this type go some way to increasing understanding of the behavioural process, they can by no means be claimed to explain all deterministic factors. Other schools of thought would argue that the approach can only handle a small number of factors (and their interactions) relative to the total.

2.5 Alternative Approaches to the Explanation of Preference Changes

The reasons for food choice and changes in preferences have so far been explored in two distinct ways, namely via economic and sociological approaches. Each has its place and their merits can be judged by their descriptive and predictive powers.

Economists build models which incorporate exogenous demand shifters, assuming that changes in tastes are a response to externalities, or build dynamic models based on the

assumption that tastes are determined by past decisions[1]. Yet this has not been the domain of many economists since, as Friedman (1962) said, "The economist has little to say about the formation of wants; this is the province of the psychologist." (Burton and Young, *op cit*).

Sociologists "... link specific (food) trends to broader issues." (Gofton, 1989). These range from cultural perceptions (Grivetti and Pangborn, 1973) to food appropriateness (Marshall, 1993), meal occasions (McKenzie, 1986), food 'patterns' with respect to family composition (Douglas and Nicod, 1974), meal 'situations' (Barthes, 1979), indeed a cosmology of factors.

Anthropologists, on the other hand, look at food as a part of culture and observe food "... and its place in human affairs." (Murcott, *op cit*). Take, for instance, Murcott's (1982) work on the place of 'cooked dinners' in South Wales, where it is concluded that eating habits are no longer a function of preferences, but a 'cultural reflection' (see Douglas, 1977). The anthropological approach uses a language entirely alien to the market researcher or economist, with descriptors such as 'food concepts', 'societal values' and 'food events'. Others, among them DeWalt (1980), who studied what an economist would call 'socio-economic class' and dietary patterns in Mexico, and Chapman (1990), who looked at drinking patterns in Brittany, have valid claims to be equally as capable of explaining food choice as those who adopt other methodologies[2].

It is inevitable that there will be at least some degree of overlap between methodologies, particularly anthropology and sociology. It is questioned by Murcott (*op cit*) whether

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1 Burton and Young (1990) compare these two methodologies using N.F.S. data. Although the direction and strength of influence of tastes could be estimated, the models cannot be used to test hypotheses regarding the reasons for taste changes.

2 See Murcott (*op cit*) for an overview of the case studies by DeWalt (*op cit*) and Chapman (*op cit*).

or not differences in theoretical approach are "... diversity *within* social anthropology, or ... an *appearance* of diversity engendered by straying across boundaries to annex work from other disciplines? Even ... (if they do) reflect the inclusion of other disciplines, does it really matter, so long as the work is worthwhile?" Gofton (*op cit*) cites Weber's view regarding the harmonisation of market research and sociological methodologies, implying that market research can be criticised for ignoring sociology, the reasons for this lying with commercial pressures and resource constraints.

The adoption of a methodology will (or should) depend on the objectives, namely the specific hypotheses to be tested, of the research and any other constraints, which might include access to data, deadlines and funding.

2.6 Summary and Conclusions

This chapter has dealt with the research process particular to the objective of determining the underlying reasons for food preference changes. There are a number of constraints on this process, particularly the data available, which will determine the types of variables which can be hypothesised as being predictors of food choice. These variables will act through a system which it is possible to specify using models of food choice behaviour.

It is possible to construct econometric models to consider food preference influences. However, the power of these models tends to be limited to estimating the value of the coefficient on the error term of demand models. Testing specific hypotheses has generally not been possible.

The disciplines of anthropology and sociology, and to a certain extent market research, tend to go hand-in-hand with each other when food choice is considered. Nevertheless, there tend to be constraints on the application of methodology, not least the quality and quantity of data available.

Specific hypotheses and the appropriate methodology will be discussed later. However, hypotheses must be generated from a suitable body of information and for this reason it is necessary to turn to two sources; an economic analysis (Chapter Four) which will identify the underlying trend in demand for foods, and a review of literature (Chapter Three) in order to provide a body of information for the establishment of hypotheses. These factors give evidence to the appropriateness of a multidisciplinary approach.

Appendix 2.I A Definition of *Demand*

As the National Food Committee points out (M.A.F.F., 1972 *et seq*) the term 'demand' is often mistakenly defined as being synonymous with consumption. It does however represent the quantities which would be demanded by consumers at different price levels, *ceteris paribus*. Therefore, "... a change in demand signifies a shift in the entire demand schedule or curve and is associated with such major factors as a change in incomes, tastes or marketing policies." (M.A.F.F., *op cit*). By removing the effects of income, we are left with the underlying trend in demand, which is a measure of "... the variation in purchases due to shifts in consumers' tastes and preferences (and any residual error)." (M.A.F.F., 1984)[3].

In order to remove the effects of income from the demand equation, the income elasticity of demand must be quantified for each estimate. The income elasticity of demand is the ratio of the relative (or percentage) change in quantity demanded to the relative (or percentage) change in income (M.A.F.F., 1981)[4].

Assuming that the income elasticity of demand (h) varies according to the level of income:

$$h = Y/E \,.\, dE/dY \qquad (1)$$

where E = expenditure and Y = net family income. However, a more reliable constant elasticity function is assumed, where:

$$E = k.Y^{h} \qquad (2)$$

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3 Appendix B, p.177.

4 Appendix B, p.185.

where k = constant. Thus, taking logarithms in (2):

$$\log E = h \,.\, \log Y \qquad (3)$$

By regressing log E on log Y, the linear regression coefficient (h) is estimated.

Chapter Three

Recent Changes in Patterns of Food Consumption: a review of issues relating to attitude changes

3.1 Introduction

It has been shown that the absolute size of the residual element of the demand function can, theoretically, be estimated. What is of interest are the factors which determine changes in this residual element and, it can be hypothesised, these factors will include fundamental *changes* in consumers' beliefs and attitudes. The objective of this chapter is to review the literature relating to those changes in attitudes which are likely to have had an influence on changes in consumers' food preferences, and perceived changes in consumption patterns which might have taken place as a result of these changes. The chapter concludes with the ways in which these attitude changes can be identified, using *a-priori* and *post hoc* variables. The specific hypotheses to be tested are the subject of Chapter Four.

It is therefore assumed that, based on the of the explanations of preference formation given by the non-economic models of consumer behaviour:

$$\text{preferences changes} = f(\text{attitudes changes}) = f(\text{characteristics changes})^{5}$$

In other words, changes in food preferences can be attributed to fundamental changes in consumer attitudes, which in turn are a function of the personal characteristics of the individual.

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5 See Marcus and Tauber (1979) and Fearne and Hutchins (1991).

3.2 Changes in Consumer Attitudes

Consumer attitudes change on a continuous basis; they are dynamic, and in this respect extremely difficult to quantify. Furthermore, attitudes are interdependent. Take, as an example, attitudes to health. Changes are certain to be influenced by changes in attitudes to, say, government health policy, as are changes in attitudes to food safety and risk. So, although the model stated above relies on changes in personal characteristics to determine changes in attitudes, it should be realised that such a model is, of necessity, simplified, as indeed are most.

Furthermore, changes in factors such as culture, although determined according to the model by personal characteristics, are as such not included within the framework of attitude changes, but will be included in the review of factors determining preference changes, together with the following issues; attitudes to health, policy, safety and risk, time, convenience and the environment.

3.2.1 A Consideration of Health Issues

If changes in attitudes to health are to be examined, it is necessary to outline the relationship between the formulation, publication and communication of dietary recommendations to the food consumer. This can be followed by a discussion of the consumer response to recommendations in the context of food preference changes.

3.2.1.1 Dietary Recommendations

The origins of contemporary 'healthy' eating, as far as policy in the U.K. is concerned, lie in nine key reports. In chronological order they are:

1. Department of Health and Social Security (D.H.S.S.) (1974). *Report on Health and Social Subjects, No.7. Diet and Coronary Heart Disease*, H.M.S.O., London;

2. Royal College of Physicians of London (R.C.P.) and British Cardiac Society (B.C.S.) (1976). Prevention of Coronary Heart Disease, *Journal of the Royal College of Physicians*, **10**, 213-275;

3. D.H.S.S. (1978). *Prevention and Health - Eating For Health*, H.M.S.O., London;

4. D.H.S.S. (1979). *Report on Health and Social Subjects, No.15. Recommended Daily Amounts of Food, Energy and Nutrients for Groups of People in the United Kingdom*, H.M.S.O., London;

5. D.H.S.S. (1981). *Report on Avoiding Heart Attacks*, H.M.S.O., London;

6. R.C.P. (1981). *Report on the Medical Aspects of Dietary Fibre*;

7. R.C.P. (1983). Obesity, *Journal of the Royal College of Physicians*, **17**, 3-58;

8. World Health Organisation (W.H.O.) Expert Committee (1982). Prevention of Coronary Heart Disease, *Technical Report Series*, **678**;

9. National Advisory Committee on Nutrition Education (N.A.C.N.E.) (1983). *A Discussion Paper on Proposals for Nutritional Guidelines for Health Education in Britain* , Health Education Council (H.E.C.)

As a result of dietary concerns shifting from minimum daily requirements to maximum levels as illustrated by dietary goals (Heasman, 1989) coupled with mounting public concern and contradictory evidence from the food industry, the media and the medical profession regarding what is 'good' to eat, a government (D.H.S.S.) working party was established in 1973. Their recommendation for simple and accurate information on nutrition led to the formation of N.A.C.N.E. in 1979 with a membership drawn from the D.H.S.S., M.A.F.F., the British Nutrition Foundation (B.N.F.), the H.E.C., the Scottish Health Education Group and the food industry.

Charged with the objective of reaching a consensus on nutritional advice, the Committee drew information principally from the first eight sources detailed above. With conflicting opinions of the membership and, as will be seen, a certain degree of conflicting advice from the principal reference material, it is not surprising that many

objections to the published N.A.C.N.E. Report (September, 1983, ten years after the original working party was established) came from within the Committee itself. It is questionable whether the Report is actually a consensus of opinion or merely a collection of opinions. It is not infeasible that the latter is in fact the case, particularly on examination of the contributory literature.

Four of the eight (see 1, 2, 5 and 8 above) deal specifically with heart disease. The remainder (3, 4, 6 and 7) deal specifically with nutrition. Each has a particular objective, making comparison difficult, particularly in view of the time span over which they were written and the advances in research that the later reports drew upon. What follows, therefore, is a review of the N.A.C.N.E. Report. A resumé of each of the eight principal contributory reports can be found in Appendix 3.I.

3.2.1.2 The N.A.C.N.E. Report Summarised

N.A.C.N.E. recommendations are centred on fibre, sugar, fat, salt and alcohol intakes, relating average intakes at the time to targets. These amounted to:

a) increasing intake of dietary fibre by 50% from 20g/person/day to 30g/person/day;
b) reducing intake of sugar from processed foods (cakes and confectionery, etc.) and *added* sugar by a total of 50% from 40kg/person/year to 20kg/person/year;
c) reducing the energy intake derived from fat by 25% from 40% total energy to 30% total energy and ensuring that energy derived from saturated fat should not exceed one third of total energy derived from all fat;
d) reducing salt intake by 50% (despite not knowing what average salt intake levels are), and;
e) reducing total energy derived from alcoholic drinks by 50% from 8% of total energy to 4%.

3.2.1.3 The Consumer Response to Dietary Recommendations

The objective of such research and subsequent publications is ultimately to educate the consumer. This poses the question of how such information is communicated to the consumer and in what form it is received. It is not so important for the method of communication of recommendations to be known, if a method is in use at all, but how much the consumer actually knows and to what extent he or she acts upon recommendations. Furthermore, is it more appropriate to tell the consumer, for example, not to increase sugar consumption, or to tell the consumer to increase or decrease consumption by a fixed percentage?

It is suggested that the consumer is aware of nutritional guidelines, even holding consistent evaluations of foods' nutritional benefits and disbenefits (Foxall and Haskins, 1985). However, it is not always the case that the consumer acts upon this knowledge. Furthermore, it is argued that the N.A.C.N.E. recommendations can only act as targets, not for the consumer, but for health educators (Black, Ravenscroft and Sims, 1984)[6].

Examining the market for trends which may or may not be the result of dietary recommendations can induce misleading conclusions. However, it is interesting to postulate that such recommendations may have contributed to changes in consumption patterns and this section is used to examine some of the published research concerning these patterns. When, though, it is clearly the case that dietary recommendations have not been heeded, there is far less likelihood of a misinterpretation. Take the case of saturated fat, for which, it has broadly, but universally, been recommended that intake be reduced. Meat and dairy products are the principal harbours of saturated fat. Taking meat first, although consumption of carcase meat fell from 21.1% of all food

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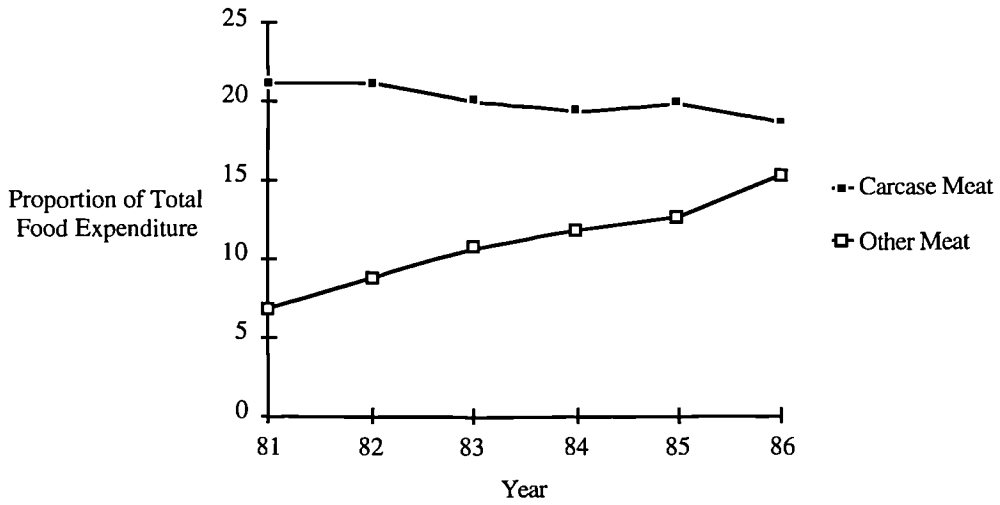
6 It was found that in a sample of dietitians, nutrition targets for sucrose intake were exceeded, whereas those for fibre and fat were not attained.

expenditure in 1981 to 18.6% in 1986, the proportion of food expenditure accounted for by all meat and meat products rose from 6.7% to 15.3% over the same period (figure 3.1).

Figure 3.1 Expenditure on Meat and Meat Products as a Proportion of Total Food Expenditure 1981 to 1986

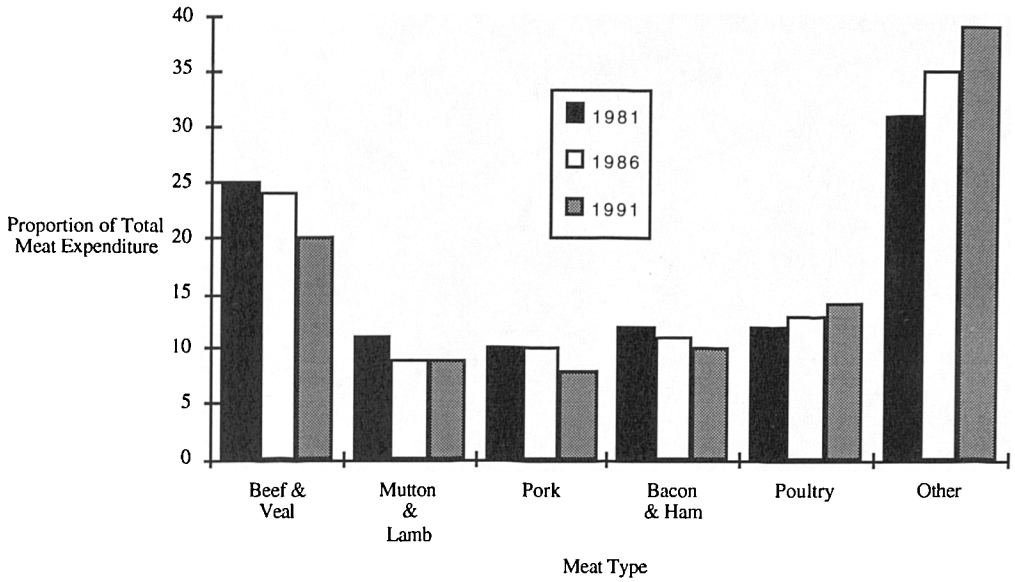


Source: adapted from Retail Business (1987)

Although the consumer may have switched away from the consumption of carcase meat, the most obvious source of animal fat, consumption has been substituted more than proportionally by an increased intake of meat based products, which of course still contain saturated fat, but in a more disguised format. This gives weight to the argument that determinants of changing preferences, in this case changes in attitudes to health, are interrelated; in this case it might be postulated that there is a conflict between 'convenience' and 'health' issues, with consumers switching consumption away from carcase joints, which take a relatively long time to prepare and cook, in favour of 'convenience' meat products.

This type of substitution may also take place within the carcase meat category, with consumers moving away from red meats such as beef, in favour of white meats such as poultry (figure 3.2).

Figure 3.2 Relative Consumer Expenditures on Meat 1981 to 1991



Source: M.A.F.F.

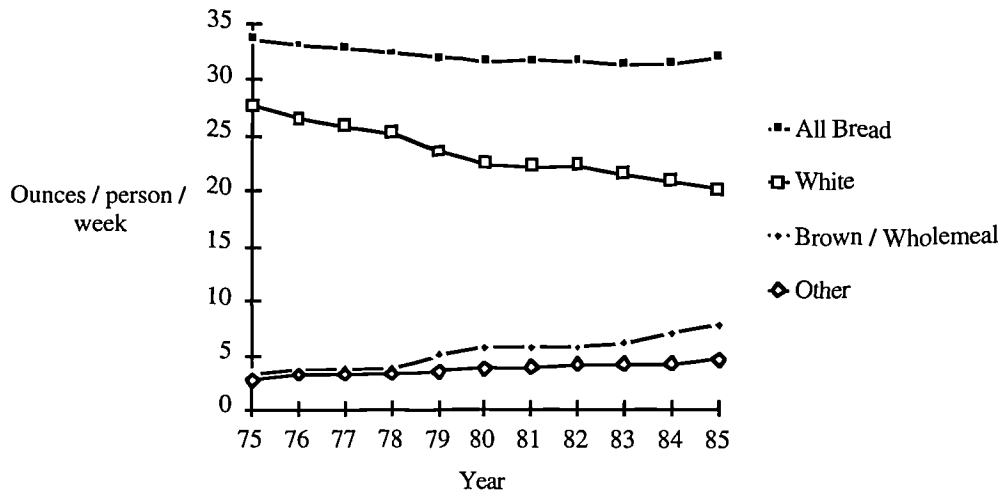
Trends in the consumption of dairy products relate rather more closely to the hypothesis that changing attitudes to health have exerted an influence on consumers' food consumption habits (Shute, 1986). Total milk consumption declined from approximately 2.75 to about 1.75 litres per person per week between 1975 and 1986 (Buss, 1988), a decreasing proportion of which is accounted for by whole milk. The gap is filled by skimmed and semi-skimmed milks which, in tandem with a doubling in size of the yoghurt market between 1975 and 1980, and between 1980 and 1988, points more readily to the impact of changes in attitudes to health.

Further evidence of the impact of health recommendations comes from an examination of consumption patterns for sugar-based products, bread and cereals, fish and fish products, fruit and vegetables and other 'foods' such as slimming products.

A reduction in sugar consumption can be regarded, along with recommendations concerning saturated fatty acids, as a cornerstone of dietary recommendation (Heasman, *op cit*; Trowell and Burkitt, 1981). However, measuring sugar intake is virtually beyond practicality since over two-thirds is accounted for by processed foods as opposed to refined, table-top sugar. Nevertheless, the consumption of packet sugar as well as sugar-based products, such as biscuits, cakes and preserves, does illustrate a moderate decline in aggregate consumption, most marked in the case of the former (Buss, *op cit*), less so for the sugar-based foods (Morden, 1987)

Aggregate bread consumption is relatively static, being approximately 0.9 Kg per person per week in the ten years from 1975 (Buss, *op cit*), but the structure of consumption has been changing (figure 3.3).

Figure 3.3 Consumption of Bread Types 1975 to 1985



Source: adapted from Morden (*op cit*)

The structure of consumption has changed in favour of wholemeal, brown and other (French bread, croissants, etc.) breads to the detriment of the still-most-popular white loaf. This, it has been suggested, may be a response, be it direct or indirect, to

changing health attitudes as a result of recommendations to consume more dietary fibre. Equally, it may reflect a retail-driven[7] response to a consumer demand for more convenient, flavoursome breads, presently available from in-store bakeries and hot bread shops.

Fish consumption data is scarce, principally as a result of the large proportion of consumption which takes place away from the home. However, two factors are generally accepted; firstly that the volume of fish consumed has declined steadily since 1940 (Goulding, 1985); secondly that the structure of demand has, in recent years, been changing with more processed fish being consumed at the expense of fresh fish. The reasons for consuming fish may be related to a number of factors, most prevalent among them the association of fish with nutrition. MacSween (1973) for example, found that the most popular reasons (among housewives) for choosing fish were 'nourishment' and 'necessity for a balanced diet'. However, in a market so diverse, where the further processed product is so different from its original form, the 'convenience' factor may tend to override the demand for a 'healthy' product. Preferences are shifting demand towards pre-packaged and pre-prepared foods (Connell, 1987). This factor sits in tandem with a third determinant of changes in fish preferences, namely the increasing unfamiliarity of the consumer with the fresh product.

Fruit and vegetable consumption has, in aggregate, increased moderately in volume terms (table 3.1) with generally small increases in consumption for most varieties (Ritson and Swinbank, 1993), particularly the now more widely available exotics (Robinson and Amack, 1986). The tendency is, though, for consumption increases to go hand-in-hand with the degree of further processing and preparation to which the

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7 It should be emphasised that retailers are consumer-driven, and that they will, in so far as is possible by means of market research, tend to react to changes in consumer attitudes.

product has been subjected. So, although aggregate consumption increases would seem to be in line with recommendations to consume more dietary fibre, it is more likely that fruit and vegetable consumption is developing for similar reasons to fish consumption.

Table 3.1 U.K. Fruit and Vegetable Consumption 1968/69 to 1988/89 (Kg/head)

Year	All Vegetables	Non-Citrus Fruit	Citrus Fruit
1968/69	61	35	-
1973/74	70	31	15
1980/81	78	33	14
1984/85	85	38	14
1988/89	65	38	21

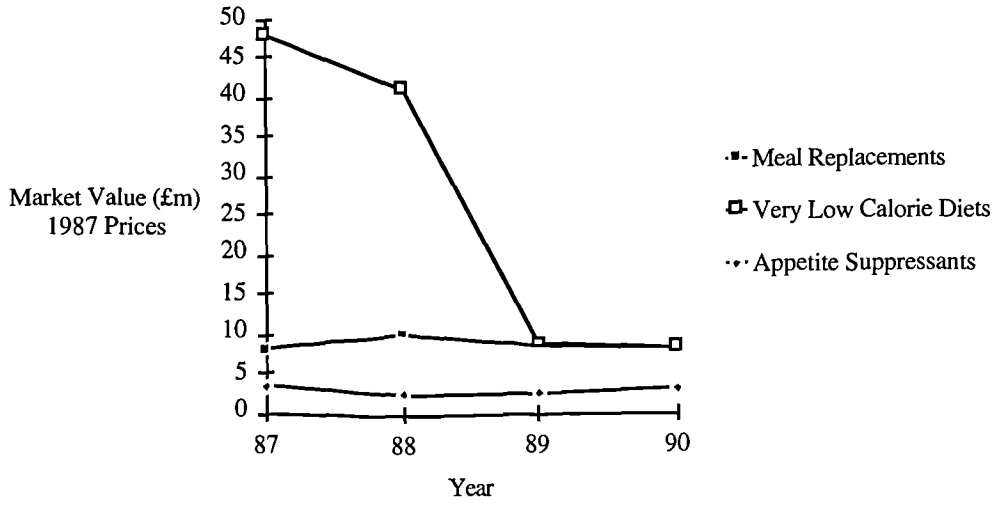
Source: F.A.O.[8] (1993)

The situation of dual hypotheses for increases in consumption for particular foods resulting from changes in attitudes to 'health' and 'convenience' issues is well illustrated by the case of mushrooms. Although not a further processed product, they tend increasingly to be prepacked and essentially ready for immediate use, as well as being versatile (Hinton, 1987). Positively, on the health side, they are low in calories, and high in protein and minerals, thus fulfilling several of the criteria set out in dietary recommendations. Accordingly, consumption of mushrooms increased from approximately 0.35 to 0.60 ounces per person per week between 1965 and 1985, and in 1992 reached 1.09 ounces (M.A.F.F., 1992), surpassing Hinton's (*op cit*) 1985 forecast of 0.9 ounces by 2000.

8 Food and Agriculture Organization of the United Nations.

The hypothesis that changes in attitudes to health have contributed significantly to changes in food consumption patterns is, perhaps, substantiated by an examination of the market for slimming products and methods of achieving weight loss. Changes in lifestyle and a move towards a balanced eating regime have led to marked changes in the demand structure for meal replacements, appetite suppressants and uptake of very-low-calorie diets (using solely powdered drinks and vitamin supplements) (Figure 3.4).

Figure 3.4 Trends in Market Size for Slimming Foods 1987 to 1990



Source: Mintel (1990)

The total value of the market fell, between 1987 and 1990, from just under £60m to about £20m (1987 prices). The reason given for the decline is the switch from the 'necessity' to be slim to a 'desire' to be slim coupled with a 'necessity' to be 'healthy'.

Finally, changes in consumer attitudes to animal welfare issues cannot be ignored. Such attitude changes have led to determined efforts by producers to develop production techniques and bring them in line with what the consumer perceives to be acceptable, particularly for pigs, poultry (meat and eggs) and veal (Hughes, 1994).

Disaggregation of the determinants of food consumption and preference changes is, from this type of published market research data, virtually impossible. However, the trends do add weight to the process of hypothesis generation. This process will be concluded in Chapter Four, but it is relatively clear that one of the attitude changes which must be borne in mind relates to health issues, be they a result of the communication of nutritional recommendations or not.

3.2.2 Changing Attitudes to Time and Convenience

It has already been demonstrated how hypothetical determinants of consumption changes may be interrelated (Gofton and Ness, 1991). Increases in the consumption of vegetables, for example, can be explained both by changes in attitudes to 'health' as well as the 'convenience' of the products available, but 'convenience' issues should also be considered on their own merit.

In general, the value of 'time' has tended to increase over time. Cowles and Dietz (1956), using a seven-day record placed with Wisconsin housewives, found that food-related activities accounted for the greatest 'expenditure' on time. Jacoby, Szybillo and Berning (1976) compared this with Walker's (1969) findings to conclude that the time devoted to these activities had decreased, although still representing a relatively large proportion of total time expenditure.

The term 'convenience' must, then, be defined in terms of time, such that a 'convenience' food will be one which takes less time to prepare and cook than a non-convenience food. The extent to which changes in attitudes to 'convenience' have determined changes in consumption patterns must, therefore, depend on individuals' perceptions of time and the value given to it (Graham, 1981).

Although different models of time use exist (for example linear-separability, circular-traditional, and procedural-traditional), and consumers can be designated a particular type of time user, three factors are clear; firstly, that time pervades every aspect of

consumer behaviour; secondly, that aggregate time-values are increasing; thirdly, that time use, and therefore attitudes to 'convenience', depend on lifestyle characteristics. Therefore, it seems reasonable to suggest that attitudes to 'convenience' have changed, and that the hypothesis is worth developing, particularly as its usage depends on individuals' lifestyle descriptors (Jacoby, Szybillo and Berning, *op cit*).

It was found by Marshall (1990) that 93% of meals took less than five minutes to prepare, and that 95% took less than ten minutes to cook. This being the case, the value of aggregate preparation and cooking time must be high and increasing (comparing Marshall (*op cit*) with Cowles and Dietz (*op cit*)) and as a consequence the demand for foods which reduce the time necessary to prepare and cook a meal will tend to be increasing in order that time value can be saved. In other words, as the opportunity cost of time increases, so the consumer will tend to be willing to forego, say, the 'healthy' attributes of food, or even the goods and services which the additional income spent on acquiring a more convenient food would have paid for.

3.2.3 Changing Attitudes to Information, Quality, Safety and Risk

When a consumer chooses a product, the information upon which they base their decision will tend to be imperfect, particularly regarding price, but even more so regarding quality (Nelson, 1970). Therefore, each time a decision is made, a risk is taken. However, as Bauer (1967) argues, risk is a subjective or perceived measure, dependent upon the individual making the decision. The view, though, taken by Stone and Winter (1985) is that although the theory regarding perceived risk holds true for most goods, it breaks down when physical risk is introduced.

Food quality and safety issues are increasingly being brought to the attention of the consumer and, assuming that there is occasionally a physical risk associated with food quality imperfections, the so-called 'food scares', risk can be measured. Clearly, Stone and Winter's (*op cit*) argument breaks down here (Mitchell, 1992). Food risk cannot

be objectively measured. However, what is clear is that consumers are increasingly aware of risk with regard to food safety and, as a result, tend to demand an increasingly large body of information about the foods they consume (Senauer, Asp and Kinsey, *op cit*).

Risk concerns differ between food groups. Kramer (1986) found that, perhaps unsurprisingly, greatest concern lies with red meats, followed by poultry and dairy products, with consumers being least concerned with the risk of consuming sugars. The greatest concerns regarding the source of food safety problems for meat lie with the processing sector, least concern being with handling in the home (probably the greatest source of food hygiene problems). Consumers appear to be less concerned with home-based risk than any other area. This is borne out by information demands, ranked lowest for suggestions on cooking, freezing and handling, and highest for guarantees of foods being additive and residue free.

With consumer opinions of the greatest risks tending to rest heavily in the areas of processing and meat, the latter traditionally forming the central element of a meal, and the former becoming more prevalent as the demand for more convenient products tends to increase, coupled with a rise in media coverage of health issues and food related scares (O'Beirne, 1986), it is unsurprising that consumers' attitudes towards food product information are changing, with more now being demanded.

The consumer is therefore facing choice decisions under uncertainty (Henson and Traill, 1992), with an increased perceived knowledge, be it accurate or not, of outcomes related to food safety hazards. As perceived potential risk increases, so the demand for information can be expected to increase. Moreover, attitudes to perceived risk will act as an increasingly significant determinant of food choice, and these attitudes will tend to change as the availability of product information and information on the consequences of food hazards increase.

3.2.4 Changing Attitudes to the Environment

Changes in concerns about the environment have led to changes in the demand for food, such that more 'environmentally friendly' products and goods which comply with consumers' social, moral and ethical concerns are being demanded (Adams, 1993). Initially consumer-led, the trend seems to be fickle in the face of other determinants, most notably the constraints put on consumers by the onset of recession, and is now producer-led following the momentum built up in producers by a somewhat sudden (relative to other attitude changes discussed) consumer interest.

The issues of concern to the 'green' consumer and the 'socially responsible' corporation range from the use of nitrogenous fertilizers on crops to the sourcing of raw materials for packaging (wood pulp) from the rain forests and still further. A number of companies and sectors have been hit hard by adverse publicity resulting from the use of socially unacceptable or 'unfriendly' processes or materials[9] . However, what cannot be disguised is the inextricable link between these issues and those already discussed, in particular attitudes to health and convenience. There are linkages at many points; damage to the environment from the use of pesticides on fruit and vegetables coupled with a potential or perceived human health risk by ingestion of pesticide residues; the inconvenience of less packaging compared with savings of raw materials and power used to make the packages.

What has been suggested by MacKenzie (1990) is that some consumers may be adopting the view that they cannot cope with all the issues at once, the trade-offs sometimes necessary, and the values attached to product attributes. It is further argued that what is needed is the satisfaction of a demand for more, clear information.

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9 Take the cases of hormone implants in beef, breast milk substitute sales in the Third World, the production of veal (in crates), and many others.

According to the Family Food Panel (1990), all of the factors discussed are at work, influencing consumption. However, it is suggested that they work together, but to varying degrees depending on the nature of the food and the situation in which it is eaten (particularly the mealtime). These attitudes, though, are to be measured, given the hypothesis that they are determined by consumer characteristic changes, using a series of *a-priori* and *post hoc* variables related to the individual or household (Wind, 1978).

3.3 Determinants of Changes in Consumer Attitudes: *A-Priori* and *Post Hoc* Variables

For the purpose of this study *a-priori* variables can be defined as those which are readily attributable to a consuming unit, namely an individual or household, and include all socio-economic measures. On the other hand, *post hoc* measures are not observable. They are formed by combining variables of interest such that the distance between one *post hoc* variable measure and another is maximised, and the within variable variance is minimised.

If the consuming unit under consideration is the individual, then it can be hypothesised that *a-priori* variables determining preference changes will include the age, sex, social class, education, religion, domicile and occupation of the consumer as well as their family composition. *Post hoc* determinants can be constructed from a cosmology of variables (Gofton and Ness, 1991), including any combination of *a-priori* variables.

3.3.1 *A-priori* Determinants

The use of *a-priori* variables to distinguish between groups of consumers is not uncommon. Data from the N.F.S. have been used extensively to do just this. For example, Lund and Derry (1985) segmented households using household characteristics to show that *a-priori* criteria are important in the determination of food

choice. The dietary behaviour of British adults (O.P.C.S.[10], 1990) was considered using similar variables.

It is useful to consider some of these variables in isolation before trying to explain how they interact. Taking the age of the consumer first, it is safe, if the assumption is made that consumption patterns have changed over time, to assume that consumers of a similar age will tend to adopt consumption patterns which bear a greater resemblance to one another than to those of older or younger generations. In a consideration of 'cooked dinners' in South Wales, Murcott (*op cit*) suggests that daughters essentially learn to cook from their mothers and subsequently adapt the learnt technique to suit their own tastes and the preferences of their own families. Ritson and Hutchins (1991) illustrate the strong relationship between the age of the housewife and the level of consumption for certain foods. Take the case of liquid milk (figure 3.5), where expenditure, expressed in pence per person per week compared with the national average, clearly increases as the age of the housewife increases. It can be hypothesised that, in this case, age is a determinant of the level of consumption, but it should also be remembered that changes in consumption patterns can only occur as a result of either changes in the age structure of the population (as indeed it is) or if the proportion of consumers of a particular age group who had adopted a particular habit changes. It suggests that food preferences are learned and subsequently carried through life in much the same way as Murcott (*op cit*) argues[11].

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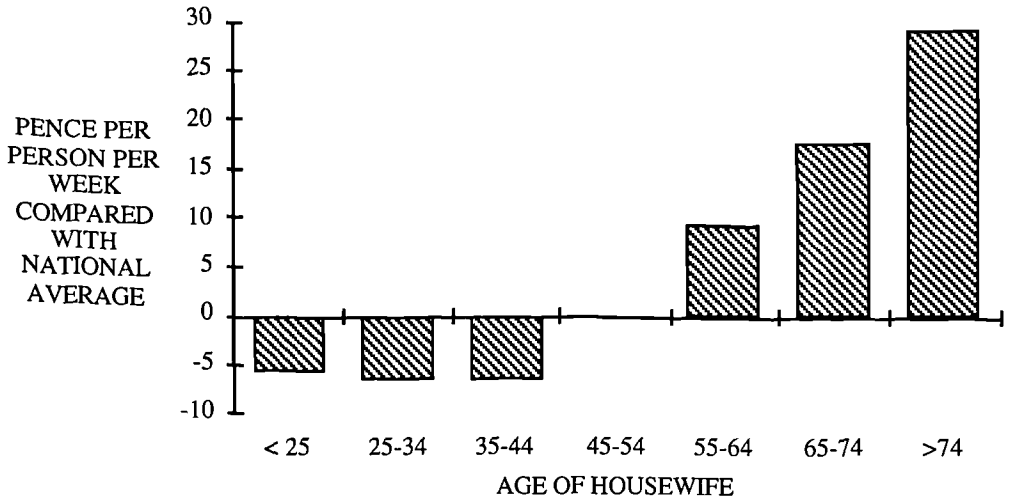
10 Office of Population Censuses and Surveys.

11 There are two issues concerning age effects. Firstly, 'old' people consume different foods simply because they are old; secondly, they have 'learned' different consumption habits which have been carried through life.

Figure 3.5 Expenditure on Full Fat Liquid Milk by Age of Housewife



Source: M.A.F.F. (1984)

Similarly, Kerr and Charles (1987) argue that particular foods have associations with particular age groups. They also discuss the ways in which gender relates to food choice and conclude that women in a family environment are of the opinion that their own preferences should be subservient to those of their husband and their children. There is a good deal of disagreement among sociologists with regard to this hypothetical determinant (Gofton, 1992). Already the confusion of other variables is masking the consideration of sex in isolation. Consideration of one variable at a time is difficult. Such a debate inevitably touches on the relationship and interaction of the one variable with others perceived as related to it (Khan, *op cit*). For example, a consideration of gender invokes references to family composition in the same way that a consideration of age does.

It should also be recognised that although *a-priori* variables can be used to distinguish between households, consumption patterns (i.e., consumption changes over time) can only be distinguished if these *a-priori* variables change. Thus age can only change preferences if the age structure of the population changes.

The influence of family composition, particularly 'single parent households', on consumption patterns is topical and has been so for some time. The hypothesis that the 'single parent household' has a bearing on the consumption of almost all goods and services cannot be and has not been disregarded. However, the question remains as to whether it is the 'single parent' attribute or the income constraint, for example, which is the strongest determinant of choice. There would be a strong case for arguing that a causal relationship exists between the presence of just one parent in the household and, say, the demand for child-minding facilities. However, does a similar causality exist between the presence of a single parent and the demand for staple foods? A more likely explanation would be the income constraint. Moreover, there are certainly other variables determined by family composition which exert an influence on food choice.

To a large extent the composition of households (in terms of the number of adults and children, their age and sex) determines the structure of the population. An ageing population, such as in the U.K. (O.P.C.S., *op cit*), caused by whatever means, will tend to result in changes in aggregate food consumption patterns (Senauer, Asp and Kinsey, *op cit*).

Many *a-priori* variables are inextricably linked. Interrelationships exist between social class, education and occupation (both in terms of the type of work undertaken and the number and distribution of hours worked) in a similar way that they exist between age, sex and family composition. Social class is largely determined by job title, at least as far as social researchers are concerned. Indeed the two are synonymous. Education, it can be argued, plays an important role in determining the type of occupation, if not its precise nature.

The absolute separation and isolation of such *a-priori*-variables is not possible. Each has its own determinants and each will serve as a determinant for one (or more) other variables. Therefore any analysis conducted on the basis of a hypothesis that an *a-*

priori variable determines a behaviour must be interpreted with caution. It is not only likely that a 'true' causal relationship will not exist, but that what has been measured is not an accurate reflection of what was hypothesised.

3.3.2 *Post Hoc* Determinants

Consumers can be grouped, or segmented (Appendix 3.II), using one or more variables, the objective being to find segments with minimal within segment variation and maximum between segment variation. This allows for the differences between consumers to be measured by more than one variable at a time.

Post hoc or clustering-based determinants are comparable with *a-priori* determinants in that 'person' or other variables are used to group consumers. However the *post hoc* approach is one "... in which segments are determined on the basis of a clustering of respondents on a set of 'relevant' variables." (Wind, *op cit*). Instead of having a predetermined number of segments, as is the case when *a-priori* techniques are used, the number of segments is determined statistically by the clustering method chosen.

There are many examples of this segmentation technique. One of particular relevance is the work of Plasser (1988) who categorised Austrian food consumers according to a number of *post hoc* lifestyle characteristics. The same consumers could have been grouped according to any number of *a-priori* characteristics, and indeed it is not uncommon for *a-priori* segmentation to be used as a means of reducing the number of variables on which consumers are to be grouped (Wind, *op cit*), but this would have masked Plasser's (*op cit*) findings that eating habits are an expression of lifestyle.

The results of *post hoc* segmentation differ markedly from *a-priori* segmentation primarily in the way that they can be read. This can be illustrated by comparing a typical example of *a-priori* segmentation, namely Lund and Derry's (*op cit*) work on N.F.S. data, with Plasser's (*op cit*) *post hoc* method. The former classified food

consumers by a number of household variables, including freezer ownership. Therefore households are segmented, to take the simplest example, by the criterion that they do or do not own a freezer. This might be extended to incorporate the variable 'age of housewife' for which the N.F.S. has seven categories. Households can now be segmented into fourteen groups, some of which may contain no households. When interpreting the characteristics of a group of households it would therefore be said that households either do or do not own a freezer and the housewife is, say, aged between 25 and 34. No other group of households will have this profile. All households in the group will be defined as the same and the distances between each group will be the same. However, describing *post hoc* segments can be more difficult in that two or more groups may be characterised as very similar as regards one variable, but very different, to varying degrees, as regards others. Indeed, Plasser's (*op cit*) so called 'Health-freak' group contained consumers with widely different ages, so although the consumers are classified as being similar, their within-group ages appear most dissimilar. This type of occurrence cannot happen with *a-priori* segmentation.

3.4 Conclusion

Changes in attitudes considered to be potentially deterministic with respect to preference changes have been considered, particularly 'health' and 'convenience', and are shown to be interrelated, but potentially determined by *a-priori* and *post hoc* variables. Unsubstantiated, but hypothesised, manifestations of these attitude changes have been demonstrated with respect to some foods. However, actual preference changes need to be measured in their own right.

Appendix 3.I A Review of the Eight Principal Contributory Reports to N.A.C.N.E.

1. D.H.S.S. (1974). *Report on Health and Social Subjects, No.7. Diet and Coronary Heart Disease*, H.M.S.O., London.

As its title suggests, this early C.O.M.A.[12] report looks at the relationship between nutrition and coronary heart disease (C.H.D.), as opposed to the W.H.O. Report, which examines all factors contributing to C.H.D. incidence. It is aimed at those responsible for public health guidance, doctors and the food industry and is a summary of the opinions of the C.O.M.A. Panel with regard to research conducted before mid-1973. Not all points have been agreed on, and where this is the case it is made clear in the report.

Some of the key points made are summarised below. These are followed by a brief resumé of diet related recommendations.

a) Only some of the risk factors of Ischaemic Heart Disease (I.H.D.) are dietary in nature and no single dietary factor is predominant with regard to susceptibility to this disease;

b) overweight and obesity increases the risk of death from I.H.D.;

c) dietary composition changes can reduce the level of concentration of cholesterol in blood serum. There is, however, no certainty that this will reduce the risk of contracting I.H.D.;

d) the members of the Panel "... therefore recommend that the amount of fat in the diet should be reduced," despite the lack of a causal relationship between death rate from I.H.D. and the proportion of dietary energy derived from fat having been established;

e) "... the Panel are unanimous in remaining unconvinced by the available evidence that the incidence of I.H.D. in the U.K., or the death rate from it, would be reduced in

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12 Committee on Medical Aspects of Food Policy.

consequence of a rise in the ratio of polyunsaturated to saturated fatty acids in the national diet."

f) with regard to sugar, "The Panel believe(s) a ... continued fall in the intake of sucrose would assist in achieving this aim" (of obesity reduction).

g) "... there is insufficient information upon which to base a recommendation for a reduction in the salt consumption of the whole population in the expectation that such a reduction would ... reduce the death rate from I.H.D. ..."

h) "There is at present too little evidence to assess the possible importance of fibre ...".

Recommendations specific to diet:

a) avoid obesity;

b) reduce total fat intake and saturated fat intake;

c) reduce sucrose intake.

Evidently this report has drawn extremely conservative conclusions and proffered tentative recommendations. However, it must be remembered that it was drafted with reference to research conducted, at the latest, in the early 1970's.

2. R.C.P. and B.C.S. (1976). Prevention of Coronary Heart Disease, *Journal of the Royal College of Physicians*, **10**, 213-275.

Produced specifically for the benefit of medical practitioners, this report covers all factors relevant to C.H.D. prevention and in this respect is of a similar *genre* to the W.H.O. report of the same title.

The dietary recommendations with regard to fat are comparable with those in the W.H.O. report in that a reduction in saturated fat intake with, "... partial substitution by polyunsaturated fats," is proposed. Similarly, "maintenance of a desirable weight is important as obesity is commonly associated with more potent risk factors for C.H.D.

..." It is not proposed that sugar in itself is a contributory factor to premature death from C.H.D., but that it is related to the problem via weight control.

No recommendation is made specifically regarding cholesterol, although it is admitted that there exists a positive relationship between plasma cholesterol levels and C.H.D. incidence. However, it is recommended that, "where plasma lipid concentrations indicate particularly high risk ... dietary recommendations should be followed more strictly."

Tentative comments are made on the subject of dietary fibre. No recommendation is made in this area since no evidence of a link between C.H.D. and dietary fibre is offered or accepted.

Salt intake is approached rather differently to the C.O.M.A. and W.H.O. reports. Although, according to the R.C.P. and B.C.S., no link between sodium chloride intake and C.H.D. incidence is proven, there is an interest in the connection between sodium chloride intake and hypertension, and consequently the implications for blood pressure and thus C.H.D. It is, though, merely recommended that caution be exercised when adding salt to infant diets and further recommended that infant food manufacturers take similar care.

Finally, the report draws the conclusion that no causality can be inferred between coffee consumption and C.H.D. incidence. Therefore, no recommendation is made in this area.

3. D.H.S.S. (1978). *Prevention and Health - Eating For Health*, H.M.S.O., London; "The purpose of this booklet is to present the facts ...".
A caveat to this statement by the Secretary of State for Social Services and the Secretaries of State for Scotland, Wales and Northern Ireland are the admissions that,

"nutrition ... will never be an exact science", and, "the booklet has been approved by the Government's Committee on Medical Aspects of Food Policy but they are not responsible for the text."

How this can be a 'factual' statement when nutrition is indeed not an exact science (when conclusions are applied to a whole population rather than to the individual) is questionable, and leading the communicators of nutritional guidelines to believe this may cause inappropriate information being communicated to the consumer. However, the information is presented in such a way that specific recommendations are not made. All relevant information is presented and the reader is left to draw his or her own conclusions. In this way it is a concise review of research and hence a useful contributory paper to N.A.C.N.E.

It is not a useful exercise to comment upon this text in detail. However, it is interesting to note its conclusions on sugar, salt, dietary fibre and saturated fat for comparison with those in the N.A.C.N.E. Report and other contributory papers.

a) Saturated Fatty Acids

The report makes it quite clear that no causality has been proven with regard to the incidence of C.H.D. and consumption of saturated fatty acids. However, it is said that, "... the balance of opinion is clearly that it would be wise to reduce the amount of fat, especially saturated fat, in the diet."

b) Sugar

The only link which is drawn regarding sugar is that it may cause diabetes. It is stated that sugar in the diet is disadvantageous, but no relationship is inferred between sugar consumption and C.H.D. In fact, it is only inferred, but not stated, that there is a causal relationship between sugar consumption and obesity.

c) Salt

It is suggested that an excess of salt consumption may lead to high blood pressure and hence to an increased risk of death from C.H.D. However, it is not defined what is meant by 'excess'.

d) Dietary Fibre

The report merely states that research is being carried out on the effects of fibre consumption on health. Few potential benefits of an increased fibre consumption had been investigated at the time. It is not suggested that fibre consumption should be increased.

4. D.H.S.S. (1979). *Report on Health and Social Subjects, No.15. Recommended Daily Amounts of Food, Energy and Nutrients for Groups of People in the United Kingdom*, H.M.S.O., London.

In the preface to this C.O.M.A. report it is quite clearly noted that 'recommended amounts' refer to averages for groups of people. Evidently it would be impossible to quantify how much food energy and nutrients each individual should consume, hence consumers are grouped by sex, age and activity level and generalisations are made. Thus, interpretation, particularly, one presumes, when writing the N.A.C.N.E. Report, must be undertaken with great caution. If not, this report degenerates into a source of misinformation, verging on disinformation. Indeed, it is admitted in the report's introduction that, "more difficulties have been encountered about the use of the figures than about their validity."

Quite clear distinctions are made between recommended amounts of food energy and recommended amounts of nutrients. On the one hand, the requirement for food energy should be such that intake must equate with energy expenditure, that is, so that a person neither gains nor loses weight. On the other hand, recommended nutrient intakes refer to the amount below which, "... signs of deficiency might develop."

The stated uses of this report should be compared with the objectives of N.A.C.N.E. This report has its uses:

a) for planning food supplies and diets;
b) as a yardstick in the assessment of information about food supplies by means of which differences between groups of individuals and trends in time can be described, and;
c) for directing attention to subgroups who may be at risk.

These do not compare with the N.A.C.N.E. objectives of providing, "... clear and simple messages ..." and, " ... unambiguous advice that could be put into practice by the public."

5. D.H.S.S. (1981). *Report on Avoiding Heart Attacks*, H.M.S.O., London.
This publication is aimed at providing health educators, teachers and others with information, both accepted and contentious in nature, regarding ways and means of reducing the risks of heart attacks. It is noted in the introduction that, "... it will also provide the individual reader with the information needed to judge the implications for his or her lifestyle and to consider what he or she should do to avoid heart attack." In this respect it is a unique publication as far as those used for compiling the N.A.C.N.E. Report are concerned, since it is the only one which is aimed, albeit only partly, at the public.

The relevant chapter on food intake and the heart makes the clear admission that not all health experts are in total agreement as to what causes heart attacks, but that in broad terms, "... people are made up of the food and drink they consume."[13] The report tends to make tentative suggestions for the consumption of fat, sugar, fibre and salt

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13 See Murcott (*op cit*).

rather than making direct recommendations which, bearing in mind the nature of its target audience, would seem sensible in the light of the stated disagreement on some aspects of C.H.D. causality. These suggestions are outlined below:

a) Fats and Cholesterol

Partial substitution of polyunsaturated fatty acids for saturated fatty acids. Replacement of food energy derived from fat with food energy derived from fibre, "... could also be beneficial to health."

b) Sugar

It is not suggested that sugar alone increases the risk of heart attack. However, it is suggested that replacing sugar with unrefined carbohydrates can help to reduce the risk of heart attack by helping to reduce overweight, and that a reduction in saturated fat consumption can be compensated for by an increase in the consumption of unrefined carbohydrates which contain a higher proportion of dietary fibre.

c) Dietary Fibre

It is initially pointed out that there is no unchallenged evidence regarding the impact of an increased consumption of dietary fibre and the risk of heart attack. It is then suggested that increasing the proportion of energy derived from those foods which are high in dietary fibre, "... will make an important contribution to the overall reduction of risk." On the one hand it seems as though the evidence to date is accepted as inconclusive and on the other hand recommendations (or suggestions) are made in this respect. The authors are evidently convinced that their hypothesis is correct, but have been unable to successfully test this hypothesis.

d) Salt

Although it is not proven that excessive salt consumption is a direct cause of C.H.D., it is proposed, as in other papers, that excessive salt consumption can lead to high blood

pressure, which in turn is a contributory cause of heart attacks. The suggestion, though, is that a reduction in salt consumption is unlikely to be harmful to all but those people who work manually in hot and humid conditions, and consumption ought therefore to be reduced.

6. R.C.P. (1981). *Report on the Medical Aspects of Dietary Fibre.*

The supposition is made that there is some medical evidence to suggest that dietary fibre in the diet can possibly help to reduce the risk of disease, but that, "... there is some conflict of evidence about the clinical value of dietary fibre." Indeed, it is stated that, "there is much more to be learned about the effects of the different types and combinations of fibre in relation to the functioning of the alimentary tract, and more generally in relation to improving health and preventing disease."

The comparison is drawn between the diets of developing and industrialised countries. It is generally known that the diet in developing countries contains a higher proportion of dietary fibre. This report makes the same point, but stops at suggesting that this may be a factor in explaining differences in health since fibre, "... is not, of course, the only difference between the diet and lifestyle of the two broad cultural groups."

The report then goes on to describe the consumption of fibre over time. Using N.F.S. data, which indicates what has been purchased for domestic consumption and not what has been consumed in total, it is shown that the consumption of fibre derived from cereals has declined since 1950, and that from vegetables has increased. Total fibre consumption declined from 22-23 g/day in 1956 to 19-20 g/day in 1976. Concluding recommendations are made with the caveat, "there are two particular reasons why conclusions and recommendations must still be tentative.

a) the diversity of the effects of the many substances called fibrous, and;
b) the differences in lifestyles between developing and industrialised nations".

Further research is recommended into the palatability of foods which are high in fibre. It is also proposed that long-term clinical trials are necessary to assess the long-term effects of an increase in fibre consumption. Finally, the following statement is made: "On present evidence, we think it highly probable, though not fully proved and possibly not susceptible of rigid proof, that increasing the proportion of 'dietary fibre' in Western countries would be nutritionally desirable."

7. R.C.P. (1983). Obesity, *Journal of the Royal College of Physicians*, **17**, 3-58.
The first part of this report is an attempt to define what is meant by 'obesity'. This is followed by the conclusion that an increase in weight, above that which is recommended to be the 'acceptable' level, leads to an increased risk of 'ill-health', particularly in those people who have a family history of diabetes, hypertension and I.H.D.

Whether or not the definitions of weight thresholds are acceptable is not the question in hand. The pertinent issue is the way in which consumers prevent themselves from becoming 'overweight', irrespective of what this may mean. The report details a number of recommendations, some of which are listed below, many of which have far-reaching implications:

a) intake of dietary fats and sugars should be reduced;
b) public health measures, health education and medical advice are needed;
c) foods should have energy levels indicated wherever possible;
d) food manufacturers should produce both low-energy food substitutes and foods with reduced fat and sugar content;
e) government should avoid legislation which encourages the consumption of fats, sugars and alcohol;
f) measures should be introduced which would allow greater availability of reduced-fat milks;

g) taxation on alcoholic beverages should be increased;

h) all adults should remain physically active.

The recommendations go further, particularly in the areas of education of the consumer and of children in particular. Despite these recommendations being far-reaching, they tend to be over-generalised. Take the first of them, relating to the intake of dietary fats and sugars. The report merely states that, "if the average fat intake of the British diet were to fall from 38% towards 30% of the total energy intake (a figure which includes alcohol) there is no evidence that such a change would do harm; current evidence suggests that substantial benefits would accrue."

8. W.H.O. Expert Committee (1982). Prevention of Coronary Heart Disease, *Technical Report Series*, **678.**

This report aims to "... provide a scientific basis and rationale, as well as specific recommendations, for public health policy and community action programmes." Its potential usefulness as a contributory paper for the N.A.C.N.E. Report is therefore evidenced in its objectives. W.H.O. proposes that C.H.D. has reached such critical levels that a preventative approach is the most appropriate for dealing with it, particularly as it is not inevitable as a consequence of ageing or affluence. It is argued that such a preventative strategy should have three components:

a) a population strategy;

b) a high-risk strategy, and;

c) a secondary prevention strategy.

The first of these, the population strategy, is the one which most concerns nutritionists in that it is aimed at changing lifestyle characteristics, which would presumably include the food we eat, when we eat it, and how we prepare it. The report goes on to make

wide-ranging recommendations, but as far as diet is concerned it suggests the following changes, appropriate for the high-incidence population:

a) a reduction in saturated fat and dietary cholesterol, assisted by a replacement of some of the saturated fat by polyunsaturated fat;

b) an increase in complex carbohydrate consumption;

c) avoidance or correction of overweight;

d) a reduction in cholesterol intake to below 100 mg/1000 kcal/day, and;

e) a reduction in salt consumption to 5g/day or less.

Furthermore, saturated fat intake should not exceed 10%, and polyunsaturated fat intake should account for at least 3%, of total daily energy intake.

Interestingly, these recommendations are then translated into foods to 'emphasise' and foods to 'de-emphasise' (table A3.1).

Table A3.1 W.H.O.'s Foods to Emphasise and Foods to De-emphasise

Emphasise	De-emphasise
Beans	High-fat Meats
Cereal Grains	High-fat Dairy Products
Vegetables	Whole Eggs
Fruit	Commercially Baked Products
Fish	Alcoholic Beverages
Poultry	
Lean Meats	
Low-Fat Dairy Products (Adults)	
Less Oil and Fat	
Liquid Vegetable Oils	

Finally, it is concluded that, "coronary heart disease risk is significantly influenced by a number of personal and population characteristics and their combination. These, in turn, are largely determined by sociocultural factors and are therefore modifiable. Such characteristics include elevated blood pressure and blood cholesterol and the associated eating and activity patterns, and smoking."

Appendix 3.II Defining Segmentation

Market segmentation has been defined by Marcus and Tauber (*op cit*) as "... the process by which markets can be conceptually divided for further analysis ... (a) separation of the market into meaningful sections." The definition is concurrent with that of Boyd, Westfall and Stasch (1989) who also specify that the objective is to "... identify groups of consumers who are relatively homogeneous."

There is little argument as to the objectives of market (or consumer) segmentation. Divergence occurs in the specification of how segments should be determined. For example, Marcus and Tauber (*op cit*) name four determinants of behaviour by which markets can be segmented, namely cultural, sociological and individual factors which influence attitudes, and consumption factors, including brand loyalty and usage, which determine product use. On the other hand, Twedt (1986) specifies demography, behaviour, physical characteristics, psychological traits (intelligence, political bias, etc.) and marketing conditions (channels of distribution, etc.) as segmenting variables.

It is however clear that the variables chosen should be appropriate to the market or group of consumers which is being segmented. This will be largely determined by *a-priori* reasoning.

Chapter Four

Measuring Preference Changes and Statement of Hypotheses

4.1 Introduction

The objective of this chapter is to illustrate how changes in preferences can be measured using the Ministry of Agriculture, Fisheries and Food's National Food Survey data and to report on the results of these measurements. These are then discussed with respect to changes in some of the attitudes described in Chapter Three, with a view to substantiating the model of the determination of preference changes. The hypotheses are then stated.

4.2 National Food Survey Data

Annual reports from the N.F.S. Committee contain indices of demand[14] estimates[15]. The effects of income changes are then removed to leave the residual, i.e., changes attributable to changes in tastes or marketing policies (M.A.F.F., 1984).

Although these indices are reported in six year time series, rolled over every year, they can be spliced together to give indices for time series of any length. This process is to be discussed, in connection with the results which it yields, at some length. However the reliability of the demand indices must first be considered. In order to do so, the sampling method adopted for the N.F.S. must be described and discussed, since the interpretation of any analysis should be conducted whilst bearing in mind any data limitations.

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14 See Appendix 2.I, Chapter Two.

15 Since 1985, these indices are obtainable only from the supplementary tables.

4.2.1 Critique of the National Food Survey

There are a number of methods of collecting food consumption and related data. The method chosen should be dependent on the objective of the study, but the size of sample required and budget available will also tend to be determinants (Pekkarinen, 1970). Broadly speaking there are two methods employable; current intake and recall of past intake. The former may involve the precise weighing of food for consumption, an estimation of portion sizes, or the recording of a menu (without quantification of portion sizes). The latter usually involves recall of foods eaten using a questionnaire, or recording of what is usually eaten. However:

"The National Food Survey is a continuous sampling enquiry into the domestic food consumption and expenditure of private households in Great Britain." (M.A.F.F., 1991).

It differs fundamentally from the current intake and recall methods in that consumption is not measured by intake of food, but approximated by purchases of food entering the home.

The Survey, in its current format, has been running since 1940. It was established in response to the demand for information regarding food shortages in order that they might be anticipated and mitigated (Baines, 1991). No pilot survey was carried out or testing undertaken, but experience was drawn from previous works, most notably Crawford and Broadley and the Carnegie Trust (Frank, Fallows and Wheelock, 1984). This lack of testing may be one source of criticism which still exists today, however the Survey did have two predecessors in the Government's Agricultural Departments' Market Supply Committee Survey of food demand, supply and prices (1934) and the work of the Health Departments' Advisory Committee on Nutrition (1935), which drew on data from the former.

The objective of the Wartime Food Survey (the original name of the N.F.S.) at its inception in 1940 was principally to answer the question of whether or not wartime food policy was effectively providing a nutritionally adequate diet for the population. The method was to continuously survey households in the working class wards of seven cities in Great Britain. Although "... it is probably given more credence than is justified by its methodology", (Frank, Fallows and Wheelock, *op cit*) the Survey has been held in high regard as the first of its kind.

The Survey's objectives and methods have changed over its fifty year history, most notably in 1950 with the commencement of a shift away from the exclusive interest in nutrition and towards the collection of data more suitable for the estimation of economic variables and with an extension of the sample to cover all areas of the country and all socio-economic groups. Household classification by social class and family type was introduced and by 1976 the emphasis of the Survey had shifted further towards economic variables with the introduction of classification by household tenure.

Nowadays the Survey categorises households by the following variables:

1. region;
2. type of area (based on electoral density);
3. income group;
4. household composition;
5. age of housewife;
6. household tenure, and;
7. deep-freeze and microwave ownership.

The Survey is used to monitor food acquired by private households and intended for human consumption within the household, with limited reporting of food eaten away from the home. It remains a continuous examination (with the exception of a short

period at Christmas) within Great Britain. Information on food intended for human consumption within the home is recorded in a diary by the person responsible for the domestic food arrangements. Details relating to the nature of the household, i.e., household characteristics, are recorded on a separate questionnaire.

A three-stage stratified random sampling scheme is used to select participant households[16]. The composition of the sample (table 4.1) is at the centre of much of the criticism levelled at the current structure of the Survey. When the emphasis was on nutritional information it was claimed that the Survey produced overestimates of calorific intakes (Durnin and Blake, 1962) although no explanation was offered as to why this was so. However, more recently Frank, Fallows and Wheelock (*op cit*), drawing on the work of Kemsley (1976), suggested a number of reasons for low response and participation rates. The former, it is postulated, is a direct result of the weakness of the electoral register on which the third stage of the sampling process relies. The register fails to capture minority groups which, for whatever reason, may decide not to register to vote or have 'no fixed abode'. The register is not sufficiently up-to-date and some addresses, particularly in inner-city areas, no longer exist when interviewers call. Assuming these claims are justified, the previously representative sample has already become biased. Participation rates are reduced by several factors. For example, the increase in the number of working women has led to negative replies to personal callers regarding the Survey; the elderly tend to be more reluctant to participate for reasons of mistrust or the large amounts of written recording involved; and similarly those who are less capable or incapable of recording the necessary information will also tend to be reluctant to participate.

16 See Appendix 4.I.

Table 4.1 Composition of the 1991 National Food Survey Sample

	Households	Households (%)
Number of households at the address selected in the sample	12238	100
Number that could not be visited for operational reasons	2	-
Number visited but no contact made with the diary-keeper	1475	12
Interview refused or not practicable	1932	16
Diary-keeper answered a questionnaire but declined to keep a week's record	806	7
Diary-keeper started to keep a week's record but did not complete it	881	7
Completed records lost in the post or rejected at the editing stage	83	1
Number of responding households	7059	58

Source: M.A.F.F. (1991)

In 1991 some 30% of households did not participate on these or related grounds. As a result the original, representative sample is now biased. It is not feasible to ascertain conclusively the nature of this bias from the Survey itself. However Kemsley (*op cit*) compared the 1971 N.F.S. sample with the Population Census of the same year and identified one-person households, households containing unrelated persons, households sharing dwellings, households containing unemployed persons and households with single, widowed or divorced heads as being particularly

underrepresented by the N.F.S. sample. On the other hand the N.F.S. closely represented households where the head is aged between 26 and 36, where the housewife is aged between 21 to 30, and households with two or three children.

These results conform with expectations that the sample does not represent elements of the population at the 'periphery' and that it is representative of the 'core' elements of society. The way in which the sample is collected can certainly account for a large proportion of the problem. However, with voluntary, unpaid participation it is difficult to see how many of these problems can be overcome, save with the commission of particular surveys to cover underrepresented groups. An extension of this discussion does not lie within the framework of objectives for this thesis, save to say that this issue has recently been high on the N.F.S. Committee agenda.

In conclusion it should be noted that Slater (1991) found that estimates of household food expenditure from the N.F.S. compare favourably with estimates derived from the Family Expenditure Survey[17]. Furthermore, a comparison of purchase estimates from the N.F.S. with balance sheet estimates, although not producing an exact match, reveals that turning points and trends are very similar. These and other favourable cross validations give a certain degree of confidence in N.F.S. data, despite it having objectives ranging from being a data source from which economic indicators (e.g., retail price indices) are estimated, to the assessment of policy proposals and of course the monitoring of consumption trends. Nutritional measures are still regarded as important.

Data from the N.F.S. were used to examine food preference changes, despite the disadvantages discussed, because it is the most comprehensive survey of household food consumption available. The Survey results run to a fifty year time series, cover

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17 See C.S.O. (1990).

food disaggregated into over 150 different categories for the whole of Great Britain and include estimates of price and income elasticities of demand for each food (as well as demand indices). The faults of the Survey are well documented and can be taken into account when conclusions are drawn. No other Survey is as comprehensive in its coverage.

4.2.2 Method of Data Analysis

The objective of this section is to explain how preference changes can be measured for individual foods using demand indices (price and income effects excluded) estimated from N.F.S. data. The method employed involves splicing demand indices to form workable time series, the subsequent plotting of these new data sets, the fitting of regression lines to each series and the collection and comparison of similar trends.

4.2.2.1 Splicing Indices

Demand indices are reported in N.F.S. Annual Reports in six year series, rolled over every year (for an example see table 4.2). In order to achieve a single set of annual indices for each food, a time period for analysis had to be selected. This should capture the most recent underlying effects responsible for demand changes and preferably originate in a period when other factors, i.e., non-underlying factors, were of greater significance in any demand function. The 1970's are generally regarded as a period of price instability (Ritson and Hutchins, *op cit*), with the importance of price diminishing concurrently with increases in the significance of underlying factors throughout the 1980's. This trend is emphasised by increasing real incomes throughout the 1980's and the decline in the proportion of income spent on food.

Table 4.2 Demand Indices for Fresh Grapes (N.F.S. Code 222) 1972 to 1987

72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
116	111	108	101	80	88										
121	116	113	106	84	92	92	108	113	106	92	109	101	128	163	163
										75	89	82	104	133	133

(figures underlined are spliced values with the base such that the average for the base period 1977-1982 = 100, rounded to the nearest whole number).

Thus, the period from 1972 to 1987[18] was taken. This, in the main, necessitated splicing three sets of indices for each food, namely those reported in 1977 (covering the period 1972 to 1977), 1982 (covering the period 1977 to 1982) and 1987 (covering the period 1982 to 1987).

Taking the data for fresh grapes as an example (table 4.2), the ratio of the first demand index in the period 1977 to 1982 to the last demand index in the period 1972 to 1977 is calculated and multiplied by each index in the period 1972 to 1977. The new, spliced value for 1976 therefore becomes 84[19].

The base for each set of six demand indices is set such that the average for the base period is equal to 100. Of the 150 or so foods included in N.F.S. Annual Reports, cases occur when, for whatever reason, demand estimates are not included. In these instances the base period has been shifted to the nearest available period.

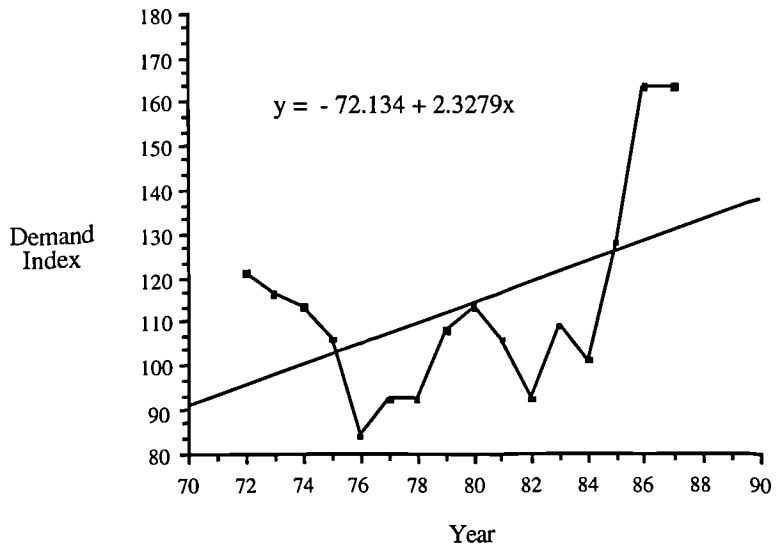
18 When this research was started, data for 1987 was the most recent available.

19 i.e., 80*(92/88)=83.64.

4.2.2.2 Regression Analysis

A measure of the change in demand for each food over the period was sought which would enable foods to be easily compared. Moreover, the measure should be one defining the strength and direction of the demand change. Such a measure could be obtained by fitting simple linear[20] regression lines to the data (figure 4.1). With the regression line taking the form $y = b_0 + b_1x$, the coefficient b_1 is therefore equal to the annual average percentage change in demand expressed as a percentage of its average value in the base period[21]. The sign on the coefficient will determine the direction of the demand change.

Figure 4.1 Demand Trend for Fresh Grapes with Linear Regression Line Fitted



20 Other functional forms were experimented with, none giving an overall better fit (as measured by the correlation coefficient) than this linear function.

21 This will henceforth be referred to as the average annual percentage change in demand, or simply the demand trend.

The equation of the regression line is $y = -72.134 + 2.3279x$. Therefore the annual average percentage change in demand is 2.3279% per annum in a positive direction, as given by the sign on the coefficient.

For each food the following hypothesis has been tested:

$$H0: \quad b_1 = 0$$
$$H1: \quad b_1 \neq 0$$

where b_1 is the simple linear regression coefficient. The results are reported in tables A4.1 to A4.12 in Appendix 4.II as *t*-statistics. These tables have been constructed as *leagues* in that foods which have the greatest positive annual average demand changes (as estimated by the regression coefficient b_1) appear at the head of each table, followed, in descending order of magnitude, by other foods in a particular category.

4.3 Discussion of Preference Changes and Changes in Attitudes to Health and Convenience

By taking the ten foods with the greatest positive (table 4.3) and ten with the greatest negative (table 4.4) annual average demand trends from those reported in Appendix 4.II it is possible to continue the development of hypotheses regarding the reasons for demand changes[22].

It is evident that two descriptors can be assigned to 'star' foods, i.e., those with the greatest positive demand trends, namely that they are seemingly characterised by 'convenience' or 'healthy eating'. On the other hand, 'dunce' foods, i.e., those with the strongest negative demand trends, are to a certain extent the antipathy of the 'stars'. Compare, for example, the perceived preparation times necessary for the consumption

22 See Ritson and Hutchins (*op cit*).

of unfilleted fish and frozen chips, or the perceived health (or safety) values of offal compared with fruit juices. These foods, however, lie at the extremities of the demand trends. A more realistic viewpoint comes from an examination of the trends of foods within food groups, where substitute products can be compared more readily.

Table 4.3 Greatest Positive Underlying Trends in Demand

Foodtype	Annual Demand Change (%)[23]
Other Fresh Green Vegetables	+29.0
Wholewheat & Wholemeal Bread	+18.2
Frozen Chips & Other Frozen Convenience Potato Products	+13.1
All Other Fats	+11.6
Frozen Convenience Cereal Foods	+11.2
Other Vegetable Products	+8.8
Fruit Juices	+7.6
Crisps & Other Potato Products, Not Frozen	+7.2
Other Fresh Fruit	+6.9
Shellfish	+6.4

It is apparent from the complete listing of demand trends within food groups (Appendix 4.II) that the 'health' issue is reinforced. Cream (table A4.1), all cheese (table A4.2), offals and carcase meats (table A4.3), butter (table A4.5), all sugars and preserves (table A4.6), canned fruit (table A4.9) and cakes, pastries, buns, scones, teacakes, canned milk puddings, white bread and other puddings (table A4.10) to name but a few could all be perceived as 'unhealthy'. All have strong, negative demand trends.

23 Only includes statistically significant trends.

Conversely, yoghurt (table A4.1), poultry products (table A4.3), other fats (including low fat spreads) (table A4.5), fruit juices and nuts (table A4.9) and wholewheat, wholemeal and brown bread and rice (table A4.10) might be perceived as 'healthy'. All have strong, positive demand trends.

Table 4.4 Greatest Negative Underlying Trends in Demand

Foodtype	Annual Demand Change (%)[24]
Unfilleted Fresh White Fish	-22.0
Fresh Peas	-16.2
Unfilleted Processed Fat Fish	-14.7
Fresh Soft Fruit, Other Than Grapes	-14.5
Instant Potato	-9.7
Offals, Other Than Liver	-8.5
Canned & Bottled Baby Foods	-8.1
Other Canned & Bottled Fruit	-8.3
Canned Potatoes	-6.8
Brussels Sprouts	-6.8

All six foods categorised under the 'sugar and preserves' (table A4.6) heading have negative demand trends. However, as Heasman (*op cit*) argues, the impact and degree of success of dietary recommendations regarding sugar intake must be measured by the change in consumption habits for those products which use sugar as an ingredient (cakes, pastries, etc.) rather than merely examining those which are regarded as sugar products in themselves (marmalade, jam, etc. (table A4.10)). Generally it is the case

24 Only includes statistically significant trends.

that demand for the former, as well as the latter, has declined, with the notable exception of chocolate biscuits (+0.1%, although insignificantly different from zero). Indeed cakes, pastries, buns scones and teacakes have, collectively, the strongest negative demand trend (-6.3%).

The underlying trend in demand for salt (table A4.12) is positive (+1.2%, although insignificantly different from zero). The question is whether or not this is a manifestation of a failure to communicate dietary recommendations, or otherwise. It should be recognised that salt, in its raw form, is not the only way that it is consumed. In this respect it is similar to sugar. Salt is an ingredient in many products, added during processing or manufacture. It is now recognised by many manufacturers that there may be some feeling amongst consumers that salt consumption should be reduced. Hence, we have seen a manifest increase in the introduction of products onto the market which are low in salt or with no added salt. Perhaps it should be hypothesised that the consumer may be consuming less salt in aggregate, but is compensating for reduced levels in processed foods by adding salt at table? Gregory (1990) reveals that extreme difficulties are encountered in measuring, with any degree of accuracy, the amounts of salt which are consumed at table or added during cooking. However, by measuring urinary sodium excretion and with the aid of a questionnaire, it was concluded that men are more likely to 'generally add salt to food at table' whilst women are more likely to add salt either 'sometimes' or 'rarely/never' and that most consumers generally add salt to their food during cooking.

There is a strong correlation between groups of people who derive the highest proportions of food energy from saturated fatty acids and the incidence of I.H.D. There is however no evidence of a causal link between consumption of foodstuffs which are lower in saturated fat and the communication of dietary recommendations regarding saturated fat, but the underlying trends in demand for foods which are low in fat tend to be positive (table A4.3). Burton and Young (*op cit*), using N.F.S. data,

show that consumer preferences for chicken and fish, which are considered relatively low in fat, are increasing, whereas for pork, lamb and beef they are decreasing.

Similarly, there is considerable evidence that the demand for milk is shifting more rapidly towards reduced fat and non-fat milks. The underlying trend in demand for 'total cheese'[25] (table A4.2) is negative (-0.4%, although insignificantly different from zero), as is butter (-4.8%) (table A4.5), whereas the trend for margarine is positive (+1.4%). However, is this evidence enough to suggest that the consumer is reducing his or her preference for saturated fats, or rather products which the consumer perceives to be harbours of large amounts of saturated fats?

Of the four main food constituents being considered, dietary fibre has received the most widespread media coverage. This may or may not be an indication of the effectiveness of the communication of dietary recommendations. Of the forty vegetable products covered in this analysis of N.F.S. data, twenty have declining demand trends (tables A4.7 and A4.8). The principal trends in this particular food group seem to stem from a demand for 'convenience' rather than a demand for fibre-rich foods. Hence, very little seems to have happened in the way of changing preferences for vegetables with respect to a hypothesised increased demand for fibre.

The pattern is very similar for fruit, where ten of the seventeen categories covered have declining underlying trends (table A4.9). One notable trend is the category 'all citrus fruit' (+2.0%) (see also 'fresh green vegetables' (-0.6% although insignificantly different from zero)). This poses the question of whether or not consumers associate fibre with fruit and vegetables, or whether it is perceived that cereal products are the sole or main domain of fibre.

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25 It is suggested by this author that the number of categories into which cheese is divided by the N.F.S. is insufficient to capture the principal preference changes within this product group.

Twenty-three cereal products are covered by the survey, of which twelve have positive demand trends (table A4.10). Wholewheat, wholemeal and brown breads seem to be the products which have been most highly elevated in the consumer's list of preferences. There is nothing to suggest that fibre is responsible for this trend, but it can be hypothesised.

It is apparent from tables 4.3 and 4.4 (and more especially tables A4.1 to A4.13) that consumers' changing attitudes to 'health' cannot be entirely responsible for food preference changes. As suggested earlier, there is evidence that 'convenience' foods and foods which may not be labelled as 'convenience', but which are however more convenient than others in terms of overall preparation and cooking times, do tend to demonstrate strong, positive demand trends. Moreover, inconvenient foods tend to demonstrate strong negative demand trends[26]. In many instances it seems that consumers are behaving in much the same way as Foxall and Haskins (*op cit*) suggested, in that they may well be aware of nutritional information and guidelines, but choose to ignore them when 'convenience', for example, becomes an issue. In an examination of the influence of nutritional awareness on the choice of dairy products, Nash (1990) concluded that although consumer understanding of nutrition is 'good', it tends to be product-specific, and among some groups of consumers there is evidence of miscomprehension. This suggests that some consumers may behave irrationally when it comes to a choice between product characteristics, say nutrition and convenience. Others are simply unaware of the *true* nutritional implications of their food choices.

A number of authors have built upon Lancaster's (1966) Model of goods' characteristics. Of particular relevance to food is Becker's (1981) thesis that *time* should be built into the demand function, since it has an opportunity cost and can be

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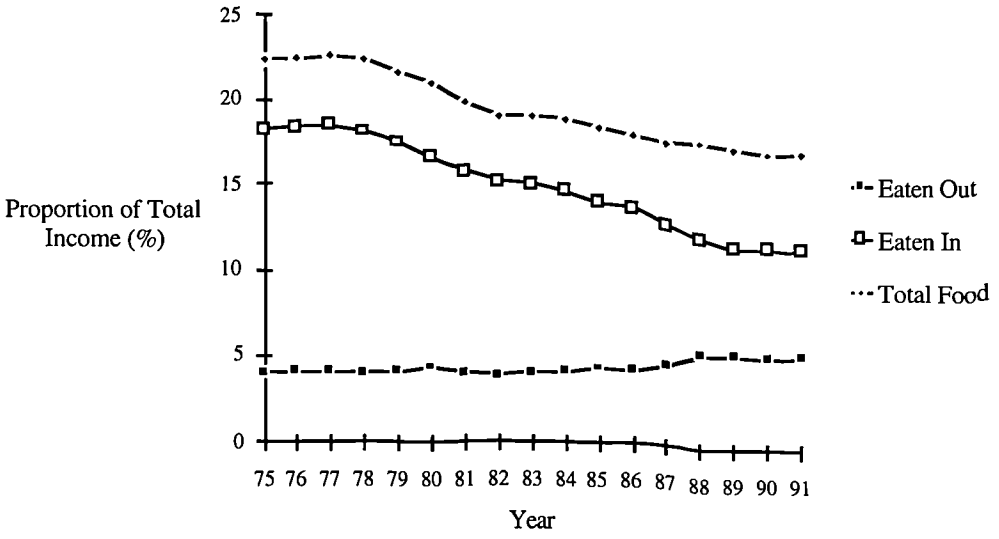
26 The annual average percentage change in demand for unfilleted fresh white fish, for example, is -22%, greater than any other food analysed.

quantified. It can be hypothesised that consumers are tending to prefer food products which take less time to prepare and cook because their opportunity cost of *time* is increasing. Therefore when comparing the cost of, say, a homemade pizza with a take-away pizza, the homemade version may cost less in terms of the cash outlay, but the take-away version may well work out cheaper as a result of *time* being given a high value in terms of, say, additional income earned as compared with income foregone in the time spent preparing and cooking the homemade pizza. In other words, the total cost is equal to the price plus the monetary value of time foregone.

It has been shown by Hull, Capps and Havlicek (1983) that as the value of *time* increases, so the incidence of consumption away from the home and the consumption of 'convenience' food within the home increase. The proportion of food consumed away from the home *is* increasing (figure 4.2). Between 1975 and 1991 the proportion of total income spent on food (including food eaten away from the home) decreased from 22.4% to 17.7%. Meanwhile the proportion of income spent on eating out increased from 4.1% to 5.7 %.

As Schur (1989) put it, "with a scarcity of time, more and more (women) contend that quality time for their families or themselves is too important to waste in the kitchen." The time associated with preparing and cooking foods is perceived as a product attribute of increasing importance to the consumer. This has been recognised by manufacturers and retailers alike and is manifested in changes in consumer food preferences.

Figure 4.2 Proportion of Total Income Spent on All Food (excluding alcoholic beverages), Food Eaten at Home and Food Eaten Out 1975 to 1991



Source: M.A.F.F. (various annual reports)

As far as the 'convenience' hypothesis is concerned, instant milk (table A4.1), frozen and cooked meats (table A4.3), filleted fish (table A4.4), frozen and processed vegetables (table A4.7) and frozen and convenience cereals (table A4.10) all have strongly positive demand trends. Indeed, by taking the descriptors given to each food (as described in N.F.S. annual reports) and comparing these descriptors with rankings associated with annual average percentage changes in demand, a crude league table of descriptors has been constructed such that the highest score is associated with the greatest positive demand change, and *vice versa*. This analysis of descriptors of all N.F.S. foods reveals that those foods described as 'convenience' foods have the greatest positive demand trends, followed by foods with the descriptor 'frozen' (table 4.5). Foods with other descriptors have, in aggregate, negative demand trends.

Table 4.5 League Table of National Food Survey Food Descriptors[27]

Descriptor[28]	Score[29]	Rank	Trend
Convenience	137	1	+ve
Frozen	105	2	+ve
Cooked	88	3	-ve
Fresh	84	4=	-ve
Dried	84	4=	-ve
Uncooked	68	6	-ve
Bottled	59	7	-ve
Canned	43	8	-ve

Furthermore, cooked foods, as described by the N.F.S., appear in third place, although with an aggregate negative demand change, albeit marginally so.

4.4 Statement of Hypotheses

Chapters Two, Three and Four have focused on the development of a series of *testable* hypotheses. These have originated from the notion that tastes and preferences have changed and that these changes have come about as a result of changes in consumer attitudes to 'health', 'convenience' and other factors. These attitudes are influenced through systems of personal characteristics (principally socio-economic and demographic), as demonstrated by the behavioural models, and may be statistically

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27 The focus of this research has been of necessity on secondary data. Ideally it would be appropriate to test N.F.S. descriptors, such as *convenience* and *fresh*, qualitatively on a sample of consumers and analyse the difference between, say, consumer perceptions of *convenience* and those foods which are described by the N.F.S. as *convenient*. The question 'do N.F.S. descriptors reflect reality?' needs to be addressed.

28 Only descriptors occurring more than three times are included.

29 A score of over 91 is associated with an aggregated positive demand trend.

significant determinants of preference changes in their own right, as *a-priori* variables, or collectively, as *post hoc* variables. In other words:

Preferences = f (Attitudes) = f (Personal Characteristics)

The hypotheses which will be tested are therefore as follows:

1. *A-priori* variables differentiate between consumers who prefer those foods which have experienced the most marked preference changes.

If it is found that these variables are insignificant determinants, the following hypothesis will be tested:

2. *Post hoc* variables differentiate between consumers who prefer those foods which have experienced the most marked preference changes.

In other words, it will be attempted to identify the links between variables which identify those consumers who prefer foods which have undergone the most marked preference changes and the characteristics of these foods.

Given a suitable body of data, as many socio-economic variables, and other variables related to food consumption practices, as possible will be used for testing these hypotheses. These will be used initially as *a-priori* variables, and thereafter to form *post hoc* variables.

Appendix 4.I The National Food Survey Sampling Scheme

"The National Food Survey is selected to be representative of mainland Great Britain (including the Isle of Wight but not the Scilly Isles or the islands of Scotland). In 1991 a three-stage stratified random sampling scheme was used, the first stage of which involved the selection of local authority districts as the primary sampling units. The number of local authority districts included in the Survey for sampling purposes was 52 at any one time. As in previous years, approximately an eighth of the local authority districts were retired and replaced each quarter (re-selection being possible). Districts selected remain in the Survey for eight consecutive quarters before being retired.

The second stage of the selection procedure in 1991 involved the selection of 15 postal sectors within each of the districts. The third stage was the selection of 18 delivery points from each postal sector. The delivery points were drawn from the Small Users Postcode Address File using interval sampling from a random origin.

The 52 local authority districts selected are randomly divided into two sets of 26. The two sets are worked in slightly overlapping 26 day intervals with two postal sectors being covered during each 26 day interval. Thus, in the first interval, 52 postal sectors from one set of 26 local authority districts are worked and in the second 26 day interval 52 postal sectors from the other set are worked."

National Food Survey (1991, p.58)

Appendix 4.II Tables A4.1 to A4.12

Table A4.1 Underlying Trends in Demand for Milk Cream

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Instant Milk	+5.4	4.35	0.00	72-80
Yoghurt	+3.5	4.86	0.00	72-83
Dried Milk*	+0.5	0.35	0.73	75-87
Full-Price Liquid Milk	-2.5	9.50	0.00	72-87
Cream	-5.0	11.27	0.00	74-87
Branded Condensed Milk	-6.0	15.67	0.00	72-87

* coefficient insignificantly different from zero

Table A4.2 Underlying Trend in Demand for Cheese

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Natural Cheese*	-0.5	1.46	0.20	80-87
Total Cheese*	-0.4	1.25	0.26	80-87
Processed Cheese	-2.0	3.38	0.00	72-87

* coefficient insignificantly different from zero

Table A4.3 Underlying Trend in Demand for Meat and Meat Products

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Frozen Convenience Meat & Meat Products	+5.2	13.63	0.00	72-87
Cooked Poultry	+4.6	6.13	0.00	72-87
Meat Products, Other Than Cooked Sausages	+2.9	30.89	0.00	72-87
Uncooked Other Poultry, Including Frozen	+1.0	2.29	0.04	72-87
Uncooked Broiler Chicken, Including Frozen*	+0.7	2.03	0.06	72-87
Other Cooked Meat, Not Canned*	+0.4	0.64	0.53	74-87
Cooked Bacon & Ham, Including Canned	-1.0	4.98	0.00	72-87
All Meat & Meat Products	-1.1	5.74	0.00	72-87
Ready-to-Eat Meat Pies & Sausage Rolls	-1.1	4.78	0.00	72-87
Uncooked Beef Sausages	-1.2	2.15	0.05	72-87
Corned Meat	-1.9	4.69	0.00	72-87
Uncooked Pork and/or Beef Sausages	-2.3	7.83	0.00	72-87
Uncooked Bacon & Ham	-2.8	15.57	0.00	72-87
Beef & Veal	-3.0	6.49	0.00	72-87
Pork	-3.2	6.50	0.00	72-87
All Carcase Meat	-3.2	7.82	0.00	72-87
Other Cooked & Canned Meat	-3.5	7.19	0.00	72-87
Mutton & Lamb	-4.9	14.06	0.00	72-87
Uncooked Pork Sausages	-4.9	15.50	0.00	72-87
Liver	-5.2	17.67	0.00	72-87
Other Canned Meat, Excluding Corned Meat	-5.6	8.59	0.00	72-87
All Offals, Including Liver	-6.3	23.74	0.00	72-87
Offals, Other Than Liver	-8.5	18.99	0.00	72-87

* coefficient insignificantly different from zero

Table A4.4 Underlying Trend in Demand for Fish

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Shellfish	+6.4	9.57	0.00	72-87
Fresh Fat Fish, Other Than Herrings	+4.6	2.89	0.02	72-81
Filleted Processed Fat Fish	+2.5	4.06	0.00	72-87
Other Canned or Bottled Fish	+1.8	2.83	0.01	72-87
Frozen White & Frozen Convenience Fish	+1.4	4.58	0.00	72-87
All Convenience Fish	+1.3	3.07	0.01	72-87
Frozen Convenience Fish Products	+1.2	4.04	0.00	73-87
Fish Products, Not Frozen*	+1.0	2.03	0.06	72-87
Cooked Fish*	+1.0	1.77	0.10	72-87
Filleted Fresh White Fish*	-0.3	0.37	0.72	72-87
Processed White Fish*	-0.5	1.31	0.21	72-87
Uncooked White Fish, Inc. Smoked & Frozen	-0.7	2.89	0.01	72-86
Frozen White Fish*	-0.7	0.88	0.39	72-87
Fat Fish*	-3.8	1.72	0.18	72-76
Canned Salmon	-6.3	3.60	0.00	72-87
Unfilleted Processed Fat Fish	-14.7	7.40	0.00	72-80
Unfilleted Fresh White Fish	-22.0	6.65	0.00	72-87

* coefficient insignificantly different from zero

Table A4.5 Underlying Trend in Demand for Fats

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
All Other Fats	+11.6	6.23	0.00	72-87
Margarine	+1.4	2.75	0.02	72-85
All Fats*	0.0	0.00	1.00	74-79
Butter	-4.8	7.41	0.00	72-83

*coefficient insignificantly different from zero

Table A4.6 Underlying Trend in Demand for Sugar and Preserves

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Honey	-1.2	2.61	0.02	72-87
Jams, Jellies & Fruit Curds	-2.6	8.50	0.00	72-87
Sugar	-3.3	12.24	0.00	72-87
Syrup & Treacle	-4.5	8.08	0.00	72-87
Marmalade	-4.9	7.61	0.00	72-87

*coefficient insignificantly different from zero

Table A4.7 Positive Underlying Trends in Demand for Vegetables

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Other Fresh Green Vegetables	+29.0	5.24	0.00	80-87
Frozen Chips & Other Frozen Convenience Potato Products	+13.1	15.39	0.00	72-87
Other Vegetable Products	+8.8	6.70	0.00	72-87
Crisps & Other Potato Products, Not Frozen	+7.2	17.04	0.00	72-87
Processed Potatoes, Including Frozen	+4.3	7.73	0.00	74-87
Miscellaneous Fresh Vegetables	+3.9	7.55	0.00	72-87
All Frozen Vegetables	+3.8	15.34	0.00	72-87
Mushrooms	+3.6	7.55	0.00	72-87
Carrots	+1.8	6.09	0.00	72-87
Vegetable Juices*	+1.2	1.40	0.19	72-87
Fresh Turnips & Swedes*	+1.2	1.81	0.09	72-87
Canned Beans	+1.0	4.20	0.00	72-87
All Other Frozen Vegetables & Frozen Vegetable Products	+0.6	0.51	0.62	72-87
Cucumbers	+0.6	2.40	0.03	72-87
Canned & Bottled Tomatoes*	+0.2	0.51	0.62	72-87
Fresh Onions, Shallots & Leeks*	+0.2	0.60	0.56	72-87

*coefficient insignificantly different from zero

Table A4.8 Negative Underlying Trends in Demand for Vegetables

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Other Fresh Root Vegetables*	-0.5	1.13	0.28	72-87
Fresh Vegetables, Excluding Potatoes*	-0.6	1.09	0.30	74-87
Leafy Salads*	-0.6	1.29	0.22	72-87
Potatoes, Excluding Potato Products	-0.7	3.14	0.00	72-87
Fresh Green Vegetables*	-0.8	1.03	0.34	80-87
Frozen Peas	-1.2	2.80	0.01	72-87
Chips, Excluding Frozen	-1.5	2.62	0.02	72-87
Fresh Tomatoes	-1.7	9.19	0.00	72-87
Cabbages	-1.7	3.94	0.02	72-84
Brassicas	-2.1	6.68	0.00	72-87
Canned Vegetables, Excluding Pulses, Potatoes & Tomatoes	-2.2	4.49	0.00	72-87
Dried Pulses, Other Than Air Dried	-2.5	2.19	0.05	72-87
Canned Peas	-2.9	8.96	0.00	72-87
Fresh Beans*	-3.3	1.35	0.20	72-87
Cauliflowers	-4.5	5.72	0.00	72-87
Frozen Beans	-5.3	10.01	0.00	72-87
Brussels Sprouts	-6.8	2.85	0.04	72-78
Canned Potato	-6.8	2.55	0.03	74-87
Instant Potato	-9.7	2.88	0.01	72-87
Fresh Peas	-16.2	2.79	0.02	72-85

*coefficient insignificantly different from zero

Table A4.9 Underlying Trends in Demand for Fruit

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Fruit Juices	+7.6	12.53	0.00	72-87
Other Fresh Fruit	+6.9	5.42	0.00	72-87
Nuts & Nut Products	+2.8	5.11	0.00	73-87
Fresh Grapes	+2.3	2.09	0.06	72-87
Fresh Stone Fruit	+1.8	1.44	0.17	72-87
Pears*	+0.3	0.52	0.61	72-87
Bananas*	0.0	0.01	0.99	72-87
Apples	-0.8	4.20	0.00	72-87
Dried Fruit & Dried Fruit Products*	-1.6	1.84	0.09	73-87
All Citrus Fruit	-2.0	4.50	0.00	74-87
Other Citrus Fruit	-2.6	4.86	0.00	72-87
Oranges	-3.5	8.86	0.00	72-87
Rhubarb*	-5.2	1.68	0.14	72-80
Canned Peaches, Pears & Pineapples	-7.1	16.43	0.00	72-87
All Canned & Bottled Fruit	-7.6	17.51	0.00	72-87
Other Canned & Bottled Fruit	-8.3	11.48	0.00	74-87
Fresh Soft Fruit, Other Than Grapes	-14.5	4.78	0.00	72-87

*coefficient insignificantly different from zero

Table A4.10 Underlying Trend in Demand for Cereals

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Wholewheat & Wholemeal Bread	+18.2	10.19	0.00	74-87
Frozen Convenience Cereal Foods	+11.2	28.09	0.00	72-87
All Wholewheat, Wholemeal & Brown Bread	+4.8	5.69	0.00	74-87
Rice	+4.4	5.42	0.00	72-87
Breakfast Cereals	+4.3	9.60	0.00	79-87
Other Bread	+3.9	5.96	0.00	77-87
Other Cereal Foods	+3.2	3.91	0.00	72-86
Other Cereal Convenience Foods	+2.0	8.36	0.00	72-87
Brown Bread	+1.7	2.47	0.03	74-87
Infant Cereal Foods*	+1.0	1.23	0.24	72-87
Oatmeal & Oat Products*	+0.7	0.67	0.52	72-87
Chocolate Biscuits*	+0.1	0.27	0.79	72-87
All Cereals	-0.5	3.51	0.03	72-77
All Biscuits	-0.8	8.40	0.00	72-87
Buns, Scones & Teacakes*	-1.0	1.67	0.13	77-87
Biscuits, Other Than Chocolate Biscuits*	-1.4	0.27	0.80	72-87
Cakes & Pastries	-1.6	6.25	0.00	75-87
Flour	-2.6	4.38	0.00	72-87
Puddings, Other Than Canned Milk Puddings	-3.0	3.27	0.01	72-87
Standard White Loaves	-3.7	17.14	0.00	73-87
Crispbread	-4.0	6.87	0.00	72-87
Canned Milk Puddings	-5.0	6.61	0.00	73-87
Cakes, Pastries, Buns, Scones & Teacakes	-6.3	7.94	0.02	72-75

*coefficient insignificantly different from zero

Table A4.11 Underlying Trends in Demand for Beverages

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Coffee Essences*	+18.4	1.33	0.25	72-77
Cocoa & Drinking Chocolate*	+1.2	1.75	0.10	72-87
Instant Coffee*	-0.5	0.84	0.42	72-84
Tea	-0.9	2.92	0.01	72-87
Bean & Ground Coffee*	-1.2	1.43	0.17	72-87
Branded Food Drinks	-3.3	2.75	0.02	72-87

*coefficient insignificantly different from zero

Table A4.12 Underlying Trends in Demand for Miscellaneous Foods

Foodtype	Annual Demand Change (%)	t-stat. (95%)	prob. > t	Series
Spreads & Dressings	+3.7	10.74	0.00	72-87
Dehydrated & Powdered Soups	+2.3	5.78	0.00	72-87
Ice-Cream (as part of a meal) & Mousse	+2.0	6.39	0.00	72-87
Salt*	+1.2	0.52	0.63	77-82
Pickles & Sauces	+0.7	3.14	0.01	72-87
Meat & Yeast Extracts	-1.7	3.78	0.00	72-87
Canned Soups	-2.1	5.58	0.00	73-87
Table Jelly, Squares & Crystals	-4.0	13.45	0.00	72-87
Canned & Bottled Baby Foods	-8.1	4.37	0.00	72-87

*coefficient insignificantly different from zero

Chapter Five

Data for Testing Hypotheses

5.1 Introduction

This chapter considers the body of secondary data used to test the hypotheses stated in Chapter Four from the original objectives and method of collection to a comprehensive description of the variables used. Furthermore, the method and result of data improvements are described.

5.2 The Newcastle Food Diaries

Since no funding was available to collect data for this specific purpose, a secondary body of data was used, namely the Newcastle Food Diary[30].

5.2.1 Description of Collection Method and Objective

The Newcastle Food Diary was chosen for a variety of reasons. Diary data is likely to be more reliable than survey data, primarily because the length of time which elapses between consumption and recording is usually shorter when the diary method is used (Marshall, *op cit*). Diaries also tend to represent more accurately the consumption of the individual. Although the objectives for the Newcastle Food Diary were to, "... provide information about the way in which fish and fish products fit into household food consumption patterns ..." (Marshall, *op cit*), with the emphasis strongly placed on fish consumption, its aims were to put this into context with other foods and therefore data relating to all foods consumed were recorded. Furthermore, the Diary contained a record of individuals', as opposed to households', food consumption, allowing comparison of variables relating to the individual (socio-economic) to be made with individuals' consumption.

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30 The Newcastle Food Diary was designed by Marshall and Gofton (see Marshall, *op cit*).

Diaries were placed in 102 households in the North East of England over a two week period in 1987. The information was recorded by the Key Kitchen Person (K.K.P.), i.e., the person principally responsible for food preparation and cooking. Each household completed two diaries, one for each week, with the first Diary being collected at the end of the first week.

Information was collected about the foods consumed in the household and about household characteristics, thus forming two sets of data. The principal variables in the food data set were:

1. description of the food;
2. the form of the food when bought, e.g., fresh, frozen;
3. the name of the meal, e.g., dinner, breakfast;
4. the type of meal the food was used in, e.g., main, light;
5. the method of cooking, e.g., grilled, boiled, fried;
6. the time the food took to prepare, cook and eat;
7. the mode of serving, e.g., hot or cold;
8. who prepared the meal, e.g., husband, daughter;
9. who ate the food, and;
10. the day on which the meal was eaten.

The principal variables in the data set relating to household (socio-economic) information were:

1. the age at which the K.K.P. stopped receiving full-time education;
2. the qualifications of the K.K.P.;
3. the sex, age and occupation of all household members;
4. the gross annual income of the household;
5. the nature of the dwelling, e.g., furnished and rented, owned outright;

6. the household expenditure on food in the last week;
7. details of any special diets;
8. the facilities used for eating, e.g., dining room;
9. details on eating away from the home;
10. the equipment used for cooking, e.g., gas oven, liquidiser;
11. household social class;
12. use of cookbooks;
13. viewing of food programmes, and;
14. attendance of cookery classes.

The coverage of both food and consumer descriptors is adequate for testing the hypotheses, with the household (socio-economic) variables acting as *a-priori* variables in the first instance. However, the nature of the coding of the data and errors in data entry[31] make comprehensive testing impossible. One further possible weakness of the sample is the degree to which it is representative of the population, although it is clear that the sample size would, in any case, be too small to allow statistically significant inferences about the population to be made.

5.2.2 Description of Sample

The 102 households were selected and recruited by ten professional interviewers on the basis of a quota sample of Tyneside homes. The sample[32] households were drawn from Newcastle (n=77), Sunderland (n=20) and Durham (n=1) postal areas, four of which were recorded as missing values in the data set.

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31 The data set contains over 21,000 lines, amounting to 1,250,000 *bits* of information.

32 The sample is well described in Marshall (*op cit*). However, as a result of the data improvements made for the purpose of this study (see section 5.2.3) and the different focus of this research, the sample is redefined here.

A summary of the composition of households is contained in table 5.1. About one-fifth (21%) contain just one adult, exactly the same as for the whole of Tyne and Wear as reported in the Census of 1991[33]. Indeed the Diary sample seems to be representative of the household compositions of the area from which it is drawn for all households not containing children. However, the sample underrepresents what can be assumed to be 'single parent family' households, containing just 1% as opposed to the Tyne and Wear level of 9%.

Table 5.1 Household Composition

Adults	Children	Food Diary (%)	Tyne & Wear (%)
1	0	21	21
1	1	1	9
2	0	22	20
2	1	10	9
2	2	16	
2	3	3	}12
2	4	2	
3	0	10	8
3	1	9	4
3	2	1	-
4	0	5	-
4	1	1	-

The distribution of K.K.P. ages is skewed towards the younger age groups (table 5.2), most of whom are female (n=94). Of the seven male K.K.P.'s, five live alone. There

33 O.P.C.S. (*op cit*).

are problems in comparing the distribution of K.K.P. ages from the sample with the distribution from all households in Tyne and Wear. Firstly, the reported categories are different, and secondly the available data for Tyne and Wear is for 'head of household' as opposed to K.K.P. However, it appears that K.K.P.'s in the ranges 17-29 and 60 and over are underrepresented, and those in the 30-59 range are over represented in the Diary sample.

Table 5.2 K.K.P. Age

Food Diary		Tyne & Wear	
Age	Frequency	Age	Frequency
17-29	9	16-29	14
30-39	27		
40-49	27	}30-59	50
50-59	19		
60-72	19	60+	37
Missing	1		

The distribution of K.K.P. social grades is heavily skewed towards the lower classes (table 5.3). However, some 39 of the 102 social grade observations are missing and caution must prevail when interpreting the nature of the sample from this respect. The fact that of the 63 recorded values, none are from grades A or B does, however, suggest that the observable bias may in fact be close to the actual bias.

Table 5.3 K.K.P. Social Grades

Social Grade	Frequency
A	0
B	0
C1	34
C2	7
D	9
E	13
Missing	39

The vast majority of K.K.P.'s (n=82) left full-time education aged 16 years or under (table 5.4). Only five left in their post-teen years. This seems to correlate well with K.K.P. qualifications (table 5.5), with about one-third (n=33) having no qualifications and five having professional institute qualifications and degrees (not necessarily held by five different K.K.P.'s)[34].

Of course, the wide variation in the ages at which K.K.P.'s left full-time education can, to a certain extent, be explained by two factors; firstly, the propensity to leave school at an early age was greater for the older K.K.P.'s; secondly, the higher propensity for the older, female K.K.P.'s to leave school at an earlier age than the opposite sex in their peer group. Younger K.K.P.'s will tend to have left full-time education at an older age.

34 This typifies the problems associated with the Diary data.

Table 5.4 End of Full-Time Education of K.K.P.

Age	Frequency
14 & under	17
15	40
16	25
17	8
18	5
19	1
20	1
Over 20	4
Missing value	1

Table 5.5 K.K.P. Qualifications

Qualifications	Frequency
Degree	2
Professional Institute	3
HNC/HND	3
Teacher Training	5
A'Levels	10
Intermediate Qualification	2
Full Apprenticeship	5
O'Levels/CSE	40
ONC/OND	4
Other	28
None	33

The gross annual income of households (as opposed to that of the K.K.P.) has been recorded on an interval scale (table 5.6). There are problems associated with analysing distributions recorded in this way, namely that the distribution of incomes within each interval is not known and that not all of the intervals are of equal width. However, of the lower five income classes, none can be said to predominate. This does not conform with *a-priori* expectations of a normal or skewed distribution, with the number of households in the lowest income class being similar to the number in the median class.

Table 5.6 Gross Annual Income

Income (£)	Frequency
0 - 2999	14
3000 - 5999	18
6000 - 8999	11
9000 - 11,999	19
12000 - 14999	17
15000 - 17999	8
18000 - 20999	4
Over 21000	4
Missing	7

The unexpected nature of this distribution is emphasised by an analysis of household income compared with household food expenditure (table 5.7). Little of note can be inferred from the distribution of food expenditure *ceteris paribus*. The modal expenditure is in the class £30 - £39.99, and the distribution appears to approach normality. It is the comparison of household income with weekly food expenditure which is most revealing.

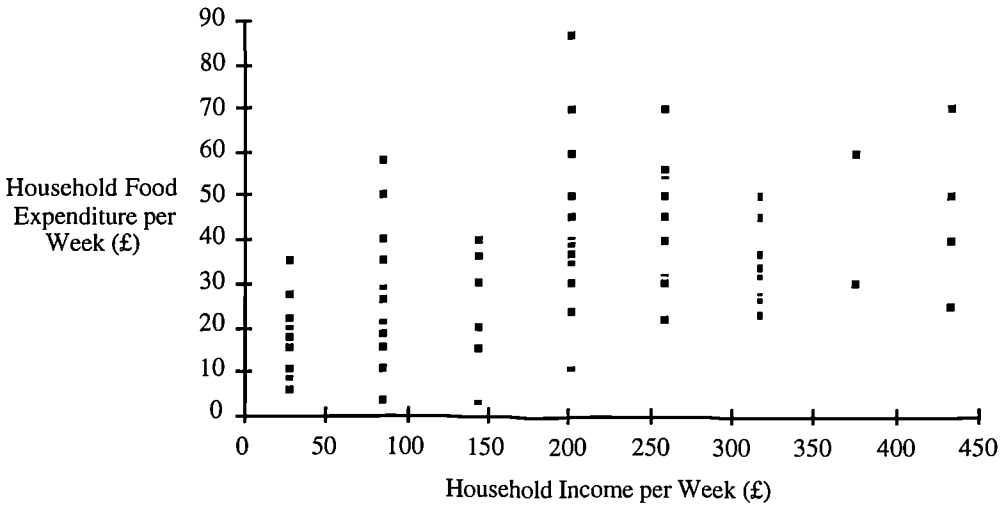
It is accepted that as income increases, so the proportion of that income spent on food will tend to decrease. This is known as Engel's Law. Aitchison and Brown (1954), extending the work of Allen and Bowley (1935), suggested a non-linear (as opposed to a linear) relationship between income and expenditure, whereby, as income increases, expenditure will initially increase at an accelerating rate, then reach a turning point, and eventually, at the highest levels of income, level off.

Table 5.7 Weekly Household Expenditure on Food

Expenditure (£)	Frequency
< 10	4
10 - 19.99	13
20 - 29.99	16
30 - 39.99	23
40 - 49.99	13
50 - 59.99	14
> 59.99	7
Missing	12

Chesher (1991) demonstrates this relationship using N.F.S. data, and these results can be replicated, albeit with a far smaller sample size, using the Diary data. Initially, household income is plotted against household food expenditure (figure 5.1). For the Diary data this gives approximately the same relationship as described by Aitchison and Brown (*op cit*).

Figure 5.1 Household Income and Food Expenditure per Week



However, by taking the log of income and plotting it against the share of income spent on food (figure 5.2), a stronger replication of Chesher's (*op cit*) results is obtained, as demonstrated by the decrease in variability of income share spent on food as income rises.

The composition of households in the sample can also be taken into consideration. Using food equivalence scales, household compositions can be weighted according to household member ages (table 5.8) based on food expenditures or based on calorific intake (Chesher, *op cit*). Extending the model would involve estimating an Almost Ideal Demand Model, but it is clear that the data conform to Engel's Law without extending the analysis further.

Figure 5.2 Log of Household Income and Share Spent on Food

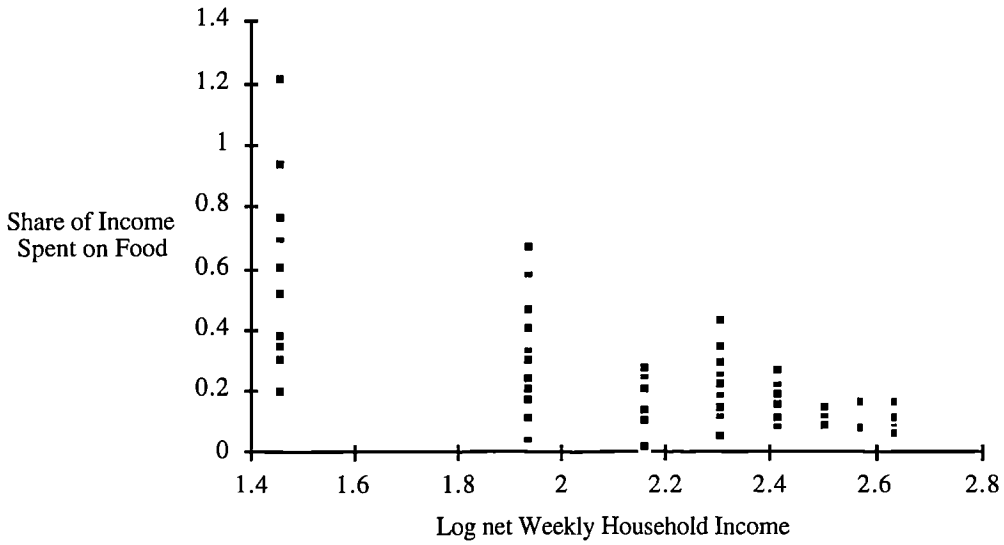


Table 5.8 Nicholson's (Adapted) Food Equivalence Scales for Children

Age	Weight[35]
0-1	0.08
2-4	0.36
5-7	0.50
8-10	0.48
11-12	0.58
13-15	0.56
16-17	0.80

35 Where an adult (>17 years) = 1.00.

Each household member is weighted, the sum of the individuals' weights being the household adult equivalent.

As far as dwellings are concerned, the majority (77%) are owned by their occupants, compared with about half (53%) in Tyne and Wear as a whole (O.P.C.S., *op cit*) (table 5.9). Less than one-fifth (19%) are rented, mainly from the council (13%). This compares with a total of 47% in Tyne and Wear. There is no obvious reason for these discrepancies, but they do reveal further weaknesses in the sample.

Table 5.9 Home Ownership

Home Type	Food Diary (%)	Tyne & Wear (%)
Unfurnished Council	13	-
Unfurnished Other Rental	2	-
Furnished Rented	3	-
Rented Outright	1	-
Total Rented	19	47
Owned Outright	24	17
Owned with Mortgage	53	36
Total Owned	77	53
Missing	5	-

Detail on the precise nature of these dwellings is scant, mainly due to the amount of missing or incorrectly coded data (table 5.10). However, over half (n=56) consider the kitchen and dining room as available eating locations, and one-third consider the dining room only (n=34). It is not possible to deduce how many households consider the kitchen a room for dining in (87 missing values).

Table 5.10 Available Eating Locations

Room	Yes	No	Missing
Kitchen & Dining Room	56	18	28
Dining Room Only	34	6	62
Kitchen Only	8	7	87

Data on the actual use of these rooms is, though, more revealing, despite contradicting the findings reported above (table 5.11). The dining room seems to be relatively heavily used with 41 households using it every day. This compares with 26 households eating in front of the television every day. The design of these questions does not allow this data to be crosstabulated with individual eating occasions. Hence it proves difficult to visualise the pattern of eating occasions.

Table 5.11 Use of Eating Locations

Usage	Dining Room	Kitchen / Diner	TV Eating
Special occasions	28	3	11
Sunday	13	1	2
2/3 Times / week	10	8	19
Every day	41	42	26
Other	10	7	12
Missing	0	41	32

Data on food preparation and the cooking equipment available for use in these households is as confusing (table 5.12). Recording has been undertaken in such a way as to duplicate many records (see the entries on refrigerators and freezers). However, it

seems that all but one have use of a conventional oven (gas, electric or aga-style), the majority (n=56) favouring gas power. Fewer than half have a microwave oven, and only five a dishwasher. There is evidence that some (precisely how many is unclear) use a wide range of powered kitchen implements, such as food processors (n=25), liquidizers (n=77) and sandwich makers (n=61).

Table 5.12 Kitchen Equipment

Equipment	Freq.	Equipment	Freq.
Electric hob	24	Frying pan or multi-cooker	33
Electric oven	44	Toasted sandwich maker	61
Gas hob	43	Rotary wisk or balloon	45
Gas oven	56	Pressure cooker	50
Oven with timer	55	Food chopper	25
Aga-style cooker	1	Food scales	6
Microwave oven	41	Wok	40
Dishwasher	5	Chip pan	45
Refrigerator	58	Extractor fan or hood	25
Freezer	44	Liquidizer	77
Fridge-freezer	50	Mincer	45
Grill	73	Food processor	25
Deep fat fryer	34	Toaster	77
Casserole or slow cooker	25		

The majority of households (n=83) eat away from the home at lunchtime (table 5.13). Half of these occasions involved taking lunch at work. The remainder did not eat away from home at lunchtime during the two week period. More than half the households (n=56) did not eat out during the evenings. Of those which did, twenty-five of the total

of eighty-five occasions involved eating at friends' or relations' homes[36]. There are similar problems interpreting this data as the data on household equipment, namely replication of occurrences, which make analysis at this level of aggregation difficult.

Table 5.13 Eating Out Occasions

Location	Lunch	Evening
Work	134	5
School	28	0
Restaurant	11	15
Pub or club	24	6
Fish and chips	5	2
Pizza	0	2
Hamburger	0	0
Sandwich	7	0
Hotel	0	4
Indian or Chinese	2	9
Friends or relations	31	25
Other	25	1
None	-	16
Total	267	85
Households	83	46

A small proportion of K.K.P.'s (n=14) are on special diets (table 5.14), half for reasons of weight control, the remainder for a variety of medical reasons. This cannot be construed as unusual, but may, to a certain extent, be influential in shaping household dietary patterns.

36 Approximately 2.2% of household weekly income is spent on 'eating out' (C.S.O., 1987).

Table 5.14 Persons on Special Diets

Diet	Frequency
No	84
Missing value	4
Yes	14

Reason	Frequency
Religious practice	0
Diabetic / coeliac	1
Ulcers	1
Vegetarian	1
Blood pressure	2
Kidney disease	0
Heart disease	0
Weight control	7
Allergy	0
Other	2
Total	14

It should be noted that a large proportion of households (33%) do not have use of a car (table 5.15). This may influence shopping habits (and possibly the foods consumed), bearing in mind the demise of 'High Street' shopping and the increase in 'out-of-town' supermarkets. However, this proportion is in fact significantly lower than for Tyne and Wear as a whole (O.P.C.S., *op cit*), where over half of all households (51%) have no car.

Table 5.15 Use of Car

Use of Car	Food Diary (%)	Census (%)
Yes	63	49
No	32	51
Missing	5	-

Finally, there are three measures of 'propensity to cook', i.e., 'use of cookbooks', 'viewing of food programmes' and 'attendance of cookery classes'. The usefulness of these measures is challengeable, but they are reported in table 5.16.

Table 5.16 Measures of Propensity to Cook

Class	Use Cookbooks	Watch Food Programmes	Attend Cookery Classes
Missing	2	2	4
Never	11	12	77
Seldom	36	49	16
Regularly	45	32	5
A Lot	8	7	0

5.2.3 Improving the Quality of the Data

Although the Diary allows exploration of a large number of *a-priori* variables with the possibility of testing whether or not they differentiate between groups of consumers who consume relatively large proportions of those foods which have experienced the most marked preference changes, the data have, as explained above, a number of

weaknesses related to coding, missing values and keystroke errors. It is not possible to rectify either of the first two of these problems. However, it is possible to locate and change keystroke errors.

In order to verify the data, a system of locating hypothetical errors had to be designed. Using S.P.S.S. (Statistical Package for Social Sciences), a mainframe and workstation application particularly amenable for the analysis of matrix-from data, both the food and household data sets were screened in two ways:

1. by calculating descriptive statistics for each variable;
2. by listing frequency tables of variable values for each variable.

Descriptive statistics, such as the mean and variance, can give an indication that the values given to one or more observation are potentially incorrect. Take the example of 'K.K.P. sex' which has been coded as follows:

Value	Code
Missing Value	0
Male	1
Female	2

If, in this simple example, the mean value, which has no interpretable meaning, is calculated as, say, 2.1, then there are evidently data errors associated with the observations on this variable. Another method of ascertaining whether or not there are data entry errors for variables is to calculate frequency distributions. If the distribution encompasses values beyond the specified codes, there are clearly data entry errors. Since most variables in both sets of data included incorrect entries, it was decided to attempt to locate each individual error.

Once each outlying variable has been established, an S.P.S.S. command file was composed which would search for outlying entries and attach to each a case and record number. Since the food data set was not entered in a logical sequence, the command file allocated each of the 21,387 lines a unique identification number. By cross-referencing this identifier with variable column numbers, specific outliers are locatable. The command file was further designed to list the Diary, day and meal numbers for each outlier. Therefore, as opposed to simply changing the outlying value to a missing value code, the correct value could be found manually in the Diary and entered accordingly.

Some 900 errors were located and checked. In most cases the correct value was located in the Diary and entered, using a similar command file to the one which was designed to locate the error in the first instance, since manual alterations were not possible with such a large data set.[37] The precise extent to which this verification exercise improved the data is unclear. However, what is certain is that it could only enhance the data quality.

5.3 Concluding Comments on the Nature of the Data and the Sample

The data, although not ideal, were judged to be adequate for testing the hypotheses. Further problems associated with its use were encountered and are discussed in context in Chapters Seven and Eight, but particularly Chapter Nine. However, the coverage of both foods and *a-priori* variables, in tandem with appropriate methods, appears more than sufficient for differentiating between consumers. The methods by which consumers are differentiated are discussed in the following chapter.

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37 The available text editor, Curlew, could not handle more than 16,384 lines of text. The food data set exceeds this by some 5,000 lines.

Chapter Six

Choice of Methodology

6.1 Introduction

The objective of this chapter is to describe the theoretical aspects and choice of methodology to be used for testing the hypotheses. The results of the application of the methods are reserved for Chapter Seven, where they will be discussed in tandem with some of the problems associated with the use of the Food Diary data.

The criteria for the choice of methodology are threefold:

1. reduction of the data into manageable proportions;
2. division of the data into similar groups;
3. classification of the data by the hypothesised variables.

These criteria will be ideally achieved with the application of one method. As Everitt (1993) states:

> "In the widest sense, a classification scheme may represent simply a convenient method for organizing a large set of data so that the retrieval of information may be made more efficiently."

There is no shortage of methods available for satisfying the classification criteria, however the effectiveness of the marriage between method and data should be judged by the usefulness of the results. Essentially, there is no right or wrong.

With these objectives in mind, two complementary methods, cluster analysis and discriminant analysis, were adopted and applied to the data.

"Cluster analysis is a technique for grouping individuals or objects into clusters so that objects in the same cluster are more like each other than they are like objects in other clusters".

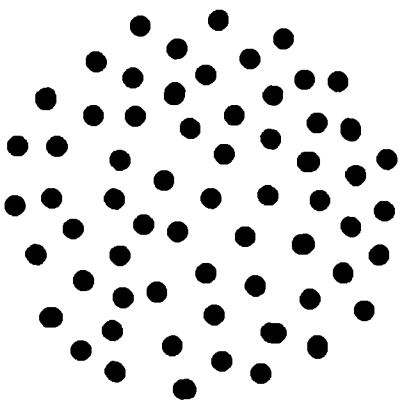
"Discriminant analysis involves deriving the linear combination of the two (or more) independent variables that will discriminate best between the *a-priori* defined groups." (Hair, Anderson and Tatham, 1987).

The reasons for the choice of these methods becomes apparent from a review of the techniques, but essentially the latter complements the former.

6.2 Theoretical Aspects of Cluster Analysis

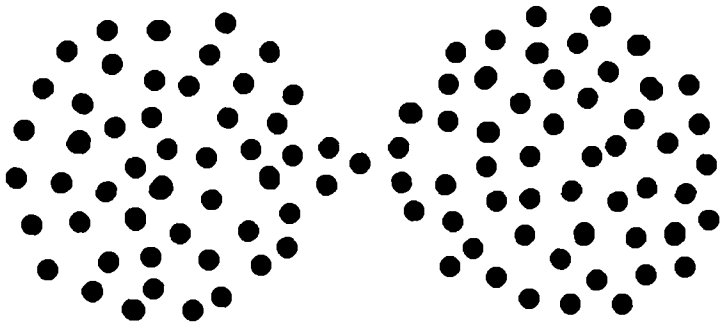
Cluster analysis classifies people or objects according to some predetermined criteria, whereby clusters have high within-cluster homogeneity and high between-cluster heterogeneity. For example, objects measured on two criteria (two variables or axes) may appear to be closely related (figure 6.1) or separable into two (or more) groups according to this choice of criteria (figure 6.2).

Figure 6.1 Data with no Cluster Structure



Source: adapted from Gordon (1980)

Figure 6.2 Data with a Two Cluster Structure



Source: adapted from Gordon (*op cit*)

In these examples, each point represents one person or object. The variables are unspecified, but are measured on the vertical and horizontal planes.

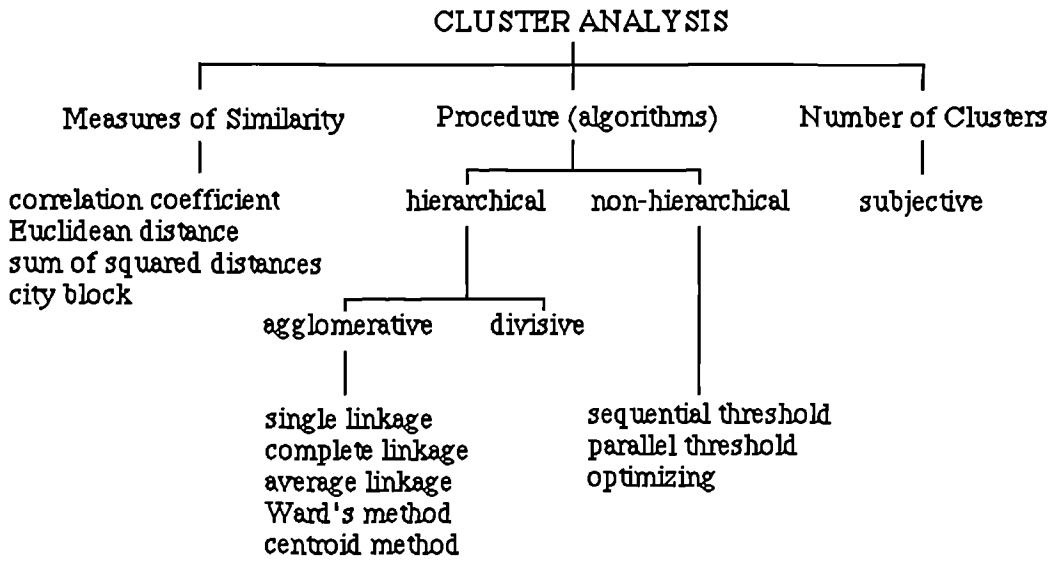
Cluster analysis allows inferences to be made about large bodies of data, with minimal loss of information, either for conclusions to be drawn or hypotheses generated. These capabilities clearly satisfy the objectives established for the choice of a method (above), but, as with most techniques, there are several alternative ways of applying it, dependent largely on the nature of the data and the hypotheses to be tested. The appropriateness of the choice of method largely depends on the skill of the researcher, which in itself is a function of knowledge of the method.

There are three stages to the clustering process:

1. measurement of similarity between objects;
2. the procedure (algorithm);
3. choice of the number of clusters.

These stages are detailed in figure 6.3, and subsequently described.

Figure 6.3 Flow Diagram of the Choice of Method of Application of Cluster Analysis



The approach taken will affect the results, but there is insufficient evidence to say which is the best.

6.2.1 Measures of Similarity

There are four ways commonly in use for measuring the proximity of each pair of people or objects:

1. correlation coefficient;
2. Euclidean distance;
3. sum of squared distances;
4. City-block.

The correlation coefficient is calculated as the correlation between two or more objects, as opposed to variables, calculated by inverting the objects' X variables matrix. Without this inversion, the variables by which the objects are to be clustered will be correlated. Thus, if:

$$X = \begin{bmatrix} X_{11} X_{12} X_{13} \\ X_{21} X_{22} X_{23} \end{bmatrix}$$

$$X' = \begin{bmatrix} X_{11} X_{21} \\ X_{12} X_{22} \\ X_{13} X_{23} \end{bmatrix}$$

$$X.X' = \begin{bmatrix} A\,B \\ C\,D \end{bmatrix}$$

where:

$$A = X_{11}^2 + X_{22}^2 + X_{13}^2$$

$$B = X_{11}X_{21} + X_{12}X_{22} + X_{13}X_{33}$$

$$C = X_{11}X_{21} + X_{12}X_{22} + X_{13}X_{33}$$

$$D = X_{21}^2 + X_{22}^2 + X_{33}^2$$

and:

$$r^2 = \frac{\sum x_1 y_1}{\sqrt{\sum x_1^2}\sqrt{\sum y_1^2}}$$

then:

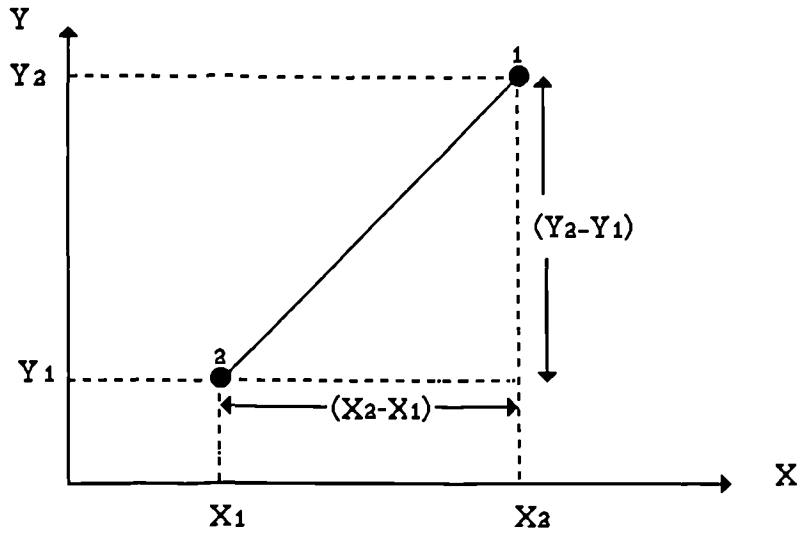
$$\sum x_1 y_1 = B = C$$

$$\sum x_1^2 = A$$

$$\sum y_1^2 = D$$

The Euclidean distance is the shortest distance between a pair of objects (figure 6.4).

Figure 6.4 Euclidean Distance Between Two Objects



The distance between objects one and two is calculated as the square root of the difference between the horizontal and vertical distances between the objects in the two dimensional space, i.e.:

$$\sqrt{[(X_2 - X_1)^2 - (Y_2 - Y_1)^2]}$$

This is the two variable case, which can be easily extended to more variables. Typically, variables will be standardized to zero mean and unitary variance, giving each an equal weighting.

The sum of squared distances is a similar measure, with the exception that the square root is not taken. Instead of the distance between objects being calculated, the measure is directly proportional to the distance. This has no detrimental effect on results since the net effect is to have the distances between each pair of objects squared. However, the City block (sum of absolute distances) measure is a non-normalised measure. In

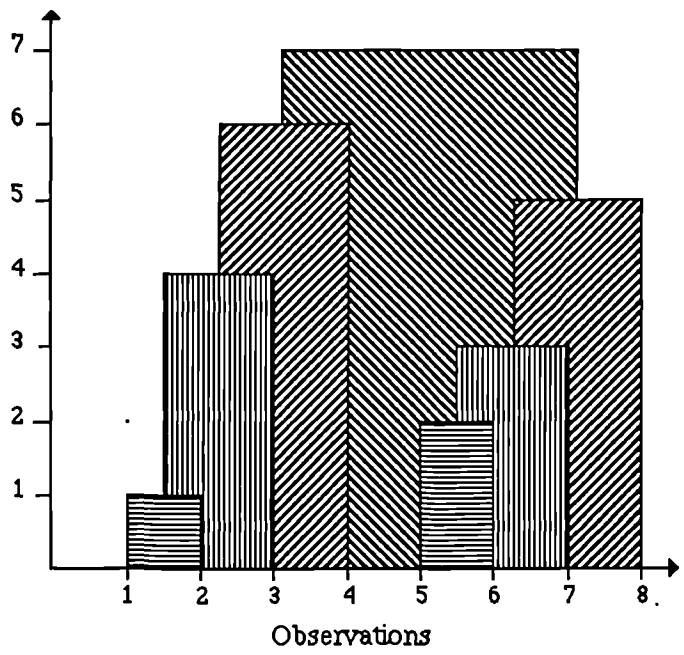
other words, no allowance is made for the units of measurement for different variables, thus causing bias.

6.2.2 Algorithms

The method, or set of rules, by which similar objects are put into clusters is known as the algorithm. There are two types of algorithms from which to choose - hierarchical and non-hierarchical.

Hierarchical procedures work in one of two directions. Agglomerative algorithms operate with each object starting in its own cluster. The two closest objects are then grouped together to form a new cluster, and the procedure is then repeated. The process is represented by a dendogram (figure 6.5) which illustrates how the number of objects in their own clusters diminishes as objects are paired to form new clusters. Eventually, the number of clusters will be reduced to one.

Figure 6.5 Example of a Dendogram



Source: adapted from Hair, Anderson and Tatham (*op cit*)

The reverse of this agglomerative process is known as a divisive method. In this case, the process starts with one cluster containing all objects, with sequential removal of objects from clusters of more than one object to create new clusters. In figure 6.5, whereas agglomerative methods are represented as going from bottom to top, divisive methods are represented as going from top to bottom.

Five recognised agglomerative procedures are in use:

1. Single linkage (or nearest neighbour) finds the two objects closest together and puts them in a cluster (figure 6.6). The proximity of clusters is measured as the distance between the two closest objects in respective clusters. The disadvantage of the technique is the tendency for one long chain-like cluster to form, with objects at one end tending to be very dissimilar to objects at the other end.

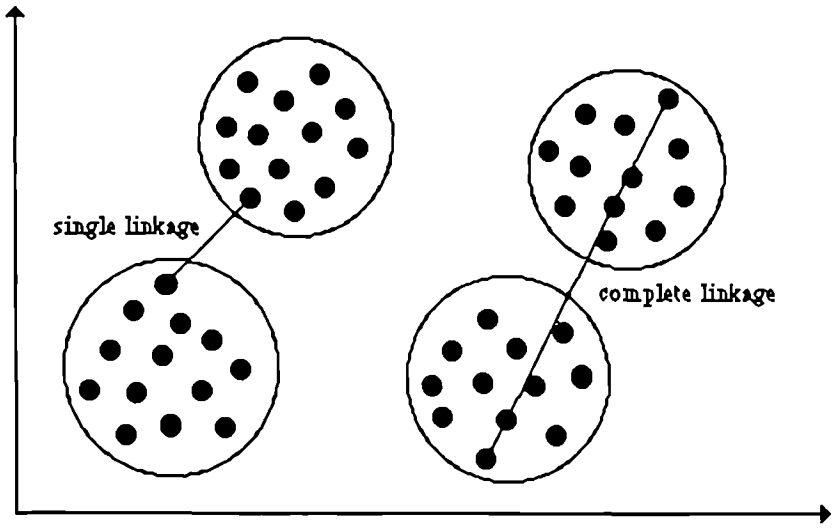
2. Complete linkage (furthest neighbour) uses the distance between the furthest two objects in respective clusters as the proximity measure (figure 6.6). The tendency is for the chain cluster problem to be eradicated.

3. Average linkage calculates cluster proximities as the mean distance between objects in one cluster and another. The technique has the tendency to group clusters with similar variances.

4. Ward's method calculates distance as the sum of squares between clusters, summed over all variables, with the tendency to group clusters with similar numbers of observations.

5. The centroid method calculates the Euclidean distance between cluster centroids, recalculated each time cluster membership changes. The technique requires metric data and is therefore largely inappropriate for the social sciences.

Figure 6.6 Single and Complete Linkage Agglomerative Procedures



Non-hierarchical procedures, on the other hand, first select a cluster centre including all objects within a specified distance from this centroid. Three types are commonly in use:

1. Sequential threshold operates as described above with the process continually repeated and objects only being considered until they have been clustered. Objects are subsequently excluded;

2. parallel threshold initially selects several cluster seeds with threshold distances being adjusted thereafter. Some objects remain unclustered;

3. non-hierarchical optimizing operates in the same way as the parallel threshold technique with the exception that objects can be reassigned to other clusters.

6.2.3 Choosing the Number of Clusters

There is no objective selection procedure for choosing the number of clusters in which to divide the people or objects being studied. The choice is ultimately left to the researcher, who can draw upon *a-priori* criteria, 'natural' divisions in the data (there may be an obvious number of clusters to choose), or distances between clusters. The number chosen, however, will probably be arrived at by analysing the results obtained from a range of cluster numbers before a final decision is made.

Hypothesis tests on the significance of differences between clusters tend to be crude. However, the larger the sample, the more reliable the test. Sarle's (1983) cubic clustering criterion (C.C.C.) performed well in a comparison of some thirty different tests (Milligan and Cooper, 1985), along with Calinski and Harabasz's (1974) pseudo *F*-statistic. It is recommended by SAS Institute Inc.(1988) that these statistics should be used in tandem. Evidence of 'local' peaks, i.e., peaks in a small range of cluster numbers, will tend to suggest how many clusters should be chosen. This approach is adopted for the purpose of this analysis and these statistics are reported in Chapter Seven.

6.3 Theoretical Aspects of Discriminant Analysis

Discriminant analysis is commonly used for classifying a dependent variable according to two or more independent variables. Typically the dependent variable will be categorical and the independent variables metric. Discrimination between, say, two groups is performed on the basis of maximising the between-group variance relative to the within-group variance.

Essentially, discriminant analysis is used to test the null hypothesis that group means are equal, and hence (particularly for the analyses performed in this research) it is a suitable complementary technique for validating the results obtained from a clustering procedure. The hypothesis is tested by calculating the discriminant score (known as the

Z-score), which is the sum of the products of the independent variables and their associated weights, i.e.:

$$Z = W_1X_1 + W_2X_2 + W_3X_3 + \ldots W_nX_n$$

where:

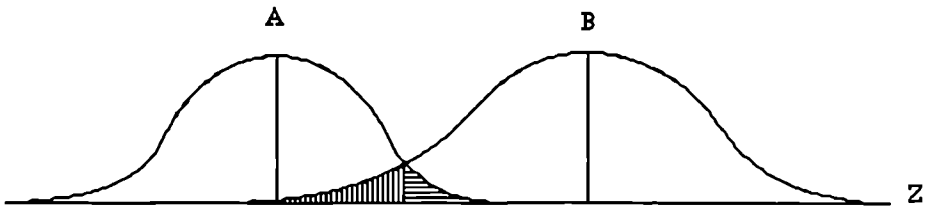
Z =discriminant score

W =discriminant weights

X =independent variables

Each person or object is allocated a discriminant score, the mean of all scores being the centroid or group mean. Each group will have a centroid. The test of the statistical significance of the discriminant function uses the distribution of these discriminant scores. The smaller the overlap of the distributions, the better the function is at discriminating between the groups. In figure 6.7, the distributions of the discriminant scores for groups A and B are represented. The overlap is represented by the shaded areas. Assuming this to be a representation of the 'best' grouping of persons or objects, any other distributions of discriminant scores would result in greater overlap, and thus a larger shaded area.

Figure 6.7 Distributions of Discriminant Scores for Two Groups.

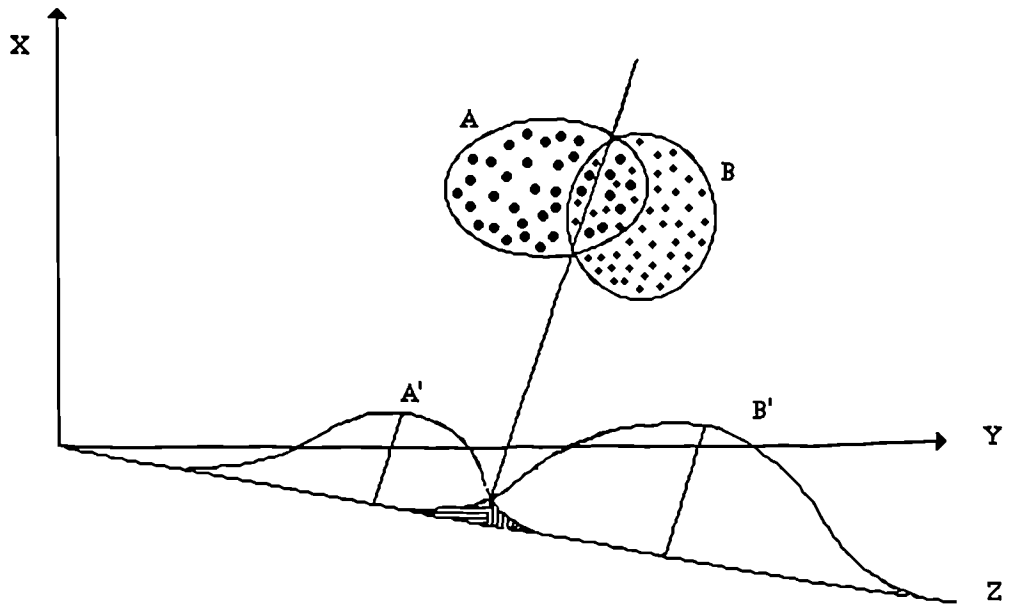


Source: adapted from Hair, Anderson and Tatham (*op cit*)

The technique is most similar to multiple (in the case of two, or more, independent variables) regression analysis, except that in discriminant analysis the dependent variable is categorical as opposed to metric. Furthermore, discriminant analysis is particularly useful for looking at large samples. The larger the sample, the smaller the bias resulting from violations of the underlying assumptions of the technique.

A hypothetical example of a two-group discriminant analysis is shown in figure 6.8. The two groups are represented by A and B, with the independent variables being X and Y. It is assumed that data on X and Y are available for members of groups A and B. Both groups are encompassed by ellipses, within which is a prespecified proportion of group members, in this case 100%. By imposing a straight line through the two points where the ellipses intersect, and projecting this onto a third axis (Z), it is shown that the overlap of the two distributions of discriminant scores, A' and B', (assumed to be normally distributed) is minimised (see figure 6.7), and thus the function is deemed the best discriminator.

Figure 6.8 Two-Group Discriminant Analysis



Source: adapted from Green, Tull and Albaumm (1988)

6.4 Applications of Cluster and Discriminant Analysis

Both cluster and discriminant analysis have been applied to the Diary data using SAS, a mainframe (or PC-based) statistical package. SAS allows most of the statistical variations on both analysis techniques to be applied, but the precise methods are described, starting with cluster analysis, below.

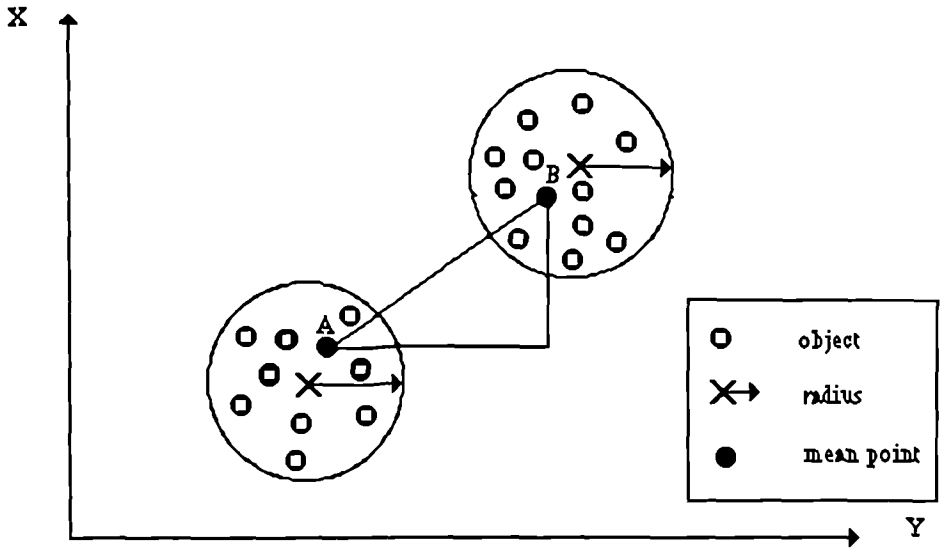
6.4.1 Application of Cluster Analysis

SAS FASTCLUS is a disjoint procedure designed for large sets of data, thus making it particularly applicable for the Diary data set. Essentially, an object can only appear in one cluster, thus satisfying one of the criteria specified for the chosen method in that assigning objects to more than one group will preclude rigid inference on the statistical difference between objects. There are no justifiable grounds for placing an object in two, or more, clusters.

The algorithm is non-hierarchical, with the maximum number of clusters, and the maximum cluster radius, to be specified at the outset (figure 6.9). In this way, *a-priori* knowledge about the number of observations, i.e., the number of households, and the likely insignificance of results based on clusters containing a very small number of households, can be taken into consideration. It may, for example, be pointless in allowing a clustering procedure to select fifty clusters, each containing, say, five or fewer households, since statistical inference will be prevented by, ironically, a lack of observations (not all households consume all the observed foods) and a lack of degrees of freedom for hypothesis testing.

Similarity between clusters is measured by the sum of squared distances, effectively a Euclidean measure. This is represented by the square of the distance AB, where A and B are mean values in the two-dimensional space given by the variables X and Y.

Figure 6.9 The SAS FASTCLUS Procedure



Cluster seeds are selected initially as a first guess, each object being assigned to the nearest seed, thus forming temporary clusters. The seeds are then replaced by cluster means and the process is repeated until stable clusters are achieved.

6.4.2 Application of Discriminant Analysis

The SAS statistical package was also used to perform the discriminant analysis, using the DISCRIM procedure. The parametric method was chosen on the basis that the independent variables are approximately normally distributed, although violation of this assumption does not seriously affect the results when large sets of data are being used. The linear discriminant function (within-class covariances are assumed equal) was calculated in order to test the significance of the differences between criteria, i.e., *a-priori* and *post hoc*, as specified by the hypotheses.

Chapter Seven

Results of the Tests of Hypotheses

7.1 Introduction

This chapter deals with the results of the application of the methods (Chapter Six) to the Food Diary data, in order to test the hypotheses (Chapter Four). Initially, the households are described using cluster and discriminant analyses. This is followed by tests of the first hypothesis, which looks at the suitability of *a-priori* variables for discriminating between food consumers with respect to their consumption of particular foods. Tests on the second hypothesis regarding the ability of *post hoc* descriptors to differentiate between consumers are succeeded by a comparison of the results of the tests on both hypotheses.

7.2 Classification of Households by Household Variables

The Food Diary sample has already been described using *a-priori* variables. However, in order to better differentiate and describe its membership, especially since data verification has been undertaken, cluster analysis can be used to group households according to a number of *post hoc* variables. These are derived from the list of principal household variables (see Chapter Five).

The results of this analysis are reported in table 7.1, giving the mean value for each variable in each of the five clusters. Although the within-cluster distances may have been minimised and the between-cluster distances maximised, it is not immediately apparent, even after households have been grouped in this way, what additional benefits this procedure yields.

It should be noted that the distribution of each variable has been standardized, giving zero mean and unitary variance. This ensures that each variable carries an equal weighting in the analysis.

Table 7.1 Household Cluster Means for Standardized Household Variables

Variable[38]	Cluster				
	One n=15	Two n=22	Three n=10	Four n=30	Five n=25
End of Full-Time Education	-0.13	-0.78	-0.27	0.38	0.30
Qualifications	0.11	0.91	-0.05	-0.25	-0.69
K.K.P. Age	0.71	0.34	-0.44	-0.44	0.47
K.K.P. Social Class	-0.18	1.20	-0.67	-0.27	-0.20
Gross Income	-0.03	-1.07	0.87	0.29	0.05
Home Ownership	0.41	-1.21	0.32	0.39	-0.23
Person on Diet	-0.38	-0.23	-0.38	-0.38	2.61
Use of Dining Room	0.18	-0.18	0.13	0.05	-0.23
Eating Out at Lunch	-0.17	-0.72	0.76	0.13	0.33
Eating Out in the Evening	0.91	-0.23	0.10	-0.23	-0.06
Kitchen Technology	0.63	-0.70	0.47	-0.01	-0.02
Use of Cookbooks	0.63	-0.88	1.00	-0.14	0.31
Watch Food Programmes	0.53	-0.82	1.10	-0.10	0.10
Attend Cookery Classes	-0.26	-0.03	1.89	-0.29	-0.14

Secondly, it is not evident from the table what the value of each mean signifies, or even how to interpret a mean value attached to some of the variables. For example, how does a negative value on the variable 'End of Full-Time Education' compare with a positive value? Alternatively, how can mean values be attached to a variable such as 'Home Ownership'? With these questions in mind, and the original objective of summarising the sample information, the cluster means have been interpreted by ranking the clusters for each variable, subjectively defining each cluster mean (table 7.2). So, for example, the lowest, negative cluster mean for the variable 'End of Full-

38 The variable 'presence of children in the household' was not initially included, but derived from the household data set at a later stage.

Time Education' is interpreted as the cluster containing K.K.P.'s who, in aggregate, left full-time education at the earliest age.

Table 7.2 Interpretation of Household Cluster Means

Variable	Cluster				
	One	Two	Three	Four	Five
	n=15	n=22	n=10	n=30	n=25
End of Education	Median	Youngest	Young	Oldest	Old
Qualifications	Low	Lowest	Median	High	Highest
K.K.P. Age	Oldest	Median	Young	Youngest	Old
K.K.P. Soc. Class	Low	Lowest	Highest	High	Median
Gross Income	Low	Lowest	Highest	Median	High
Home Ownership	Highest	Lowest	Median	High	Low
Person on Diet	Least Prob.	Median	Least Prob.	Least Prob.	Median
Use Dining Room	Most Freq.	Infrequent	Frequent	Median	Least Freq.
Eat Out at Lunch	Infrequent	Least Freq.	Most Freq.	Median	Frequent
Eat Out in Evening	Most Freq.	Least Freq.	Frequent	Infrequent	Median
Kitchen Tech.	Highest	Lowest	High	Median	Low
Use Cookbooks	High	Lowest	Highest	Low	Median
Watch Food Progs	Frequent	Least Freq.	Most Freq.	Infrequent	Median
Cookery Classes	Infrequent	Frequent	Most Freq.	Least Freq.	Median

A more subjective, but revealing interpretation of the cluster characteristics is gained by selecting the more extreme characteristics of each cluster, listing them, and labelling each cluster accordingly. This is strictly qualitative, and open to a great deal of artistic licence, however it is better to interpret the results further than be faced merely with the means. These subjective interpretations can, of course, still be cross-referenced with the quantitative results. However, bearing in mind the objective at this early stage of the analysis is to describe the sample, it is not unconventional to undertake this type of

process. Indeed Plasser (*op cit*) did just this in an analysis of lifestyle and its relationship with eating habits for Austrian consumers, using cluster analysis.

Subjective Interpretations of the Five Household Clusters:

'Granny's a Good Cook' **Cluster One (n=15)**	
Poorly qualified	Use dining room most frequently
Old	Don't eat lunch out, but do in evenings
Low social class	High level of kitchen technology
Low income	Use cookbooks
Own the house	Watch cookery programmes
Not on a diet	Don't go to cookery classes

'Coronation Street' **Cluster Two (n=22)**	
Left school young	T.V. eating
Poorly qualified	Don't eat out
Middle-aged	Lowest level of kitchen technology
Working class	Infrequent use of cookbooks
Low-paid	Infrequent use of food programmes
Council house	Frequently use cookery classes

'Nice day at the bank, Dear? The babysitter's arrived'
Cluster Three (n=10)

Left school young	Not on diet
Some qualifications	Frequently use dining room
Young Key Kitchen Person	Frequently eat out
Highest social class	Highest level of kitchen technology
Highest income	Driven by cookery information

'Young, free and single (and doing rather well, thanks)'
Cluster Four (n=30)

Went to college	Mortgaged house
Highly qualified	Not on a diet
Very young	Sometimes use the dining room
High social class	Sometimes eat out
Average income	Not at all interested in cooking

'Who am I?'
Cluster Five (n=25)

Post-school training	On a diet
Extremely well qualified	Don't use dining room
Oldish	Sometimes eat out, especially lunch
Good income	Moderately disinterested in cooking
Rented house	

These descriptors may have highlighted a qualitative justification for reducing the number of clusters from five to four. Cluster Five, or 'Who am I?', has a number of contradictory traits. For example, its members tend to live in rented accommodation, but have good incomes and are extremely well qualified. Nevertheless, the statistical

(cluster analysis) justification for five clusters is strong. Compared with a range of clusters from two to eight, the F-statistic is relatively high, thus allowing acceptance of the alternative hypothesis that there is a statistically significant difference between the clusters, and does not conform with the generally downward trend of the range (table 7.3). The C.C.C. is similarly high, although only within the range of four to eight clusters.

Table 7.3 Justification of Choice of Five Household Clusters

No. of Clusters	F-stat.	C.C.C.
Two	20.46	17.60
Three	14.42	13.29
Four	10.57	7.91
Five	11.02	10.56
Six	8.93	6.31
Seven	8.98	7.40
Eight	7.62	3.78

When two clusters are selected, the C.C.C. is at a peak value of 17.6. An earlier analysis of the data, which included a larger range of variables, revealed considerable evidence that two clusters should be selected. However, the distribution of responses tended to be heavily skewed, making statistical differentiation between two clusters difficult, and between five clusters unlikely. This is particularly evident with variables which have just three possible responses. For example, in response to the question 'Do you have a kitchen with a table and a separate room with dining table?', the possible responses are 'yes', 'no' and 'missing value'. If 95%, say, of respondents reply in the affirmative, there will be no tendency to cluster into more than one group. With several variables behaving in this way, the analysis becomes totally unproductive.

Thus, the distributions of variables were screened prior to clustering (Appendix 7.I, table A7.1) with a view to removing those variables with heavily skewed distributions. Hence the heavy emphasis on two clusters eased in favour of five. Moreover, it is thought that it is better to have five, rather than two, since it allows a more refined distinction between groups. There is, of course, a tendency for the number of households in some clusters to approach the minimum, and for some to approach the maximum. However, in the case of five clusters, there is none with a membership below ten households and none containing more than thirty.

The similarity between clusters is measured by the pairwise squared distances between clusters (table 7.4). This reveals that clusters two, four and five ('Coronation Street', 'Young, free and single' and 'Who am I') are most similar, and cluster one ('Granny's a good cook') is the most isolated.

Table 7.4 Pairwise Squared Distances Between Clusters

Cluster	Cluster				
	One	Two	Three	Four	Five
One	0.00	-	-	-	-
Two	22.18	0.00	-	-	-
Three	35.96	17.53	0.00	-	-
Four	17.00	11.33	21.45	0.00	-
Five	29.73	10.62	15.34	9.30	0.00

The SAS DISCRIM procedure also estimates error rates. The redistribution classification (table 7.5) reveals a misclassification of thirty-two households, equal to an error rate of 31%.

Table 7.5 Redistribution Classification of Households

From Cluster	To Cluster					
	One	Two	Three	Four	Five	Total
One	14	0	1	0	0	15
Two	0	18	0	2	2	22
Three	0	1	4	2	3	10
Four	3	3	1	19	4	30
Five	0	3	4	4	14	25
Total	17	25	10	27	23	102

7.3 Selection of Criteria

There are three criteria upon which the analysis of data must be based in order that the hypotheses can be tested; firstly, the *a-priori* variables must be selected; secondly, the period of time over which the analysis of consumption takes place must be specified; thirdly, the foods must be specifically defined. The criteria would ideally be to look at all foods consumed during a one year period for all measurable household variables. The first constraint on these ideals is the nature of the Diary, being a 'snap shot' of just two weeks during a year and covering barely more than a dozen variables related to household characteristics. Other constraints will be discussed in relation to one or more of these criteria, however this discussion must focus on all three criteria simultaneously for reasons which become apparent during the discussion.

A list of theoretically testable *a-priori* criteria, together with some descriptive statistics, can be found in Appendix 7.I (table A7.1). The distributions of observations over each variable (see Chapter Five) do not present any particular problems, save for the number of missing values. However, the hypotheses to be tested are food-specific, and it seems logical to choose those variables which can differentiate between groups of

consumers for specific foods. Furthermore, it is worth persuing the theme that *time* (or 'convenience') can be used as a discriminantory variable by dividing the day, as opposed to the week, or other unit of time measurement, into recognised periods, namely breakfast, lunch and dinner.

Turning specifically to the definitions of the foods to be examined, the 21,000 or so observations on nearly 600 different foods were reduced to a manageable number. Inevitably this involves aggregation of individual food codes (coded using McCance and Widdowson, 1985) into food groups (Appendix 7.I, table A7.2). Although such an aggregation would be relatively simple given no further constraints, it had to be borne in mind that the results of the analysis of Diary data would, at some stage, have to be compared with foods as coded in the N.F.S. Inevitably complications will accrue when foods, coded using two systems, are to be compared, mainly in that the 'aggregate' groups will tend to be either all-encompassing, comprising many codes, or disaggregated to the absolute level. Further complications arise with the introduction of a third coding system (for the aggregated foods) and, to save confusion, the aggregated foods will subsequently only be referred to by their name or abbreviated name (table 7.6).

A further problem associated with the method of recording of food usage in the Food Diary is the total lack of information regarding the quantity of each item consumed on each occasion. It therefore had to be assumed that the quantities consumed were, on each occasion, equal. In so doing, the frequencies of consumption could be taken as proxies for quantities, the proportion of each food consumed being equal to the frequency of consumption of each food as a percentage of the total number of items consumed in a defined period of time.

Table 7.6 Aggregated Food Diary Foods For Hypothesis Testing and Comparison with N.F.S.

Code	Food	Code	Food
1	Coffee	15	Fruit
2	Tea	16	Rice
3	Non-alcoholic Drinks	17	Chicken
4	Alcoholic Drinks	18	Mutton and Lamb
5	Milk	19	Pork
6	Desserts	20	Beef
7	Biscuits	21	Other Meat
8	Bread	22	Fish
9	Continental Breakfast	23	Sauces
10	Cereals	24	Miscellaneous
11	Cheese	25	Vegetables
12	Eggs	26	Potatoes
13	Fats	27	Pizza
14	Margarine		

The defined time periods are based on the number of foods consumed during each hour of the day over the two week period in order that the influence of the 'day of the week' is eliminated. For each food item, the hour during which it was consumed is recorded (with the exception of the 8.7% missing values). The distribution of items consumed throughout the day was considered and the day divided into three 'mealtimes', each of which was given a title (table 7.7).

Table 7.7 Number of Items Consumed at each 'Mealtime'

Meal Title	Definition (Time)	Number of Items	Proportion of Items
Breakfast	04.00 - 10.00	4721	21.7
Lunch	12.00 - 15.00	5446	25.1
Dinner	15.00 - 22.00	8738	40.2
Other Times		951	4.4
Missing Values		1887	8.7
Total		21743	100.0

It is therefore possible to test both the hypotheses at each of three mealtimes for up to twenty-seven foods. Furthermore, the hypotheses can be tested for each of five food 'conditions', namely whether or not the food item was frozen, microwaved, ready prepared, hot or cold.

The choice of *a-priori* variables to report was made by consideration of ten household variables at breakfast and, using analysis of variance (ANOVA), testing the hypothesis that there is no difference between the proportions of each of the twenty-seven foods consumed for each variable, i.e., a possible total of 270 hypothesis tests, the results of which are not reported, save in the case of those variables selected as *a-priori* criteria. However, a summary of significant results is reported in table Appendix 7.I (table A7.3), from which the four best discriminating variables have been selected. These will be used to test the first hypothesis and are:

1. presence of children in the household;
2. K.K.P. qualifications;
3. K.K.P. age;
4. household social class.

Although there is just one food for which a significant difference is observed for the variable household social class, once all foods accounting for less than 0.3% of consumption, those households consuming no items (n=11) and those consuming fewer than 20 items (n=10) at breakfast have been removed, and the proportions reestimated, there are in fact two foods for which significant differences are observable. Furthermore, social class is a variable which is commonly used as a descriptor of behaviour. Its inclusion in the analysis will throw further light on its ability to describe food consumption behaviour.

To summarise, the data have been aggregated into twenty-seven foods (ultimately to facilitate comparison with N.F.S. results) and the three mealtimes of breakfast, lunch and dinner. The proportion of each food consumed at each mealtime, after removing households consuming twenty items or fewer, is presented for each value of four *a-priori* variables. It will now be determined whether or not these *a-priori* variables are significant discriminators between consumers for each food and each food condition at each mealtime.

7.4 Analysis of *A-priori* Variables

7.4.1 Foods and Conditions at Breakfast

As stated above, twenty-one households have been excluded from the analysis of *a-priori* criteria at breakfast on consideration of the number of items which they consumed at breakfast ($n \leq 20$), leaving eighty-one. Of these, fifty contain no children and thirty-one contain one or more, fifty-six contain a K.K.P. with one or more qualification, twenty-five with none, nineteen contain a K.K.P. aged thirty-five or under, thirty aged fifty or over and thirty-two aged thirty-six to forty-nine. Finally, the distribution of social classes is skewed towards the upper end with fourteen A's and B's, thirty-eight C1's, seventeen C2's and twelve D's and E's.

These households consume an average of between forty-three and sixty-one items at breakfast over the two week period. There are significant differences ($p<0.01$) between the number of items consumed by households where the K.K.P. has one or more qualifications (56 items) and those where the K.K.P. has none (25), and significant differences ($p<0.001$) between households in social classes A and B (70 items), C1 (54), C2 (60) and D and E (43).

It can be seen (table 7.8) that sixteen of the twenty-seven foods have been considered on the basis of consumption proportions being greater than or equal to 0.3%. Of these, it is unsurprising to discover that bread, tea and cereals account for by far the largest proportions of food consumed.

Looking sequentially at each of the four variables, there are statistically significant differences between the proportions of tea ($p<0.05$), non-alcoholic drinks ($p<0.001$), milk ($p<0.05$), bread ($p<0.05$), cereals ($p<0.01$) and fruit ($p<0.05$) consumed between households with and without children. Those without children consume the greater proportions of tea, bread and fruit.

The variable K.K.P. qualifications differentiates significantly between the consumption of cereals ($p<0.01$), bread ($p<0.01$), eggs ($p<0.01$) and fruit ($p<0.05$), the former being consumed in the greater proportion by households where the K.K.P. has one or more qualifications.

Significant differences exist for three foods when K.K.P. age is considered, with households where the K.K.P. is between thirty-six and forty-nine consuming the greatest proportion of non-alcoholic drinks ($p<0.05$) and the lowest proportion of fruit ($p<0.01$), and households containing the youngest K.K.P.'s consuming the greatest proportion of cereals ($p<0.05$).

Table 7.8 Foods Consumed at Breakfast with Respect to *A-Priori* Criteria

Foods	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Coffee	7.7	7.0	7.6	6.9	6.6	10.5	4.6	6.8	7.4	6.9	8.8
Tea	17.5	12.6	15.8	15.2	16.8	12.6	18.1	11.1	17.0	16.0	15.9
Non-alc. Drinks	3.4	8.8	6.1	4.0	6.4	7.5	2.7	4.7	6.7	5.6	2.3
Milk	2.9	5.7	4.5	2.8	3.6	5.5	2.6	4.9	4.1	2.9	4.0
Biscuits	1.4	1.2	1.2	1.5	1.5	1.6	0.8	1.2	1.1	1.5	1.6
Bread	27.4	21.1	21.9	31.9	21.3	24.4	27.9	24.5	23.9	23.3	31.2
Preserves	8.3	4.9	7.3	6.4	5.4	5.9	9.2	7.3	8.8	5.1	3.7
Cereals	11.5	22.0	18.6	8.7	23.8	14.9	10.9	14.2	15.9	21.0	8.2
Cheese	0.2	0.7	0.4	0.3	0.2	0.4	0.5	0.5	0.4	0.1	0.7
Eggs	4.4	4.0	3.3	6.4	3.3	4.9	4.2	6.0	3.5	2.5	7.1
Fats	2.0	0.7	1.6	1.4	0.7	0.7	2.9	1.5	0.6	3.8	1.3
Fruit	5.2	2.2	2.9	6.6	2.7	1.9	7.1	3.6	3.0	3.8	7.8
Pork	2.9	2.2	2.6	2.8	2.3	2.3	3.4	4.6	1.9	2.7	2.8
Other Meat	1.1	1.9	1.1	1.6	0.9	1.5	1.1	1.3	1.2	0.8	1.7
Miscellaneous	1.3	2.5	2.1	1.0	2.5	2.1	0.9	2.1	1.3	2.8	1.4
Vegetables	2.1	1.6	1.7	2.2	1.3	2.0	2.0	3.7	1.9	0.6	1.3

(Figures underlined represent statistically significant differences[39])

There are statistically significant differences between the proportions of two foods, eggs and vegetables, consumed by households of different social classes. Eggs are consumed in the greatest proportions by households in the highest and lowest social classes ($p<0.05$) and vegetables by those in the highest class ($p<0.05$).

39 $p<0.05$ for all cases

A-priori criteria differentiate poorly between the consumption of foods consumed at breakfast as described by the five food conditions (table 7.9). Households with children present ($p<0.01$) and those in the highest social classes ($p<0.01$) consume the greater proportions of ready prepared foods. Households where the K.K.P. has no qualifications ($p<0.05$) consume statistically greater proportions of hot food compared with those where the K.K.P. has one qualification or more.

Table 7.9 Food Conditions at Breakfast with Respect to *A-Priori* Criteria

Conditions	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Frozen	0.5	0.9	0.6	0.6	0.6	0.8	0.4	0.4	0.5	0.8	1.1
Microwave	1.9	1.6	2.1	1.2	2.7	0.8	2.3	2.3	1.6	1.1	2.8
Ready Prepared	26.5	37.2	32.2	26.9	35.9	29.1	29.0	35.6	32.3	33.9	14.5
Hot	50.3	44.0	45.2	53.8	48.6	48.1	47.1	42.8	47.4	49.3	53.3
Cold	39.4	41.0	40.6	38.8	40.7	37.3	42.5	39.7	43.0	37.2	35.2

(Figures underlined represent statistically significant differences)

7.4.2 Foods and Conditions at Lunch

Some ninety-eight households are considered at lunch, the increased inclusion rate resulting from a greater number of households consuming twenty items or more. On average, between forty-one and seventy-one items are consumed, with significant differences between the numbers consumed between household social classes ($p<0.05$). Twenty-four foods are included in the analysis, three (milk, cereals and margarine) being excluded on the grounds of proportionate consumption being less than 0.3%. Vegetables account for by far the greatest proportion of consumption (table 7.10).

Table 7.10 Foods Consumed at Lunch with Respect to *A-Priori* Criteria

Foods	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Coffee	5.1	3.7	4.9	4.0	2.5	6.0	4.3	5.0	5.2	4.0	3.3
Tea	8.1	5.3	7.0	7.2	8.3	5.9	7.4	4.4	7.7	7.3	8.1
Non-alc. Drinks	0.9	4.3	3.1	0.4	3.5	2.8	0.8	2.7	2.4	2.7	0.6
Alc. Drinks	0.2	0.8	0.5	0.3	0.5	0.5	0.3	0.2	0.7	0.1	0.3
Desserts	3.9	3.5	3.8	3.7	4.2	2.8	4.4	2.7	3.9	3.4	5.0
Biscuits	4.4	4.5	3.9	5.6	4.0	5.0	4.1	3.5	4.7	4.2	5.2
Bread	9.6	9.5	9.4	9.9	10.0	9.2	9.7	8.6	9.2	9.8	11.1
Preserves	0.7	2.3	1.5	0.9	2.4	1.3	0.6	0.7	1.3	2.3	0.8
Cheese	2.5	3.6	2.9	3.0	2.3	4.0	2.2	4.4	2.1	2.8	3.3
Eggs	2.0	2.4	2.0	2.6	1.9	1.9	2.5	1.8	2.2	2.8	1.8
Fats	0.6	0.4	0.6	0.4	0.3	0.4	0.9	1.2	0.3	0.4	0.4
Fruit	5.2	4.9	5.6	4.1	5.0	5.1	5.2	5.8	5.6	4.7	3.7
Rice	0.3	0.1	0.2	0.3	0.3	0.2	0.2	0.5	0.2	0.1	0.1
Chicken	1.6	1.6	2.0	0.7	1.3	1.9	1.3	1.5	1.8	1.9	0.9
Mutton & Lamb	1.0	0.8	0.7	1.3	0.3	1.1	0.8	1.0	0.8	0.3	1.8
Pork	2.1	2.0	1.8	2.7	1.6	2.2	2.2	1.4	1.9	2.8	2.4
Beef	3.2	1.8	2.4	3.1	2.5	2.1	3.3	3.0	2.3	2.6	3.1
Other Meat	6.6	8.6	7.0	8.1	8.3	7.2	7.0	7.6	7.2	8.6	6.1
Fish	2.5	3.4	2.7	3.1	2.2	2.8	3.3	2.9	2.3	2.9	4.0
Sauces	1.1	0.2	0.7	1.0	0.3	0.9	0.9	1.4	0.8	0.2	0.5
Miscellaneous	6.9	7.7	7.4	6.8	7.9	9.0	5.1	8.1	8.0	6.9	4.9
Vegetables	23.1	18.4	20.6	23.0	18.8	19.5	24.6	24.0	20.1	18.9	23.8
Potatoes	7.7	8.5	8.3	7.4	9.4	7.0	8.2	7.1	7.5	9.2	8.8
Pizza	0.3	0.3	0.3	0.2	0.2	0.4	0.1	0.2	0.5	0.1	0.0

(Figures underlined represent statistically significant differences)

Statistically significant differences between the proportions of food consumed between households with and without children occur for six foods. Those without children consume the greater proportions of tea ($p<0.05$), beef ($p<0.05$), sauces ($p<0.01$) and vegetables ($p<0.05$) and smaller proportions of non-alcoholic drinks ($p<0.001$) and preserves ($p<0.01$).

The *a-priori* variable K.K.P. qualifications differentiates significantly between the proportionate consumption of just two foods, non-alcoholic drinks ($p<0.01$) and chicken ($p<0.05$). In both cases, households where the K.K.P. has one qualification or more consume the greater proportions.

Significant differences occur between the proportionate consumption levels of households differentiated by K.K.P. age. Younger K.K.P.'s tend to consume the greater proportions of non-alcoholic drinks ($p<0.05$) and preserves ($p<0.05$) and the lower proportions of vegetables ($p<0.05$). Households where the K.K.P. falls into the middle age class consume the greatest proportion of miscellaneous foods ($p<0.05$).

The *a-priori* variable household social class does not significantly differentiate between proportionate consumption levels of any of the twenty-four foods consumed at lunch. The case is the same for food conditions (table 7.11), where the consumption of just two foods is differentiated by only one variable. Households with children consume the greatest proportions of ready prepared foods ($p<0.01$) (as is the case with breakfast foods) and those without children consume the greatest proportion of hot foods ($p<0.05$).

Table 7.11 Food Conditions at Lunch with Respect to *A-Priori* Criteria

Conditions	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Frozen	7.9	10.1	9.4	7.3	9.4	7.9	9.2	10.1	7.1	10.9	8.5
Microwave	3.8	3.0	3.7	3.0	3.6	2.9	4.0	5.2	3.7	2.9	1.5
Ready Prepared	16.1	26.7	21.0	18.1	20.9	20.8	18.9	22.8	18.8	25.4	14.3
Hot	56.5	46.9	51.5	55.8	57.4	48.6	54.9	46.1	50.9	53.0	65.0
Cold	34.3	42.2	38.5	34.8	33.2	41.0	35.7	43.2	39.3	36.1	27.4

(Figures underlined represent statistically significant differences)

7.4.3 Foods and Conditions at Dinner

Three households are excluded from the analysis of foods consumed at dinner. The remaining ninety-nine consume more items at dinner, between seventy-three and ninety-three, on average, than at the other two mealtimes, although none of the *a-priori* criteria distinguish significantly between the numbers consumed. However, all twenty-seven foods are considered (table 7.12), the consumption of vegetables again accounting for the greatest proportion, even when meat is taken in aggregate.

The variable presence of children distinguishes significantly between the proportionate consumption of three foods at dinner. Households with children consume, as might be expected, more non-alcoholic drinks ($p<0.001$), cereals ($p<0.01$) and pizza ($p<0.05$) than those without.

Table 7.12 Foods Consumed at Dinner with Respect to *A-Priori* Criteria

Foods	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Coffee	3.4	3.4	3.9	2.4	2.5	4.6	2.7	3.6	3.7	3.7	2.2
Tea	9.1	6.3	7.7	8.7	6.3	7.3	10.0	5.1	7.3	9.9	11.3
Non-alc. Drinks	0.7	3.0	2.0	0.7	2.3	2.0	0.6	1.7	1.6	2.5	0.2
Alc. Drinks	0.4	0.4	0.5	0.1	0.9	0.3	0.1	0.5	0.5	0.3	0.0
Milk	0.7	1.2	1.2	0.3	1.0	0.9	0.8	0.1	1.2	1.1	1.0
Desserts	3.1	4.0	3.5	3.3	2.6	3.4	3.9	4.6	3.0	3.4	3.1
Biscuits	8.6	6.3	6.9	9.6	5.8	6.4	10.5	5.5	7.6	8.3	10.4
Bread	6.4	7.3	6.9	6.3	6.7	6.9	6.6	5.4	6.4	8.2	7.3
Preserves	1.1	1.3	1.3	0.9	0.9	1.1	1.4	1.0	1.3	1.3	0.9
Cereals	0.1	0.9	0.6	0.1	0.6	0.7	0.0	0.2	0.5	0.7	0.1
Cheese	2.4	2.6	2.3	2.8	2.1	2.5	2.6	2.2	2.4	2.4	3.1
Eggs	2.4	2.0	2.2	2.5	2.5	2.0	2.4	1.7	2.2	2.8	2.7
Fats	1.0	0.6	0.9	0.8	0.7	0.6	1.3	0.6	0.5	1.7	1.0
Margarine	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.2	0.1	0.0	0.0
Fruit	4.2	4.4	4.6	3.6	3.9	4.4	4.4	6.9	3.9	3.8	2.5
Rice	1.1	1.0	1.2	0.7	2.0	1.1	0.5	1.1	1.4	0.9	0.4
Chicken	2.1	1.9	2.1	1.8	2.3	2.3	1.6	2.1	1.9	2.7	1.2
Mutton & Lamb	0.6	0.5	0.6	0.5	0.8	0.5	0.5	0.7	0.7	0.2	0.3
Pork	2.3	2.6	2.4	2.5	2.8	2.6	1.8	2.4	2.3	2.2	2.7
Beef	2.8	2.9	2.7	3.1	3.5	2.9	2.3	2.9	2.9	2.3	3.3
Other Meat	6.3	6.7	6.3	6.7	6.3	6.2	6.7	6.3	5.6	7.0	8.0
Fish	2.7	2.5	2.5	2.8	3.5	2.4	2.3	2.2	2.7	2.3	3.2
Sauces	0.9	1.3	1.1	1.0	1.1	1.0	1.0	1.3	1.1	0.4	1.1
Miscellaneous	5.1	4.3	4.7	4.8	4.3	4.1	5.8	3.2	5.2	5.4	4.8
Vegetables	24.1	22.6	22.6	25.4	22.3	24.3	23.4	28.5	24.3	18.2	21.8
Potatoes	8.5	9.8	9.3	8.4	12.0	9.3	6.7	10.0	9.6	8.2	7.1
Pizza	0.1	0.4	0.2	0.2	0.2	0.3	0.1	0.1	0.2	0.4	0.2

(Figures underlined represent statistically significant differences)

Households in which the K.K.P. has one qualification or more consume proportionately more non-alcoholic drinks ($p<0.05$) and milk ($p<0.05$), but less (not necessarily fewer!) biscuits ($p<0.05$). The differences between the consumption of all the remaining twenty-four foods are insignificant, although households with a 'qualified' K.K.P. consume proportionately six times more cereals than 'unqualified' K.K.P. households.

As far as K.K.P. age is concerned, there are significant differences and trends for five foods. On the one hand, households with younger K.K.P.'s tend to consume proportionately more non-alcoholic drinks ($p<0.05$), alcoholic drinks ($p<0.05$), rice ($p<0.05$) and potatoes ($p<0.001$). On the other hand, those with older K.K.P.'s tend to consume more biscuits ($p<0.01$).

The variable household social class differentiates between the consumption of tea, fruit and vegetables, with the lower social classes tending to drink proportionately more tea ($p<0.05$) and eat less fruit ($p<0.05$). There is no linear trend for vegetables ($p<0.01$), with class C2 consuming the lowest proportion and classes A and B the highest.

None of the four *a-priori* variables discriminates between the proportionate consumption levels for any of the food conditions at dinner (table 7.13).

Table 7.13 Food Conditions at Dinner with Respect to *A-Priori* Criteria

Conditions	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
Frozen	9.7	12.4	10.3	11.5	11.3	12.1	8.8	11.2	10.2	10.1	12.2
Microwave	4.4	3.9	4.1	4.3	4.1	4.1	4.3	4.9	4.5	4.3	2.1
Ready Prepared	16.8	21.9	18.6	18.9	20.6	17.9	18.3	16.2	19.0	23.0	15.6
Hot	56.4	54.6	55.3	56.7	60.8	57.6	50.5	59.2	55.3	52.5	56.6
Cold	34.7	33.3	33.9	34.7	28.7	32.1	40.0	29.4	36.2	36.1	32.4

7.4.4 Concluding Comments on *A-Priori* Variables

The four variables appear to be relatively poor at discriminating between the consumption of foods. Of the sixteen foods covered at all three mealtimes, there are no significant differences between any segments of the sample for coffee, cheese, fats, pork or other meat. Of the twelve possible significant differences (four variables and three mealtimes), only non-alcoholic drinks exhibits significant differences for half or more. Indeed, when all foods are taken in aggregate, there are no significant differences between household social classes, a significant difference between K.K.P. ages at lunch and a significant difference between K.K.P. qualification groups at breakfast. However, significant differences occur between households with and without children at all three mealtimes, as is the case with food conditions, with no significant differences for the other three variables at any of the mealtimes.

7.5 Analysis of *Post Hoc* Variables

On the basis that the original variables used to cluster households were largely inappropriate, owing principally to the distribution of observations within each variable

and the number of missing values associated with many variables, households were clustered on the basis of the proportions of each of the foods they consumed.

7.5.1 Foods and Conditions at Breakfast

Four clusters of households, containing twenty-seven, thirty-two, sixteen and six households (a total of eighty-one, as was the case for the *a-priori* analysis) respectively, were selected at breakfast on the basis of the C.C.C.[40]. The linear discriminant function reveals a misclassification of just 1.7% of households, the distance between clusters being greater than the within-cluster distances.

It can be seen (table 7.14) that of the sixteen foods, included on the same basis as those in the *a-priori* analysis, just three, milk, fruit and miscellaneous foods, do not reveal significant differences in the proportions consumed between the clusters.

Households in cluster one consume the greatest proportions of biscuits, preserves, cereals and miscellaneous foods, and the lowest proportions of bread (albeit a high proportion of total consumption), fats and fruit. The proportion of tea consumed is high and coffee low, and across the clusters these two foods, as might be expected, seem to be close substitutes.

Those in cluster two consume relatively high proportions of coffee, non-alcoholic drinks and milk, and the lowest proportions of tea and biscuits, whereas the aggregate consumption of tea and coffee by those in cluster three is low with milk tending to be favoured. The proportions of cheese, eggs, pork, other meat and vegetables are highest when compared with the other clusters, perhaps suggesting a tendency for a cooked meal at breakfast. Conversely, households in cluster four tend to favour tea,

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40 Wilk's Lambda = 0.038.

bread, cereals and fats (possibly butter) and consume low proportions of eggs, pork and other meat.

Table 7.14 Foods Consumed at Breakfast with Respect to *Post Hoc* Criteria

Foods	Cluster			
	One	Two	Three	Four
Coffee*	2.9	14.2	3.3	2.0
Tea*	23.0	9.1	12.7	25.3
Non-Alc. Drinks*	2.3	10.0	3.4	0.9
Milk	3.5	4.7	4.0	1.9
Biscuits*	2.9	0.4	0.6	0.4
Bread*	21.7	25.0	23.6	43.4
Preserves*	11.8	5.9	2.2	4.3
Cereals*	21.4	14.6	12.4	2.7
Cheese*	0.2	0.1	1.6	0.0
Eggs*	1.8	4.6	8.9	0.8
Fats*	0.6	0.8	1.7	9.2
Fruit	2.7	3.5	5.7	8.4
Pork*	1.2	2.4	6.7	0.4
Other Meat*	0.2	0.8	4.2	0.0
Miscellaneous	2.4	1.7	1.3	0.0
Vegetables*	0.6	1.4	5.6	0.4

* significant differences between proportions consumed ($p<0.05$)

The hypothesis that households in cluster three may prefer a cooked breakfast is, to a certain extent, borne out by the differences between food conditions (table 7.15). Although there are statistically insignificant differences between the proportions, cluster three households do consume the highest proportions of hot and microwaved foods and the lowest proportion of cold food.

Table 7.15 Food Conditions at Breakfast with Respect to *Post Hoc* Criteria

Conditions	Cluster			
	One	Two	Three	Four
Frozen	0.8	0.4	0.9	0.0
Microwave	1.1	1.6	3.7	0.9
Ready Prepared	31.3	32.2	27.8	26.3
Hot	41.4	50.3	53.4	49.2
Cold	43.5	40.0	33.4	42.2

7.5.2 Foods and Conditions at Lunch

On the basis of the C.C.C., four clusters were chosen at lunch, comprising nineteen, fifty-six, eleven and twelve households respectively[41]. Again, a small proportion of households (1.8%) are misclassified as suggested by the linear discriminant function. Of the twenty-four foods considered, there are significant differences between the cluster proportions for all but five, being, coffee, preserves, pork, other meat and fish (table 7.16).

41 Wilk's Lambda = 0.05.

Table 7.16 Foods Consumed at Lunch with Respect to *Post Hoc* Criteria

Foods	Cluster			
	One	Two	Three	Four
Coffee	2.9	4.6	6.3	5.5
Tea*	12.4	5.5	3.2	9.0
Non-Alc. Drinks*	4.8	1.7	2.4	0.3
Alcoholic Drinks	0.3	0.6	0.3	0.0
Desserts*	1.7	5.5	1.2	1.2
Biscuits*	3.5	3.5	10.6	4.3
Bread*	11.1	8.4	7.5	14.5
Preserves	1.6	1.0	2.5	0.8
Cheese*	1.7	1.8	6.5	7.0
Eggs*	5.0	1.5	1.0	1.8
Fats*	0.3	0.3	0.2	2.2
Fruit*	2.3	5.2	11.6	3.0
Rice*	0.0	0.2	0.9	0.0
Chicken*	1.1	2.1	0.2	0.8
Mutton & Lamb*	0.3	1.4	0.3	0.0
Pork	3.1	1.8	2.1	1.5
Beef*	2.0	3.8	0.7	0.4
Other Meat	10.2	6.6	7.3	6.5
Fish	4.2	2.7	2.1	2.1
Sauces*	0.4	0.4	1.4	2.3
Miscellaneous*	7.7	4.4	10.5	16.6
Vegetables*	12.9	26.4	15.4	16.6
Potatoes*	7.4	10.1	4.9	1.8
Pizza*	0.8	0.1	0.2	0.4

* significant differences between proportions consumed ($p<0.05$)

Households in cluster one consume relatively high proportions of tea (as opposed to coffee), non-alcoholic drinks (as opposed to alcoholic drinks), eggs, pizza and meat in general, but in particular pork, other meat and fish. Those in cluster two also consume

a relatively high proportion of meat, focused, though, on chicken, lamb and beef. Furthermore they rank highest on alcoholic drinks, desserts, vegetables and potatoes, suggesting a substantial, two course, cooked lunch. Further weight is given to this proposal by the differences in food conditions between clusters (table 7.17) where the highest proportions of frozen ($p<0.01$), microwaved and hot ($p<0.001$) foods, and the lowest proportions of cold ($p<0.001$) foods, are attributed to cluster two, all bar microwaved being statistically significant.

Table 7.17 Food Conditions at Lunch with Respect to *Post Hoc* Criteria

Conditions	Cluster			
	One	Two	Three	Four
Frozen*	6.5	11.3	4.2	4.6
Microwave	3.4	3.6	1.9	4.3
Ready Prepared*	21.1	16.4	32.6	24.0
Hot*	52.2	61.6	26.6	37.6
Cold*	38.9	29.3	63.5	47.8

* significant differences between proportions consumed ($p<0.05$)

Households in cluster three consume the highest proportions of ready prepared ($p<0.05$) and cold foods, which seems logical as they consume a low proportion of meats (12.7% in aggregate, including fish, as compared with 20.9% for cluster one and 18.4% for cluster two) and high proportions of coffee, biscuits, preserves, cheese, fruit and rice.

Cluster four households' consumption is characterised by high proportions of cold food, and relatively large quantities of bread, cheese, fats, sauces and miscellaneous foods, and the lowest proportion (11.3%) of meats.

7.5.3 Foods and Conditions at Dinner

The C.C.C. suggests four clusters of seven, sixty-three, twenty-five and four households respectively[42], with just 1.4% of households misclassified. All twenty-seven foods are included in the analysis, with the proportionate consumption differences between clusters being insignificant for seven foods, coffee, eggs, fats, margarine, other meat, sauces and pizza.

Clear cluster characteristics are observable from the differences in food (table 7.18) and condition (table 7.19) proportions. Cluster one, for instance, is typified by a high proportionate consumption of alcoholic and non-alcoholic drinks, coffee, milk, and pizza, as well as ready prepared foods, and a low proportionate consumption of meats (13.0% in aggregate). This may be the result of these households' dinner consumption not being captured by the framework of the Diary, or the definition of dinner, or simply that they consume 'unusual' foods for this time of the day. Cluster two, and especially cluster four, households consume high proportions of meats, the former favouring beef and other meat, the latter chicken, lamb, pork and fish. Although the differences between the proportions of hot foods consumed are insignificant, the values for these two clusters are both exceptionally high.

Cluster three is characterised by large proportions of cold food, especially bread, cheese, fats, preserves, biscuits, miscellaneous foods and pizza, with a low proportionate consumption level for meats (11.1% in aggregate), particularly bearing in mind the time of the day.

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42 Wilk's Lambda = 0.03.

Table 7.18 Foods Consumed at Dinner with Respect to *Post Hoc* Criteria

Foods	Cluster			
	One	Two	Three	Four
Coffee	6.0	3.5	2.5	3.3
Tea*	8.7	6.6	12.0	4.7
Non-Alc. Drinks*	9.6	0.9	1.2	1.5
Alcoholic Drinks	0.7	0.3	0.3	1.3
Milk*	1.7	0.4	1.9	1.5
Desserts*	2.7	4.2	1.9	1.2
Biscuits*	5.5	6.3	12.9	2.4
Bread*	7.9	5.8	9.0	5.0
Preserves*	1.5	0.7	2.4	0.0
Cereals*	3.1	0.2	0.4	0.0
Cheese*	2.7	1.9	4.0	0.6
Eggs	2.2	2.2	2.6	1.9
Fats	1.4	0.5	1.6	1.2
Margarine	0.1	0.0	0.2	0.0
Fruit*	2.0	4.2	5.6	0.3
Rice*	0.4	1.1	0.5	6.5
Chicken*	2.1	2.0	0.9	8.1
Mutton & Lamb*	0.1	0.6	0.1	2.7
Pork*	1.6	2.7	1.4	3.6
Beef*	1.2	3.6	1.5	2.5
Other Meat	5.4	7.0	5.8	3.7
Fish*	2.6	2.8	1.4	6.6
Sauces	1.1	1.2	0.7	0.3
Miscellaneous*	3.4	4.2	6.9	3.0
Vegetables*	18.3	26.1	19.0	20.1
Potatoes*	8.0	10.9	3.1	18.0
Pizza	0.2	0.2	0.3	0.0

* significant differences between proportions consumed ($p<0.05$)

Table 7.19 Food Conditions at Dinner with Respect to *Post Hoc* Criteria

Conditions	Cluster			
	One	Two	Three	Four
Frozen*	5.5	13.0	5.4	17.2
Microwave	2.1	5.5	1.4	5.1
Ready Prepared	29.2	16.7	20.6	20.5
Hot	52.1	62.3	35.7	82.9
Cold	39.7	28.3	50.8	12.8

* significant differences between proportions consumed ($p<0.05$)

7.5.4 Concluding Comments on *Post Hoc* Variables

It has been possible to find groups of households consuming similar combinations of foods and it is evident that grouping households using *post hoc* variables provides the best differentiation of household consumption patterns at the three mealtimes. Significant differences between the proportionate consumption levels of the clusters are observable for the greater proportion of foods (52 out of 67) and some of the food conditions (5 out of 15).

7.6 Comparison of *A-priori* and *Post Hoc* Results

It is evident, and indeed expected, that *post hoc* variables provide the best means of grouping households. Analysis of variance reveals significant differences between the proportionate consumption levels of a relatively small proportion of foods between

households segmented by *a-priori* criteria compared with *post hoc* criteria (table 7.20)[43].

Table 7.20 Proportion of Food Items for which Significant Differences Occur Between the Proportionate Consumption Levels of Households Segmented by *A-Priori* Criteria and *Post Hoc* Criteria at Different Mealtimes

Mealtimes	*A-Priori* Criteria				*post hoc* Criteria
	Children Present	K.K.P. Qual's	K.K.P. Age	Social Class	
Breakfast	38%	25%	14%	13%	81%
Lunch	25%	8%	17%	0%	75%
Dinner	11%	11%	19%	11%	70%

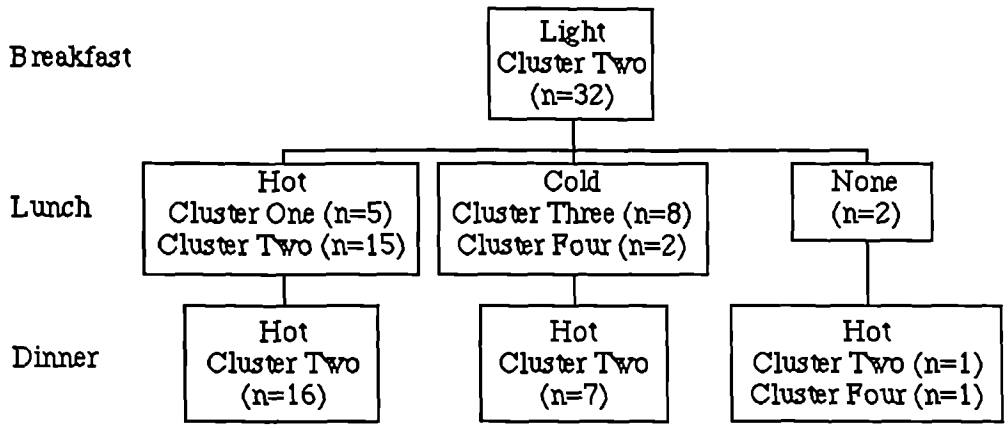
Of the sixteen foods consumed at breakfast, there are insignificant differences between the clusters for the proportionate consumption levels of just three, milk, fruit and miscellaneous foods. There are therefore significant differences for 81% of foods, compared with between 13% and 38% of foods using *a-priori* criteria. There are significant differences between the clusters for 75% of foods segmented by *post hoc* criteria at lunch, compared with between 0% and 25% of foods segmented by *a-priori* criteria, and at dinner 70% compared with between 11% and 19%.

43 The differences between the observed and expected numbers of households in the clusters are insignificant for all *a-priori* criteria except K.K.P. age at dinner, adding weight to the justification for segmentation by *post hoc* criteria.

7.7 Conclusion

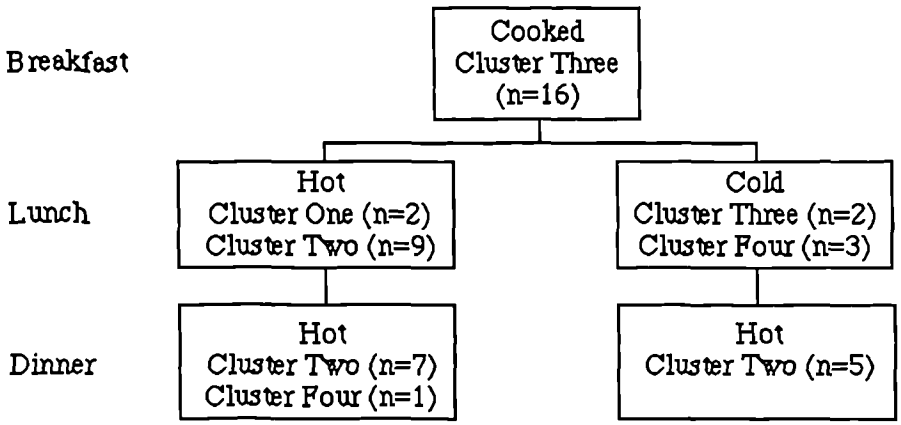
By following household cluster memberships from breakfast through to lunch and dinner, a useful description of consumption habits emerges (figure 7.1). Taking cluster two at breakfast, a cluster in which households (n=32) are characterised by their consumption of a 'light breakfast' consisting, in the main, of coffee and bread (toast), twenty go on to consume a 'hot lunch' and sixteen of these a 'hot dinner'. Of the remaining ten consuming a 'light breakfast', two have no lunch whatsoever and subsequently a 'hot dinner', and ten have a 'cold lunch', of which seven have a 'hot dinner'.

Figure 7.1 Household Meal Combinations: the Light Breakfast Case



Some sixteen households are members of breakfast cluster three (figure 7.2), which can be described as the 'cooked breakfast' cluster. Of these, eleven have a 'hot lunch' of which seven then have a 'hot dinner'. The remainder have a 'cold lunch' and a 'hot dinner'.

Figure 7.2 Household Meal Combinations: the Cooked Breakfast Case



Therefore, of the forty-eight households studied with respect to the type of meals consumed in a typical day, as defined by the cluster analysis, thirty-eight (79%) take a 'hot dinner', irrespective of the nature of the breakfast. Of those taking a 'light breakfast', 63% take a 'hot lunch' and 78% take a 'hot dinner', and of those taking a 'cooked breakfast', 69% take a 'hot lunch' and 81% take a 'hot dinner'. Although the sample is small, it would appear that the nature of the breakfast has little influence on the nature of the subsequent meals taken.

Post hoc segmentation provides a useful, and far more rigid, description of household food consumption when compared with *a-priori* segmentation. Firstly, significant differences between the proportionate consumption of a far greater number of foods are observable using cluster analysis than when households are grouped by what might have been considered robust *a-priori* criteria. Secondly, *post hoc* criteria can, once tested, be used to enhance the description of households' food consumption practices.

The next question to be addressed is whether or not this method of grouping households according to their consumption of particular foods can explain preference changes as demonstrated by the analysis of N.F.S. data.

Appendix 7.I Tables A7.1 to A7.3

Table A7.1 Distributions and Range of Values for Household Descriptors

Variable	Min.	Max.	Mean	SD
End of Full-Time Education	0	2	1.42	0.52
Qualifications	0	1	0.32	0.47
K.K.P. Age	1	3	2.14	0.77
K.K.P. Social Class	1	4	2.36	0.99
Gross Annual Income	0	7	3.41	2.01
Home Ownership	1	2	1.77	0.43
Special Diet	0	1	0.13	0.34
Use Dining Room	0	4	2.43	1.49
Eat Out at Lunch	1	5	3.05	1.39
Eat Out in the Evening	1	3	1.63	0.78
Kitchen Technology	1	3	2.10	0.64
Use Cookbooks	0	4	2.46	0.86
Watch Food Programmes	0	4	2.30	0.84
Attend Cookery Classes	0	3	1.22	0.59

Table A7.2 Food Codes

Aggregate Codes	N.F.S. Codes	Food Diary Codes
1=Coffee	307, 308, 309	870, 872
2=Tea	304	876, 877
3=Non-alcoholic Drinks	248, 312, 313	868, 873, 874, 875, 879, 880, 885, 886, 888, (986)[44]
4=Alcoholic Drinks		(985)
5=Milk	4, 11	126, 129, 135, 136
6=Desserts	286, 329, 332, 333	97, 98, 107-109, 117-119, 121
7=Biscuits	270, 274, 277	58, 59, 61, 62-65, 68-75, 78-91, 103, 105, 106, 111-113
8=Bread	255, 256, 260, 263, 264, 271, 281, 299, 301	2, 3, 5-14, 17, 18, 24, 26-28, 30-32, 34, 35, 37-40, 42-44, 67, (998)
9=Preserves	152-154	843-845, 847, 849-851, 853
10=Cereals	282	46-57
11=Cheese	22, 23	151-154, 156-160, (996)
12=Eggs	129	165, 169-173
13=Fats	135, 148	186, 193, (995)
14=Margarine	138	187

44 Figures in parentheses represent codes for Food Diary foods not directly encompassed by a N.F.S. code.

Table A7.2, cont'd

Aggregate Codes	N.F.S. Codes	Food Diary Codes
15=Fruit	210, 214, 217, 218, 221, 222, 227, 228, 229, 231, 240, 245	675, 677, 682, 692, 693, 695, 696, 699, 724, 727, 732, 738, 740, 751, 758, 763, 764, 766, 769, 773, 776, 779, 785, 791, 793, 795, 802, 809, 810, 814, 817, 819, 822, 823, 826, 827, 832, 835, 837-840, (988)
16=Rice	287	19-21
17=Chicken		(990)
18=Mutton and Lamb	36	264, 266, 274, 279, 284, 287, 291, (992)
19=Pork	41	294, 301-306, 308, (994), (991)
20=Beef	31	235, 243, 245, 247, 249, 256, 259, (993)
21=Other Meat	46, 51, 93, 328	361, 370, 373, 375, 381, 391, (989), (993)
22=Fish	100-127	(100)
23=Sauces	323, 327	925, 926, 930, 970-974, 980-983, (984)
24=Miscellaneous	9, 17, 150, 267, 318, 319	76, 77, 95, 132, 134, 141, 144, 147, 842, 937-948, 950, 951, 955, (983), (987), (997)
25=Vegetables		(999)
26=Potatoes		639-646, 648, 650-652, 664
27=Pizza	296	178

Table A7.3 Variables for which there are Significant[45] Differences Between the Proportions of Foods Consumed at Breakfast

Variable	Food
K.K.P. Qualifications	Bread
	Cereals
	Eggs
	Fruit
K.K.P. Age	Cereals
	Fruit
	Pork
Household Social Class	Fruit
Gross Annual Income	Coffee
	Fruit
Home Ownership	Milk
	Fruit
Eat Out at Lunch	Bread
Eat Out in the Evening	Fats
Kitchen Technology	Biscuits
	Preserves
	Other Meat
Car Ownership	Preserves
	Fruit
Presence of Children	Tea
	Bread
	Cereals
	Fruit

45 ($p < 0.1$).

Chapter Eight

Comparison of National Food Survey and Newcastle Food Diary Results

8.1 Introduction

The objective of this chapter is to draw together the analyses of N.F.S. and Food Diary data. The *post hoc* criteria will be used to try and explain why preferences for certain foods, consumed in households, have changed so markedly. The method of comparison of the two sets of results, starting with the choice of N.F.S. foods used in the comparison, is followed by a report and discussion of the results of the comparison in light of tests of statistical significance.

8.2 The Choice of N.F.S. Foods for Comparison with Food Diary Results

In view of the fact that over 150 foods have been analysed with respect to changing preferences, the majority over the period 1972 to 1987, and hypothesised problems of comparison of two sets of foods (Food Diary and N.F.S.) coded using different systems, it was considered impractical to attempt a comparison of *post hoc* criteria with all foods as defined by the N.F.S. Furthermore, it was hypothesised that if *post hoc* criteria were to prove significant determinants of preference changes, these would most likely be manifested in those foods for which preferences have changed by the greatest degree. Furthermore, some foods as coded by the N.F.S. were not consumed, as far as could be ascertained from the definitions of food codes, by households involved in the Food Diary study.

There are, then, three principal factors, summarised below, which determine the choice of N.F.S. foods for comparison with *post hoc* criteria:

1. greatest likelihood of preferences changes being determined by *post hoc* criteria for those foods shown to have the most marked preference changes;

2. comparison of N.F.S. and Food Diary data due to coding problems;
3. no evidence of consumption of some foods by the Food Diary sample.

Twenty foods were chosen, being those with the strongest positive and negative underlying trends in demand after taking into consideration the criteria of coding problems and proportionate consumption detailed above. Of the ten foods initially found to have the strongest positive underlying trends (Chapter Four, table 4.3), three remain to be considered; wholewheat and wholemeal bread, fruit juices and other fresh fruit (table 8.1). However, the remaining seven all have strong positive demand trends ranging from 18.2% to 1.8% per annum and appear at least 35 times (out of some 21,000) in the Food Diary, i.e., account for at least 0.17% of all Food Diary records. Breakfast cereals appear over 800 times in the Food Diary, accounting for over 4% of all food (defined by frequency of occurrence) consumed by the 102 households in the two week period. The lowest ranking of those selected is fresh stone fruit, 34th highest positive demand trend of 155 analysed.

Of the ten foods selected with strong negative demand trends (table 8.2), just two, soft, fresh fruit, other than grapes and offals, other than liver, appear in the overall top ten (Chapter Four, table 4.4). The lowest ranking of the remainder is fresh oranges, ranked 34th greatest negative demand trend of 155, at -3.5% per annum.

Table 8.1 Strong Positively Trending Foods

Food	N.F.S. Code	Trend[46] (%)	Diary[47] (%)
Wholewheat and Wholemeal Bread	256	18.2	0.68
Fruit Juices	248	7.5	2.06
Other Fresh Fruit	231	7.0	0.35
Rice	287	4.4	0.49
Breakfast Cereals	282	4.3	4.11
Other Bread	263	3.9	0.44
Yoghurt	13	3.5	0.73
Nuts and Nut Products	245	2.8	0.17
Cereal Convenience Foods	299	2.0	0.44
Fresh Stone Fruit	221	1.8	0.43

46 Average annual percentage trend in demand expressed as a percentage of the base period.

47 Proportion of occurrences in the Diary.

Table 8.2 Strong Negatively Trending Foods

Food	N.F.S. Code	Trend[48] (%)	Diary[49] (%)
Soft, Fresh Fruit, other than Grapes	227	-14.5	0.34
Offals, other than Liver	51	-8.5	0.06
Liver	46	-5.2	0.22
Cream	17	-5.0	0.58
Marmalade	152	-4.9	1.24
Mutton and Lamb	36	-4.9	0.40
Butter	135	-4.8	0.93
Crispbread	271	-4.0	0.30
Table Jellies, Squares and Crystals	329	-4.0	0.25
Fresh Oranges	210	-3.5	0.40

8.3 Method of Comparison of N.F.S. and Food Diary Results

The twenty foods chosen from the analysis of N.F.S. data are compared with consumption, as recorded in the Food Diaries, using two approaches, each at the three mealtimes, defined as the time of the day at which consumption takes place, of breakfast, lunch and dinner. The ten foods with strong, positive demand trends will forthwith be know as 'positive' foods, and the ten with strong, negative demand trends as 'negative' foods.

Firstly, households consuming one or none of each of the positive and negative foods at each of the prescribed mealtimes are considered with respect to their cluster membership (i.e., with respect to *post hoc* segmentation). It is hypothesised that if these *post hoc* criteria are good descriptors of food consumption behaviour, i.e., if the

48 See table 8.1.

49 See table 8.1.

criteria can differentiate significantly between consumers of foods which have been shown, from the analysis of N.F.S. data, to have undergone strong preference changes, then those households consuming large or small proportions of the so called positive and negative foods will tend to appear in similar clusters. In other words, there will tend to be significant differences between the distributions of households with respect to the cluster (*post hoc*) analysis of foods and the distribution of those households consuming small proportions of positive and negative foods among these clusters.

Secondly, and under the same hypothesis, the cluster membership of those households consuming relatively large numbers, i.e., those ranked in the top ten of household consumers of the positive or negative foods, are compared with the distribution of all households between the clusters. In total, therefore, there are twelve comparisons to discuss, being the cluster membership of households consuming *small* numbers of positive and negative foods at the three mealtimes as well as the cluster membership of households consuming *large* numbers of positive and negative foods at the same mealtimes.

The comparisons of the distributions are made using a Chi-squared test of statistical significance, where the hypotheses to be tested are as follows:

H0: there is no difference between the distributions

H1: the distributions are independent

If H0 is true:

$$\sum \frac{(O_i - E_i)^2}{E_i} \sim \chi^2_{0.05,\,(r-1)(c-1)}$$

where:

O_i = the observed values of cluster membership (from the comparison of consumption by households in the Food Diary with N.F.S. positives and negatives), and;

E_i = the expected values of cluster membership (from the *post hoc* analysis), and;

r = number of variables, i. e., cluster membership deemed by *post hoc* analysis and consumption of positives and negatives, and;

c = number of categories, i. e., number of clusters, including no affiliation.

If the null hypothesis is accepted, it will be concluded that the observed values follow the same distribution as the expected values. In other words, it can be inferred that the *post hoc* criteria do not differentiate between consumers with respect to foods with strong positive and negative demand trends. Rejection of the null hypothesis implies that the *post hoc* criteria are relatively good at differentiating between consumers for these foods.

8.4 Results of the Comparison of Distributions of Households Between Clusters

The results of the comparisons are detailed in Appendix Eight (tables A8.1 to A8.12), and summarised in table 8.3 below, where the Chi-square statistics are reported[50].

Clearly these results illustrate that in eleven of twelve cases at the 1% level of significance, and in all twelve cases at the 5% level, the null hypothesis is rejected. In

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50 The Chi-squared critical values with (r-1)(c-1) degrees of freedom are 9.49 (at the 5% level of significance), 13.28 (1%) and 18.47 (0.1%).

other words, the distribution of the observed values does not conform to the distribution of the expected values. This implies most strongly that *post hoc* criteria, as defined by the clustering of households, are good discriminators between consumers of those foods which have undergone marked preference changes and those which have not.

Table 8.3 Summary of Chi-squared Values for the Comparison of Cluster Membership by *Post Hoc* Analysis and Analysis of Households Consuming Large and Small Numbers of 'Positive' and 'Negative' Foods.

Test	Breakfast	Lunch	Dinner	Tables
One or No Positives	65.15	**10.30**	108.40	A8.1-A8.3
One or No Negatives	23.13	37.38	68.61	A8.4-A8.6
Top Ten Positives	31.02	28.47	21.54	A8.7-A8.9
Top Ten Negatives	29.08	427.32	27.36	A8.10-A8.12

(figures in bold represent acceptance of the null hypothesis at the 1% level of significance)

It is useful, albeit complicated, to compare the distributions of observed and expected values, given that they are in the main distributed differently, at the points where relatively large differences occur. This is conducted in conjunction with the description of the clusters (the *post hoc* analysis), but more particularly with the description of the meal flows (figures 7.1 and 7.2, Chapter Seven).

Looking first at those households consuming one or two (items) of the positive foods, i.e., those households which consume relatively small proportions of foods which have exhibited the strongest negative demand trends, many are unclassified by the *post hoc* analysis, making deductions weak. Furthermore, the distribution of the observed

values at lunch has been shown to be the same as the distribution of the expected values.

Of those households consuming relatively small numbers of negatively trending foods, none of the observed values appear in breakfast cluster three (the cooked breakfast cluster, as defined in figures 7.1 and 7.2), and marginally more of the observed values than expected appear in cluster two (light breakfast). This supports the research findings from both analyses (N.F.S. and Food Diary data) in that it is expected that a relatively large proportion of households consuming small numbers of foods with negative demand trends would consume a light, uncooked breakfast.

This type of pattern is evident elsewhere. For example, there are fewer observed values in lunch cluster two (hot) for households consuming a small number of negative foods. However, there are more observed values in dinner clusters two and four (hot).

When considering households consuming relatively large numbers of positive foods, more observed values occur in breakfast cluster two (light), with overall fewer hot lunches (more in cluster one, but proportionately fewer in cluster two). This again corresponds with expectations that households consuming relatively large numbers of positive foods would tend to consume uncooked breakfasts and lighter lunches. This is further verified by the relatively large number of observed values occurring in the cooked breakfast cluster, and relatively small number of observations occurring in the light breakfast cluster for those households consuming relatively large numbers of negatively trending foods.

Such results are encouraging. There are, though, reservations which must be highlighted. These reservations, together with the implications of the results, will provide the focus of the discussion in the concluding chapter. Nevertheless, perhaps the most important test of the appropriateness of *post hoc* criteria for segmenting

households, at least as far as this analysis is concerned, must be to discover whether or not the *post hoc* criteria highlight socio-economic variables which could have been used in the first instance. Since there are few variables in the Diary which can be used to describe the clusters, the same four socio-economic criteria as were used in the analysis of *a-priori* variables are used here, the hypothesis being that if the *post hoc* criteria are good at segmenting households, and, moreover, better than the *a-priori* criteria as doing so, then there should be insignificant differences between the proportions of households in each cluster with respect to these socio-economic, *a-priori* criteria at the three mealtimes (tables 8.4 to 8.6).

Table 8.4 Proportion of Households in each *Post Hoc* Cluster Characterised by *A-Priori* Socio-Economic Criteria at Breakfast

Cluster	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
One	56	44	78	22	33	30	37	0	72	11	17
Two	50	50	69	31	16	58	26	0	58	8	33
Three	50	50	50	50	19	38	44	0	33	17	50
Four	83	17	50	50	17	0	83	0	0	67	33

Table 8.5 Proportion of Households in each *Post Hoc* Cluster Characterised by *A-Priori* Socio-Economic Criteria at Lunch

Cluster	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
One	47	53	68	32	32	32	36	0	63	0	37
Two	64	36	64	36	20	35	45	0	51	14	35
Three	45	55	55	45	18	55	27	0	50	0	50
Four	50	50	75	25	8	67	25	0	40	20	30

Table 8.6 Proportion of Households in each *Post Hoc* Cluster Characterised by *A-Priori* Socio-Economic Criteria at Dinner

Cluster	Children Present		K.K.P. Qual's		K.K.P. Age			Household Social Class			
	No	Yes	Yes	No	≤35	36-49	≥50	A, B	C1	C2	D, E
One	16	86	86	16	43	43	16	0	60	0	40
Two	52	48	59	41	21	45	34	0	53	6	42
Three	76	24	76	24	8	36	56	0	47	29	24
Four	75	25	75	25	100	0	0	0	67	33	0

Indeed, this does seem to be the case, although demonstrating it *statistically* is inappropriate owing to the small number of observations in each cell. In table 8.4, for example, there appears to be little difference between the proportions of households containing children between clusters one, two and three, and a large difference between

these clusters and cluster four. However, the data are expressed in proportionate terms, and given that there are only six households in cluster four at breakfast, one more household containing children results in a swing of 33% in favour of this category.

It is therefore concluded that the evidence *suggests* that the *post hoc* criteria are more appropriate than *a-priori* criteria.

Appendix 8.I Tables A8.1 to A8.12

Table A8.1 Proportion of Households Consuming One or None of Positive Foods with Respect to Cluster Membership at Breakfast

Cluster	None	One	Two	Three	Four
Households in Breakfast Cluster (%)	21	27	31	16	6
Households Consuming One or None of the 'Positive' Foods (%)	53	13	20	7	7

Table A8.2 Proportion of Households Consuming One or None of Positive Foods with Respect to Cluster Membership at Lunch

Cluster	None	One	Two	Three	Four
Households in Lunch Cluster (%)	4	19	55	11	12
Households Consuming One or None of the 'Positive' Foods (%)	7	13	67	7	7

Table A8.3 Proportion of Households Consuming One or None of Positive Foods with Respect to Cluster Membership at Dinner

Cluster	None	One	Two	Three	Four
Households in Dinner Cluster (%)	3	7	62	25	4
Households Consuming One or None of the 'Positive' Foods (%)	20	0	60	20	0

Table A8.4 Proportion of Households Consuming One or None of Negative Foods with Respect to Cluster Membership at Breakfast

Cluster	None	One	Two	Three	Four
Households in Breakfast Cluster (%)	21	27	31	16	6
Households Consuming One or None of the 'Negative' Foods (%)	32	26	37	0	5

Table A8.5 Proportion of Households Consuming One or None of Negative Foods with Respect to Cluster Membership at Lunch

Cluster	None	One	Two	Three	Four
Households in Lunch Cluster (%)	4	19	55	11	5
Households Consuming One or None of the 'Negative' Foods (%)	16	21	47	11	5

Table A8.6 Proportion of Households Consuming One or None of Negative Foods with Respect to Cluster Membership at Dinner

Cluster	None	One	Two	Three	Four
Households in Dinner Cluster (%)	3	7	62	25	4
Households Consuming One or None of the 'Negative' Foods (%)	0	11	74	0	16

Table A8.7 Proportion of Households Ranked in the Top Ten Consumers of Positive Foods with Respect to Cluster Membership at Breakfast

Cluster	None	One	Two	Three	Four
Households in Breakfast Cluster (%)	21	27	31	16	6
Households in the Top Ten Consumers of the 'Positive' Foods (%)	8	33	50	8	0

Table A8.8 Proportion of Households Ranked in the Top Ten Consumers of Positive Foods with Respect to Cluster Membership at Lunch

Cluster	None	One	Two	Three	Four
Households in Lunch Cluster (%)	4	19	55	11	12
Households in the Top Ten Consumers of the 'Positive' Foods (%)	0	33	33	17	17

Table A8.9 Proportion of Households Ranked in the Top Ten Consumers of Positive Foods with Respect to Cluster Membership at Dinner

Cluster	None	One	Two	Three	Four
Households in Dinner Cluster (%)	3	7	62	25	4
Households in the Top Ten Consumers of the 'Positively' Foods (%)	0	17	58	25	0

Table A8.10 Proportion of Households Ranked in the Top Ten Consumers of Negative Foods with Respect to Cluster Membership at Breakfast

Cluster	None	One	Two	Three	Four
Households in Breakfast Cluster (%)	21	27	31	16	6
Households in the Top Ten Consumers of the 'Negative' Foods (%)	29	29	14	29	0

Table A8.11 Proportion of Households Ranked in the Top Ten Consumers of Negative Foods with Respect to Cluster Membership at Lunch

Cluster	None	One	Two	Three	Four
Households in Lunch Cluster (%)	4	19	55	11	12
Households in the Top Ten Consumers of the 'Negative' Foods (%)	0	100	0	0	0

Table A8.12 Proportion of Households Ranked in the Top Ten Consumers of Negative Foods with Respect to Cluster Membership at Dinner

Cluster	None	One	Two	Three	Four
Households in Dinner Cluster (%)	3	7	62	25	4
Households in the Top Ten Consumers of the 'Negatively' Foods (%)	0	0	57	43	0

Chapter Nine

Summary, Conclusions and Suggestions for Further Research

9.1 Introduction

Following a brief review of the research processes undertaken and a summary of the most important findings, this concluding chapter deals with a number of issues pertaining to individual parts of the research, focusing on reservations about the conclusions reached. The chapter concludes with recommendations for further work in this area.

9.2 Summary of the Research Process

The objective of this research was to determine and quantify those factors responsible for the formation of preferences for food in the U.K. The thesis stems from the notion that underlying factors, i.e., those not attributable to real changes in prices and incomes, have become relatively more important in the food choice decision process since prices began to stabilise in the post-oil crisis years of the early 1970's. Knowledge of these underlying determinants has become increasingly important.

Hypotheses have been developed from two sources; firstly, the literature provides an insight into the causal variables and economic and non-economic approaches to the measurement of this issue; secondly, an analysis of N.F.S. data both illustrates how preferences have changed and can be used to support many of the hypotheses highlighted by other research in this area.

The hypotheses are focused on the notion that food preference changes are determined by changes in consumers' attitudes to a number of factors, centred on 'health' and 'convenience' issues, but encompassing many inextricably linked factors such as food safety, risk and the environment. These attitude changes can be subsequently determined by changes in socio-economic and household variables.

Using secondary data, collected by means of a food diary, *a-priori*, and subsequently *post hoc* variables were analysed with a view to determining their power at differentiating between consumers with respect to their consumption of food. Multivariate (cluster and discriminant analysis) statistical techniques were employed and, accompanied by appropriate tests of statistical significance, a number of conclusions were drawn.

9.3 Summary and Discussion of Findings

The first hypothesis, that *a-priori* variables are significant discriminators between households with respect to their consumption of foods, tested on the Newcastle Food Diary data, revealed that, on the whole, only one variable, 'presence of children in the household', could be described as a reasonably good discriminator, and even this is only the case at the mealtimes of breakfast and lunch (table 7.20, Chapter Seven). The remaining variables, 'K.K.P. qualifications', 'K.K.P. age' and 'social class' all performed poorly.

The second hypothesis, that *post hoc* variables could essentially differentiate better between households with respect to their food consumption, revealed substantial improvements in the proportion of significant differences between the consumption of foods between households.

These *post hoc* criteria, given that it has already been demonstrated they are good discriminators, were then used to differentiate between consumers with respect to their consumption of those foods, as demonstrated by the analysis of N.F.S. data, which have exhibited both the strongest positive and the strongest negative underlying demand trends in recent (post-1972) years, the hypothesis being that, say, heavy consumers of those foods which have undergone the strongest changes in preferences would tend to belong to the same (*post hoc*) clusters.

In eleven of twelve cases (three mealtimes and four criteria - light and heavy users of the strongest 'positive' and 'negative' foods) at the 1% level of significance, and in all twelve cases at the 5% level, the distribution of the observed values, i.e., the proportion of households consuming large or small quantities of the 'positive' and 'negative' foods, did not conform to the distribution of the expected values, i.e., the proportion of households belonging to each cluster as defined by the *post hoc* analysis. This strongly indicates that these *post hoc* criteria are good at differentiating between consumers of those foods which have undergone marked preference changes and those which have not.

Furthermore, these findings are supported by a comparison of the cluster membership of observed and expected values at points where relatively large discrepancies occur. At these points, consumers (households) of relatively small proportions of negatively trending foods at breakfast, say, tend to be found in those clusters which have been described (according to the *post hoc* analysis) as light meals, as opposed to cooked breakfasts.

Given a body of data which would afford the exploration of more socio-economic variables, it would have been possible to test statistically the level of usefulness of *post hoc* criteria relative to *a-priori* criteria (tables 8.4 to 8.6). However, it has been demonstrated how this can be done and is suggested, although not prove, that this is in fact the case for the Diary.

9.3.1 Positive Issues Relating to the Conclusions of the Research

As expected, the *post hoc* criteria performed better than the *a-priori* criteria, but demonstrating this result, together with the degree to which the former outperforms the latter, is an issue of relevance for two reasons; firstly, some of the commercially commissioned research into the determinants of food consumption and preference

changes relies on these and other *a-priori* criteria to differentiate between consumers[51]; secondly, there would be little point in persuing tests using *post hoc* criteria should *a-priori* criteria perform well in their own right. Thus, it has been shown that *a-priori* criteria are, within the overall context of this field of research, possibly redundant and without a great deal of use (see section 9.4).

Further light has been thrown on the determinants of changes in preferences for those foods which have undergone the most marked preference changes, in addition to the definition of the extent to which preferences for over 150 foods have changed in the period 1972 to 1987. The former has been refined by the division of consumption into three mealtimes, as defined by the hour of the day when consumption took place, and consumption has been subjectively described with respect to these mealtimes, and on the basis of the *post hoc* segmentation process, using the meal flow diagrams (figures 7.1 and 7.2, Chapter Seven).

Finally, by comparing the proportions of households in each cluster with respect to the *post hoc* analysis (expected values) and the analysis of households consuming small and large quantities of 'positive' and 'negative' foods, and comparing this with the meal flow descriptions, specific types of consumers defined by the *post hoc* analysis have been verified.

Some of the reasons for preference changes have, therefore, been identified and verified and consumers (households) can be segmented and described, with a good deal of accuracy, with respect to their consumption of food. However, these results and

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51 It is acknowledged that much work may have been undertaken, particularly by private companies and organizations, in order to categorise consumers according to 'lifestyle' criteria, but this author does not have access to it.

conclusions should be taken into consideration only in tandem with the reservations which follow.

9.3.2 Reservations Relating to the Conclusions of the Research

Although the conclusions drawn appear to be most positive, there are reservations which need highlighting. These reservations are focused on the comparison of the cluster membership of households consuming large and small amounts of 'positive' and 'negative' foods with the overall classification of households using *post hoc* criteria, but relate largely to the nature of the two sets of data - N.F.S. and Newcastle Food Diary.

These two data sets, both secondary, have been coded using different systems. Therefore, in order to compare the value of a variable related to a particular food in one data set with the value of a variable in the other for the same food, problems are encountered related to the precise definition of the food in each set. In order to overcome this difficulty, the Food Diary foods (approximately 600) were aggregated and recoded to N.F.S. codes (approximately 150). This process inevitably leads, in many circumstances, to some food groups being aggregated into one code, and others remaining at the totally disaggregated level (hence pizza remains disaggregated, and vegetables are totally aggregated). This in itself can be a problem in that, for example, refined conclusions for particular types of vegetables are not possible. However, the most damaging aspect is that foods may be recoded inaccurately in that the precise definition in the Food Diary does not match the precise definition by the N.F.S. This issue was dealt with most carefully, but errors are inevitable.

Remaining with the data, the Food Diary is essentially a cross-sectional analysis, and the N.F.S. a time series. So, although the *post hoc* criteria may be relevant at the end of the N.F.S. time series (1987), it is questionable, and almost certain, that the same criteria would not differentiate as well between consumers at the beginning of this

analysed time series (1972). The minimum requirement would be that the Food Diary data are collected continuously for one year, so allowing for seasonality differences to be judged. This issue is developed in section 9.4, but is similar to the types of reservations which must accrue from the differences in the areas from which the two samples are drawn; the N.F.S. encompasses Great Britain in as representative way as is feasible, but the Food Diary sample is drawn from the North East of England. Although this area is typically said to be representative of the whole of the U.K., it has been shown (Chapter Four) that the sample is not a demographically fair representation of the North East consumer, let alone the U.K. consumer. The Food Diary sample is also small for this type of analysis (102 households), particularly when compared with the N.F.S. sample of approximately 7,000 per annum.

The distributions of Food Diary observations and their coding only permitted the use of four *a-priori* variables, subsequently forming the *post hoc* criteria. Ideally, the number would be larger, and the more the better, since the addition of a variable would simply add refinement to the *post hoc* groupings.

Finally, the subjective descriptions of these groupings are open to criticism. However, they are based on robust statistical evidence which, if necessary, can be referred to. Their use is a matter for judgement, but this author believes there is potential for this when put side-by-side with specific values for *post hoc* criteria.

9.4 Suggestions for Further Research

This field of research is dynamic and will hold the attention of academics, professional market researchers and others into perpetuity. This thesis provides a minute contribution to the field, and the potential for extension is great. However, there are some specific recommendations for extensions which result directly from the methods employed and results obtained here.

Firstly, although it has been shown that *post hoc* criteria can be used reasonably successfully for the differentiation of consumers with respect to changes in preferences, and that these criteria operate through changes in attitudes to factors such as 'health' and 'convenience', it is necessary to examine in greater detail the precise nature of these attitudes with respect to the individual clusters. The manifestations of these attitude changes are clear, as are the definitions of groups of consumers holding these attitudes, but more detail is required on the attitude changes themselves. Furthermore, although the *post hoc* groups are well described, it would also be useful to describe them in terms of different *a-priori* criteria.

Secondly, classifications of consumers should possibly be made on the basis of descriptions of the type reported by Plasser (*op cit*) and in this thesis (see Chapter Five) whereby consumers are described by a standardized label, incorporating a combination of descriptors. It would be useful, particularly for commercial researchers, to develop this standard consumer description based on a series of *a-priori* variables, grouped into *post hoc* variables, specifically for food consumption analysis purposes. Problems associated with this are the dynamism of consumption patterns and preference changes, and the dynamism of consumer characteristics. The size of one (significantly differentiated) group of consumers will tend to change with time, hence the occasional need for redefinition of groups, in tandem with what they are consuming, and the addition of further classifications at the expense of those which become redundant.

This type of research would require measurement of a considerable number of variables for the effectiveness of *post hoc* variables in differentiating between consumers to approach a maximum. Furthermore, and ideally, the research would have to be undertaken on a continuous basis, or at regular and frequent intervals, in order that changes in all variables related to the consumer and their consumption could be monitored.

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