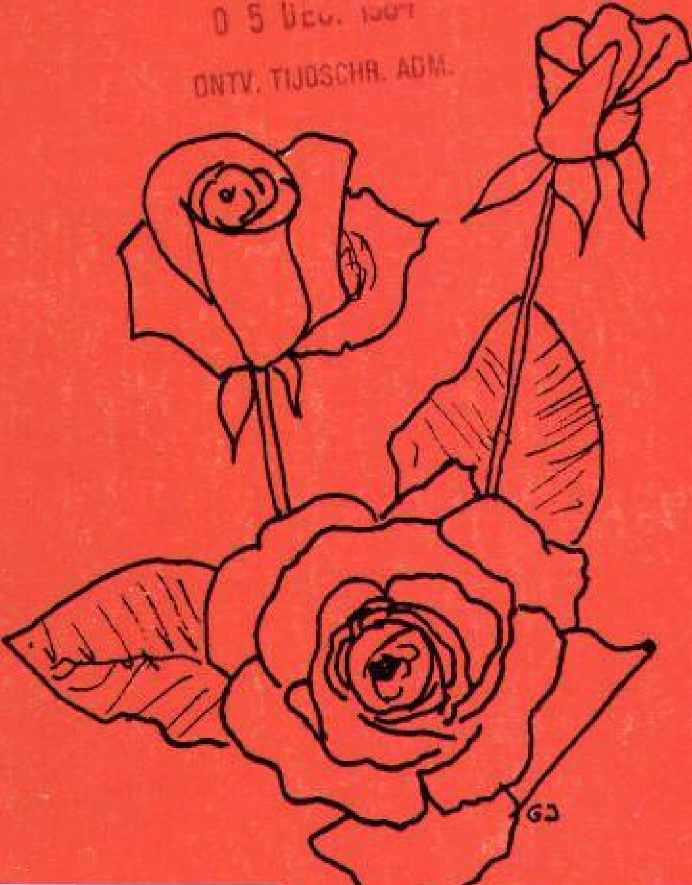
# Consumer choice of cut flowers and pot plants

A Study based on consumer panel data of households in the Netherlands








NN08201.1009

# STELLINGEN

I

Een analyse gebaseerd op de veronderstelling van een getrapt keuzeproces door gewoontekopers van bloemen en planten verhoogt het inzicht in dit koopgedrag.

(Dit proefschrift)

II

Een model, waarin geschatte responsparameters van individuele huishoudingen zijn gerelateerd aan kenmerken van deze huishoudingen, draagt bij tot het vinden van relevante segmenten in de markt.

(Dit proefschrift)

III

Het opbouwen van consistente tijdreeksen is van grote betekenis voor het analyseren van agrarische markten. Hiervoor heeft men in de praktijk nog te weinig aandacht.

IV

Het nadeel dat analoge concepten uit de marktkundige theorie voor bepaalde toepassingsgebieden verschillen, weegt niet op tegen het voordeel dat de gebruikers van een theorie hun situatie in deze concepten herkennen.

(E. F. FERN and J. R. BROWN (1984). The industrial/consumer marketing dichotomy: a case of insufficient justification. Journal of Marketing, Vol. **48** (Spring), 68–77.)

V

In een evaluatie van een marketingsysteem aan de hand van criteria voor struktuur van, gedrag in, en werking van de markt, dienen de criteria in overeenstemming te zijn met de doeleinden van de maatschappij.

(D. I. BATEMAN (1976). Agricultural Marketing: a review of the literature of marketing theory and of selected applications. Journal of Agricultural Economics, Vol. **27**, 171–224.)

VI

De flexibiliteit van handelaren in landbouwprodukten in ontwikkelingslanden ten aanzien van het inspelen op behoeften van boeren aan marktinformatie, snelle afhandeling van een transactie, krediet, en transport, verschaft hen veelal een sterke positie bij de opkoop van deze produkten.

(G. KALSHOVEN et al. (1984). Paddy farmers, irrigation and agricultural services in Malaysia. Pudoc, Wageningen; A. VAN TILBURG (1981). Evaluation of the performance of the existing marketing system for highland vegetables in West Java, Indonesia. Proceedings EAARM-conference, Copenhagen, 1366–1383.)

VII

De inbreng van andere disciplines dan de marktkunde bij de bestudering van de keuze van boer of boerin voor één of meer afzetkanalen in een ontwikkelingsland is van belang vanwege de invloed op die beslissing van faktoren als grondbezitsverhoudingen, rechten op de grond, teelt van boer of boerin, loon in natura of geld, en arbeid buiten de landbouw.

(G. KALSHOVEN et al. (1984) o.c.; J. DEY (1981). Gambian women: unequal partners in rice development projects. Journal of Development Studies, Vol. **17**. No. 3, 109–122.)

VIII

Een voedselstrategie van de overheid in een ontwikkelingsland dient mede gebaseerd te zijn op resultaten van onderzoek naar de consumentenvoorkeur voor dit voedsel.

(C. G. ROSS (1980). Grain demand and consumer preference in Senegal. Food Policy, Vol. **5**, No. 4, 273–281; H. P. JOSSERAND (1984). Farmers' consumption of an imported cereal and the cash/foodcrop decision. An example from Senegal. Food Policy, Vol. **9**. No. 1, 27–34.)

IX

De naam van de Landbouwhogeschool in de engelse taal, Agricultural University Wageningen, suggereert enerzijds dat men overal ter wereld weet waar Wageningen ligt, en anderzijds dat er meer van dergelijke instituten in Nederland zijn. Om verwarring te voorkomen verdient de naam Netherlands Agricultural University de voorkeur.

X

Het bewerken van muziekcomposities voor andere muziekinstrumenten en/of een andere categorie vocalisten is een vorm van produktvernieuwing welke bijdraagt om de belangstelling voor muziek te wekken of te stimuleren.

XI

Het bij een stemming in het parlement bindend verklaren van het fractiestandpunt voor alle leden van een fractie, ongeacht bestaande gewetensbezwaren, mag in een parlementaire democratie niet voorkomen.

XII

In het gezegde 'Beloven en niet doen is gelijk een hoen die wel kakelt op zijn stok, maar geen eieren legt in 't hok', kan de b van beloven ook vervangen worden door een g.

A. van Tilburg
Consumer choice of cut flowers and pot plants.
A study based on consumer panel data of households in the Netherlands.

*Wageningen*, 7 december 1984

# CONSUMER CHOICE OF CUT FLOWERS AND POT PLANTS

A study based on consumer panel data of households in the Netherlands

Promotor: dr. ir. M. T. G. Meulenberg, hoogleraar in de marktkunde en het marktonderzoek

Co-promotor: dr. ir. L. C. A. Corsten, hoogleraar in de wiskundige statistiek

A. VAN TILBURG

# CONSUMER CHOICE OF CUT FLOWERS AND POT PLANTS

## A study based on consumer panel data of households in the Netherlands

Proefschrift
ter verkrijging van de graad van
doctor in de landbouwwetenschappen,
op gezag van de rector magnificus,
dr. C. C. Oosterlee,
hoogleraar in de veeteeltwetenschap,
in het openbaar te verdedigen
op vrijdag 7 december 1984
des namiddags te vier uur in de aula
van de Landbouwhogeschool te Wageningen

AGRICULTURAL UNIVERSITY WAGENINGEN,
THE NETHERLANDS, 1984

This thesis is also published as
AGRICULTURAL UNIVERSITY WAGENINGEN PAPERS 84-2 (1984)

Voor Augustine, Gerrit Jan en Petrie
Ter herinnering aan mijn vader, Gerrit van Tilburg

# VOORWOORD

De personen en instanties die het mede mogelijk hebben gemaakt dat deze studie in de voor U liggende vorm tot stand kwam, ben ik veel dank verschuldigd. De adviezen en stimulerende belangstelling van prof. dr. M.T.G. Meulenberg zijn voor mij van grote waarde geweest gedurende de gehele onderzoeksperiode. Prof. dr. L.C.A. Corsten en dr. M.A.J. van Montfort adviseerden met betrekking tot de statistische aspecten van de studie. Door de medewerking van het Produktschap voor Siergewassen en het Nederlands Instituut voor Agrarisch Marktonderzoek (N.I.A.M) was het mogelijk de studie te baseren op de oorspronkelijke gegevens uit het N.I.A.M.-panel. De heer J.A. Bijkerk zette mijn vele en soms lastige rekentechnische vragen om in computerprogramma's waarvan de resultaten, mede dankzij de faciliteiten van het Rekencentrum van de Landbouwhogeschool, steeds weer snel op mijn bureau verschenen. De Landbouwhogeschool en het Fonds Landbouw Export Bureau 1916/1918 maakten het financieel mogelijk het gebruik van de engelse taal te laten corrigeren. Mevrouw H.J. West nam deze taak op zich en gaf daarnaast adviezen omtrent de 'layout' van deze publicatie. Mevrouw C.A. Bijkerk en Mevrouw A. van Tilburg typten het laatste manuscript. De redactie van Agricultural University Wageningen Papers was bereid de studie in genoemde reeks op te nemen. Al deze personen en instanties kan geen enkele van de eventueel resterende onvolkomenheden in de studie worden aangerekend.

# ABSTRACT

Tilburg, A. van (1984) Consumer choice of cut flowers and pot plants. A study based on consumer panel data of households in the Netherlands in 1973 and 1974. Agricultural University Wageningen Papers 84-2 (1984), ISBN 90-6754-059-5, 184 p., 15 figs, 98 tables, 61 refs, 5 appendices, summary in Dutch.

Free descriptors: European context, multistage choice process, budget allocation model, stochastic model of consumer behaviour, response parameter estimates, price and budget elasticities, socio-economic and demographic characteristics, market segments.

The objectives of the study were to relate aspects of consumer behaviour on cut flowers and pot plants to marketing variables and characteristics of households, to determine whether market segments could be found, and to determine the applicability of methods and models developed to the market research in the flower industry.

Several categories of flower and plant buyers were distinguished, in increasing order of buying frequency, occasional, nonhabitual and habitual buyers. The depth of analysis varied with buying frequency. Habitual buyers were assumed to select flowers and plants according to a multistage choice process consisting of a budget, priority and choice stage. For each stage, differences in parameter estimates between households, reflecting the response to marketing or market variables, were related to socio-economic en demographic characteristics.

The variables, living in the west or east of the country, and living in municipalities of more than 30 000 inhabitants, were found to be positively related to expenditure on flowers and plants, whereas the variable, having a positive attitude to housekeeping, was found to be negatively related to this expenditure.

The mean price elasticity of the demand for flowers and plants was –0.28 for nonhabitual and –0.81 for habitual buyers (budget stage). For those habitual buyers purchasing in all three subclasses distinguished (55%), the mean price elasticity was –0.86 for flowers, –0.87 for flowering plants and –0.96 for green plants. Purchases of flowers were the least affected by price fluctuations in other subclasses (priority stage). In the choice stage, an increase in relative prices seemed to have caused a small decrease in the marketing attraction of a particular type of flower. The effect of national advertising on demand was higher in seasons when demand was increasing than in seasons when demand was decreasing.

From an analysis of the results for all three stages of the multistage choice process, the following segments of habitual buyers were distinguished. The first

segment (44%) was sensitive to price changes, but insensitive to national advertising and consisted of those, either living in the west in urbanized municipalities, or living in the east or south and being under 30 years of age. The second segment (40%) tended to be insensitive to both price changes and national advertising, and consisted of those, either living in the west in a rural municipality, or in the east or south and over 30 years of age. The third segment (13%) was sensitive to changes in price and advertising and consisted of habitual buyers in the highest social class and living in the west, east, or south of the country.

CONTENTS

# 1 SCOPE AND FRAMEWORK OF THE STUDY

## 1.1 Introduction

In Europe, there is strong pressure on consumers by market suppliers of cut flowers and pot plants. In some countries there are signs of consumer market saturation, for example, the market for cut flowers in West Germany (De Kleijn 1981). In a number of European countries, various aspects of consumer behaviour in respect of cut flowers and pot plants have been studied. However, until now, no comprehensive analysis has been undertaken in which consumer behaviour of individual households is related to marketing variables, and in which differences in household responses to these variables are related to socio-economic and demographic characteristics.

This study is an analysis of consumer behaviour in respect of cut flowers and pot plants in the Netherlands. Consumer behaviour is defined as the acts of individuals involved in obtaining and using products and services, including the decision processes that precede and determine these acts (Engel and Blackwell 1982). In this study the term buying behaviour relates to purchases of cut flowers and pot plants. It was decided to carry out such a study of households in the Netherlands, because the home market is of great economic importance to the Dutch flower industry, and because there is a long tradition of purchasing cut flowers and pot plants in that country. In addition, data on consumer behaviour were relatively easy to obtain. The size of the market can be illustrated by the increase in turnover at flower and plant auctions in the Netherlands from 956 million guilders in 1974 to 2519 million guilders in 1982. The 1982 turnover includes 1947 million guilders for cut flowers of which about 75% was exported, and 572 million guilders for pot plants and plants for flower gardens of which about 50% was exported. About 63% of the export value of flowers was received from West Germany.

The total number of cut flowers, pot plants, and floral arrangements (for example, bridal bouquets and funeral wreaths) purchased by households in the Netherlands in the period 1973 to 1980 is given in Table 1.1. It can be seen that the volume has stabilized in the last few years. Total household expenditure and changes in flower and plant prices during this period are given in Appendix I, Tables I.1 and I.2. Household expenditure on cut flowers rose from 213 million guilders in 1973 to 430 million guilders in 1980; and for pot plants, from 101 million guilders in 1973 to 141 million guilders in 1980. In the same period, the price index of cut flowers rose by 77% and pot plants by 47%. In general, the price of flowers increased more than, and the price of pot plants increased less than the cost of living.

TABLE 1.1 Total number of cut flower stems, pot plants, and floral arrangements ($10^6$) purchased by households in the Netherlands (1973-1980)

| | Cut flowers stems | | Pot plants | | Floral arrangements |
|---|---|---|---|---|---|
| | Number | Price index | Number | Price index | Number |
| 1973 | 760 | 100 | 32.8 | 100 | |
| 1974 | 800 | 105 | 35.2 | 107 | |
| 1975 | 771 | 101 | 32.6 | 99 | |
| 1976 | 733 | 96 | 32.0 | 98 | |
| 1977 | 781 | 103 | 33.8 | 103 | 4.45 |
| 1978 | 816 | 107 | 30.6 | 93 | 4.48 |
| 1979 | 865 | 114 | 30.6 | 93 | 4.45 |
| 1980 | 866 | 114 | 31.2 | 95 | 4.32 |

Source: PvS/NIAM panel of 2000 (5000 from 1976) households

## 1.2 OBJECTIVES OF THE STUDY

The main objectives of the study are : to improve understanding of consumer behaviour regarding cut flowers and pot plants in the Netherlands by relating aspects of consumer behaviour to marketing variables and socio-economic and demographic characteristics of households; to determine whether segments can be distinguished in the cut flower and pot plant market in which households react similarly to marketing variables; and to determine the applicability of methods or models developed in this study to the market research in the flower industry.

## 1.3 ASSUMPTIONS ON WHICH THE STUDY IS BASED

Variables affecting consumer behaviour in respect of cut flowers and pot plants can be derived from general models of consumer behaviour as depicted in Figure 1.1. Incoming information is processed in the consumers' 'black box' by intervening variables, such as, perception, choice criteria, and attitude, before an actual purchase is made.

Variables affecting the consumer's 'black box' and indirectly consumer behaviour as to flowers and plants include commercial variables (e.g., advertising), social variables (e.g., reference groups), demographic variables (e.g., age), socio-economic variables (e.g., income) and situational factors (e.g., anniversaries). Experience with the purchased product may influence the intervening variables and therefore future buying behaviour (feed-back). The relationship between incoming information and consumer behaviour was investigated but not the mental process going on within the 'black box'. This approach has the disadvan-

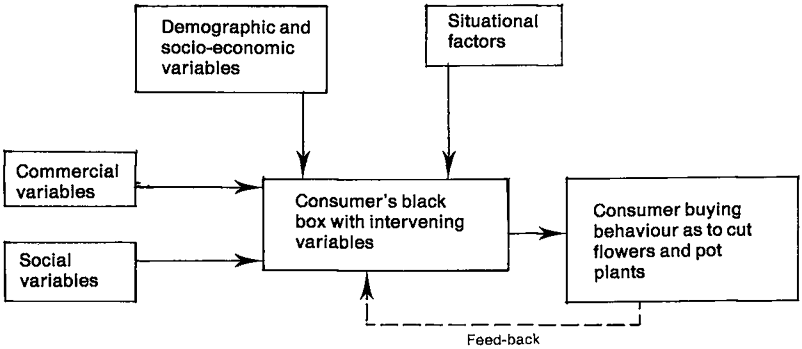


FIG. 1.1 Variables affecting consumer behaviour on cut flowers and pot plants.

tage that some relationships between stimulus and response may not be understood, but it prevents difficulties in interpretation and measurement of intervening variables.

It is assumed that households follow some type of planning procedure before the household budget is actually committed, and that such procedure consists of a number of stages. In the first stage, the budget is allocated to various product classes. If these product classes are broad, as for example cut flowers and pot plants, then it is assumed that in the following stage, the budget for a particular product class is allocated, either explicitly or implicitly, to a number of subclasses. In the final stage, the choice is made of products to be purchased within a particular subclass. Many minor factors are assumed to affect the final choice. In the case of cut flowers and pot plants, such factors include: display by retailer; availability; weather; and the advice of a friend or the retailer. Further, it is assumed that the model in Figure 1.1 is applicable to all three stages of this multistage choice process. In addition, it is assumed that there is a specific relationship between commercial variables and household buying behaviour as to cut flowers and pot plants, that is, households are heterogeneous in their response to stimuli, such as, price, advertising, and the assortment available. In this study, this heterogeneity is explained in terms of differences in household characteristics and purchase characteristics.

## 1.4 THE DATA SET

A considerable amount of data collected from consumer panels in many countries in Europe has been used to analyse changes in the market for cut flowers and pot plants. The 'Produktschap voor Siergewassen' (Dutch Commodity Board for Ornamentals) used a consumer panel for market research in the Netherlands for the period 1973 to 1980. This panel was organized by the Netherlands Institute for Agricultural Marketing Research (NIAM), which is connected to the AGB Group of Companies. The panel consisted of 2000 households, but was increased to 5000 in 1976. The Commodity Board and NIAM have given permission for the use in this study of data in respect of the individual households in the panel for the period December 1972 to November 1974. Detailed descriptions of the panel are given by De Koning (1979) and Van der Zwan and Verhulp (1980). For this study, only households which had participated in the consumer panel for the entire period between December 1972 and November 1974 were selected. Thus, all household purchase histories were of equal length, and of sufficient length for analysis. Using the same criteria as for the original sample, a subset of 1000 households was selected as being representative of households in the Netherlands.

The degree of conditioning, that is the tendency to change purchasing habits once consumers commence recording expenditure, may vary between those selected and the other panel members who participated for less than two years. However, previous studies have shown that the effect of conditioning on buying behaviour does not differ greatly between households in relation to length of membership of the panel (Carman 1974; Parfitt 1972; Van der Zwan and Verhulp 1980). Purchase characteristics of the panel are given in Appendix I which also includes frequency distributions of the household characteristics (Table I.3). In addition, monthly expenditure on national advertising for cut flowers and pot plants obtained from the advertising agency of the Commodity Board are given in Table I.4 of this appendix.

## 1.5 Outline of the study

In Chapter 2, characteristics of consumer behaviour regarding cut flowers and pot plants in the Netherlands and other West European countries are compared in order to place this study in broader context. The concept of a multistage choice process in buying behaviour as to flowers and plants is discussed in Chapter 3. The three stages distinguished in this process, together with a model to describe each stage, are also considered in this chapter. In Chapter 4, on the basis of buying intensity, the segments occasional and regular buyers are distinguished. On the same basis, and on the proportion of purchases for the home, the segment of regular buyers is further divided into habitual and nonhabitual buyers. How market segments can be found with the analysis in the following chapters is also discussed. In Chapter 5, the size of the budget spent on flowers and plants is related to variables depicted in Figure 1.1 for all households in the sample. Differences in response parameter estimates are related to socioeconomic and demographic characteristics of regular buyers. Buying behaviour of habitual buyers is examined in terms of the multistage choice process in Chapters 5 to 7. The first stage, the budget stage, is also examined in Chapter

5. In Chapter 6, the second stage in the choice process, the priority stage, is considered for habitual buyers only. A model is proposed for the allocation of a household flower and plant budget to subclasses of flowers and plants. Differences in parameter estimates are related to household characteristics. The final stage in the process, the choice stage, is examined in Chapter 7 as the choice made within the subclass cut flowers by habitual buyers. A suitable stochastic model of consumer behaviour to describe flower buying behaviour is proposed, and differences in households in estimated purchase probabilities are related to household characteristics. In Chapter 8, the analysis in the preceding chapters is examined to determine segments in the cut flower and pot plant market in the Netherlands. These segments need to be measurable, accessible, and substantial. In Chapter 9, a number of conclusions are drawn about buying behaviour of households in the Netherlands in respect of flowers and plants, namely those regarding general purchase characteristics and response to marketing variables. Conclusions are also drawn about market segmentation as regards occasional, nonhabitual, and habitual buyers; segmentation on consumer reactions to aspects of marketing policy; and the segments obtained with the multistage choice process. Finally, consideration is given to whether the hypothesis of a multistage choice process for cut flowers and pot plants is valid.

# 2 REVIEW OF AVAILABLE INFORMATION ON HOUSEHOLD BUYING BEHAVIOUR IN RESPECT OF CUT FLOWERS AND POT PLANTS IN WESTERN EUROPE

## 2.1 INFORMATION FROM CONSUMER PANELS

Data collected from consumer panels have been used to compare household buying behaviour as regards cut flowers and pot plants in a number of Western European countries and in the Netherlands. Details of these panels, including the names of organizations using the panels, the consumer panel agency, panel size, and the period in which data were collected, are given in Appendix II. All are household panels with the exception of the SOFRES panel in France, which is a personal panel. Questionnaires were sent monthly to the members of the French panel, every two weeks to the Belgian panel, and weekly to the others. To facilitate comparisons between countries, all data on buying behaviour were converted to annual data, data from the French personal panel converted to household data, and all national currencies converted to Swiss francs (SWF). Data on buying behaviour as regards cut flowers, pot plants, and floral arrangements for each country are presented in Appendix II. Household buying behaviour on cut flowers and pot plants has been compared in the Netherlands, Belgium, France, West Germany, Great Britain, Switzerland, Austria, Denmark, Norway, and Sweden. The following aspects have been studied: household expenditure; the average price paid for a bunch of ten flowers or a pot plant; the proportion of households making purchases; the assortment purchased; and the market outlet patronized.

### *2.1.1 Household expenditure*

Household expenditure on cut flowers and pot plants was found to vary considerably in the various countries. From the available data for the years 1980 and 1981 (see Appendix II, Table II.2), countries can be divided into three groups on the basis of expenditure (see Table 2.1).

TABLE 2.1 Household expenditure on cut flowers and pot plants (Swiss francs) in a number of West European countries (1980-1981)

| High<br>>80 SWF | Medium<br>40-80 SWF | Low<br><40 SWF |
|---|---|---|
| Belgium | Switzerland | Great Britain |
| France | Austria | Denmark |
| West Germany | Norway | |
| Netherlands | Sweden | |

Although total expenditure on cut flowers, pot plants, and floral arrangements was high in Belgium, France, West Germany, and the Netherlands, the distribution of such expenditure over these subclasses differed considerably. About 80% of expenditure of households in the Netherlands on this product class was on cut flowers, whereas the figure was about 50% for the other three countries in this category. The proportion spent on pot plants was by far the highest in France, being about 50%. This was also the case for floral arrangements in Belgium, about 25%. In the medium expenditure group, the distribution of expenditure on cut flowers and pot plants was similar in Switzerland and Austria, being about 50% for each, and similar also in Norway and Sweden, being about one-third and two-thirds, respectively. In the two countries having the lowest expenditure, Denmark and Great Britain, the amount varied considerably. About two-thirds of such expenditure by British households was spent on cut flowers, as against about one-third by Danish households. Data from the market research reports have been examined in an endeavour to explain the varying levels of expenditure and of demand.

### *2.1.2 Proportion of households purchasing cut flowers and pot plants*

From data presented in Table II.4 in Appendix II, countries can be grouped on the basis of the proportion of households purchasing cut flowers and pot plants (Table 2.2). Proportion of household purchasing in both Belgium and France have been shown to be below the average for Western Europe, but the actual expenditure on cut flowers and pot plants per household was well above average. This indicates that flower and plant prices were relatively high in Belgium and France.

TABLE 2.2 Proportion of households purchasing cut flowers and pot plants in a number of West European countries during a four-week period (1980-1981)

| High<br>>50% | Above average<br>30-50% | Below average<br>20-40% | Low<br><30% |
|---|---|---|---|
| Netherlands | West Germany | Switzerland<br>Austria<br>Denmark<br>Sweden<br>Belgium[a] | France[b]<br>Great Britain<br>Norway |

[a]Estimate; [b]Figures of 1977.

### *2.1.3 Prices paid for cut flowers, pot plants, and floral arrangements*

The level of expenditure is also affected by the price level, and prices paid differed considerably between countries (Appendix II, Table II.3). Further, the relatively high prices for flowers in a particular country did not necessarily mean that prices for plants were also high, nor was the reverse necessarily so (Tables 2.3a and 2.3b). For example, cut flowers were extremely expensive in Norway, whereas pot plants were relatively cheap (Figure 2.1). To the contrary in France, pot plants were extremely expensive and flowers relatively cheap.

From Figure 2.1 it may be concluded that there are groups of neighbouring countries in Western Europe with about the same price structure for cut flowers and pot plants. Possible reasons for this, such as, the composition of the assortment of flowers and plants purchased, and the type of outlet patronized, are discussed.

TABLE 2.3a Average prices paid for cut flowers in a number of West European countries (1980–1981)

| High<br>> 12 SWF | Above average<br>8-12 SWF | Medium<br>5-8 SWF | Low<br>< 5 SWF |
|---|---|---|---|
| Norway | Switzerland | Belgium | Netherlands |
| | Austria | France | Great Britain |
| | Sweden | West Germany | |
| | | Denmark | |

TABLE 2.3b Average prices paid for pot plants in a number of West European countries (1980-1981)

| High<br>> 10 SWF | Above average<br>5-10 SWF | Medium<br>3-5 SWF | Low<br>< 3 SWF |
|---|---|---|---|
| France | Belgium | Netherlands | West Germany |
| | | Great Britain | Austria |
| | | Switzerland | Denmark |
| | | Norway | |
| | | Sweden | |

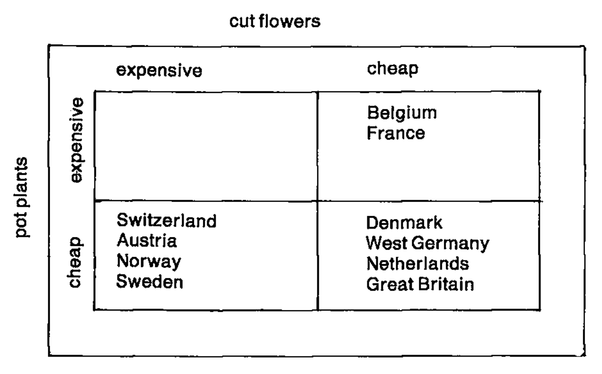



FIG. 2.1 Relationship between the price for cut flowers and pot plants in a number of West European countries (1980/1981).

### *2.1.4 Types of cut flowers and pot plants purchased*

The types of flowers purchased varied considerably between countries (see Appendix II, Table II.5). The first two preferences for cut flowers in each country are given in Table 2.4. The Belgians and the French showed a greater preference for roses and carnations, the West Germans and Swiss for mixed bunches and roses; the Dutch for chrysanthemums and roses; the British for mixed bunches and chrysanthemums; the Austrians and Norwegians for mixed bunches and carnations; and the Danes and Swedes for tulips and mixed bunches.

TABLE 2.4 First two preferences for cut flowers based on household expenditure in a number of West European countries

| Chrysanthemum | Rose | Carnation | Mixed bunch | Tulip |
|---|---|---|---|---|
| Netherlands<br>Great Britain | Belgium<br>France<br>West Germany<br>Netherlands<br>Switzerland | Belgium<br>France<br>Austria<br>Norway | West Germany<br>Great Britain<br>Switzerland<br>Austria<br>Denmark<br>Norway<br>Sweden | Denmark<br>Sweden |

Data on the assortment of pot plants were available for all countries except Belgium and France (Appendix II, Table II.6.). The first two preferences for pot plants in each country are given in Table 2.5. A very strong preference was shown for the begonia in the assortment of pot plants purchased in many countries. Of the four pot plants listed in Table 2.5, three were purchased mainly for indoors: azalea, begonia, and poinsettia; and the geranium as balcony plant. The average price paid for pot plants in West Germany, Switzerland, Austria, and Sweden was relatively low because of the large proportion of cheap balcony plants in the assortment. Pot plants were cheap in Denmark because many are produced locally; and in Great Britain also because of the large proportion of cheap potted chrysanthemums in the assortment offered.

TABLE 2.5 First two preferences for pot plants based on household expenditure in a number of West European countries

| Azalea | Begonia | Geranium | Poinsettia |
|---|---|---|---|
| Netherlands<br>Great Britain | West Germany<br>Netherlands<br>Switzerland<br>Austria<br>Denmark<br>Norway<br>Sweden | West Germany<br>Switzerland<br>Austria<br>Sweden | Denmark<br>Norway |

*2.1.5 Proportion of expenditure on cut flowers and pot plants spent at various market outlets*

From the little information available on prices paid at various market outlets, it would seem that florists and the garden centres (or gardeners) were the most expensive outlets, and markets, street stalls, supermarkets, and house-to-house selling were comparatively cheap.

Apparently, florists have a relatively large share of the market in Belgium and France; markets, street stalls, and house-to-house sellers in the Netherlands; growers, garden centres, and gardeners in West Germany, Austria, and in Norway for balcony plants; supermarkets in Switzerland (Migros in particular), Denmark, and Sweden; and greengrocers in Great Britain particularly in spring because daffodils are then cheap.

*2.1.6 Buying behaviour in the Netherlands as compared with other West European countries.*

In the Netherlands, as compared with other West European countries, the number of households purchasing flowers and plants as a proportion of all households was highest, and the purchase pattern was fairly regular throughout the year. Dutch households spent most on cut flowers and were quite exceptional in that they spent about 60% of their flower budget for their own homes rather than for gifts. Prices paid for flowers were relatively low in the Netherlands, partly because of the widespread local production, and partly because of the large proportion of the flower budget spent at cheap outlets: markets, supermarkets, street stalls, and house-to-house selling. A wide assortment of cut flowers and pot plants was purchased. In the Netherlands cut flowers were mostly purchased in bunches, whereas in 1981 in France about one-third of flower purchases consisted of a single bloom. In the Netherlands, about 90% of expenditure on cut flowers was for bunches of one type only, while in West Germany the figure was about 60%. Mixed bunches were very popular in all countries examined other than in the Netherlands.

## 2.2 Information from earlier studies

Several studies on consumer behaviour on cut flowers and pot plants have been carried out for Belgium and West Germany (Altmann and Von Alvensleben 1982; De Kleijn 1981; Nicolaus 1975, 1976; Ostendorf 1975; and Timm 1978).

*2.2.1 Belgium*

Nicolaus (1975 and 1976) analysed data collected from the consumer panel of the 'Landbouw-Economisch Instituut' (Agricultural Economics Institute) on cut flowers, pot plants, and floral arrangements for the year 1973. The analysis included importance of the product class; reason for purchase; composition of the assortment; market outlets; seasonal pattern in consumption; and the relationship between consumption and socio-economic factors. Monetary income elasticities were obtained by relating average household income in each income group in 1973 to average household expenditure on such items (Table 2.6). Demand for pot plants was less and demand for floral arrangements more income elastic than that for cut flowers.

TABLE 2.6 Monetary income elasticities of Belgian households for cut flowers, pot plants, and floral arrangements in 1973

| Product class | Reason for purchase | | Total |
|---|---|---|---|
| | Use at home | Gift | |
| Cut flowers | 0.80 | 0.69 | 0.73 |
| Pot plants | 0.40 | n.s. [a] | 0.24 |
| Floral arrangements | – | – | 0.96 |

[a] Not significant at a 5% level

### 2.2.2 *West Germany*

Ostendorf (1975) estimated income and price elasticities of the demand for cut flowers for three types of households in West Germany. These households differed in size, income, social class, and stage in the life cycle (two-person households of social security recipients, four-person households of employees in the middle income class, and four-person households of employees with high incomes). The data set contained time series of aggregated household expenditure on cut flowers in each class during the period 1956 to 1973. Ostendorf estimated annual income elasticities of the expenditure on cut flowers as 2.51, 0.94, and 0.58 for the low, middle, and high income class, respectively. He concluded that expenditure on cut flowers was income elastic in West Germany at that time.

Timm (1978) examined the market for cut flowers and pot plants in West Germany. Reported data on household expenditure on these were obtained from a panel bureau and from the same consumer expenditure survey used by Ostendorf. Timm discussed the effect of separate socio-economic and demographic variables on expenditure on cut flowers and pot plants. Annual income elasticities of the demand for cut flowers and pot plants were 1.86, 0.87, and 0.63 for the low, middle, and high income class, respectively, for the period 1965 to 1976. Annual price elasticities of this demand differed significantly from zero for households in the middle and in the high income class, being –1.16 and –1.18, respectively, for the period 1965 to 1976.

From consumer panel data for the period 1975 to 1980, De Kleijn (1981) estimated price elasticities for cut flowers, pot plants, and balcony plants in West Germany. He used data aggregated for periods of four weeks and thus had 78 observations. The year was divided in four seasons, resulting in 24 observations for the winter and 18 observations for each of the other seasons. In his model, the explanatory variables were: the deflated prices for each of the subclasses of flowers and plants distinguished; average daily temperature; a trend; length of holidays; and variables for celebration days: Easter, Mother's Day, All Souls' Day, and Christmas. Price elasticities for the number of purchases are given in Table 2.7. The demand for cut flowers was shown to be price elastic during the winter and price inelastic during the other seasons, whereas the demand for pot plants was elastic in all seasons, except summer.

TABLE 2.7 Seasonal price elasticities for the demand of the total number of cut flower stems and pot plants purchased in West Germany (1975-1980)

| | Number of cut flower stems | Number of pot plants |
|---|---|---|
| Winter | -1.69 [a] | -1.62 [a] |
| Spring | -0.63 [d] | -1.14 [a] |
| Summer | -0.74 [b] | -0.87 [c] |
| Autumn | -0.43 [c] | -1.27 [a] |

[a] $p < 0.5\%$; [b] $p < 2.5\%$; [c] $p < 10\%$; [d] $p > 10\%$

Altmann and Von Alvensleben (1982) reported the results of a survey on buying behaviour on cut flowers and pot plants of 236 consumers in Hannover during summer 1979. They attempted to group consumers on the basis of scores obtained on five-point rating scales for 11 statements, as for example, 'Pot plants give more value for money than cut flowers, because they keep longer', and 'A bunch of cut flowers looks fresher and more beautiful than a pot plant'. Three groups of consumers were distinguished. The first consisted of those who tended to purchase modern pot plants, especially green pot plants. Those in this segment were mainly of the age groups less than 35 years and more than 65 years. The second group were those who preferred traditional cut flowers and flowering pot plants, for example, carnations, chrysanthemums, azaleas, and cyclamen and tended to be more than 50 years of age and were very often women. The third group referred to as indifferents tended to be men, and those less than 65 years of age (see also, Altmann 1984).

### *2.2.3 Conclusion*

No studies of consumer behaviour as to cut flowers and pot plants are available for France and the Netherlands. From the studies reported in this section it would seem that there are positive income elasticities in the purchase of cut flowers and pot plants. In the present study, as data on household incomes were not available, the variable, social class, was used as a measure of income. It was assumed that social class is positively related to expenditure on cut flowers and pot plants. Price elasticities of cut flowers and of pot plants derived from aggregated data were shown to be negative, but this does not necessarily mean that the price elasticity of each individual consumer was significantly negative. The present study differs from the earlier studies because a more comprehensive analysis of consumer behaviour as to flowers and plants has been carried out in which several stages in buying behaviour are distinguished.

# 3 MULTISTAGE CHOICE PROCESS IN THE PURCHASE OF CUT FLOWERS AND POT PLANTS

## 3.1 Review of the literature

One of the assumptions in this study is that there is a particular group of households which decides upon purchases of cut flowers and pot plants according to a multistage choice process. It has been assumed that the first stage in this process is the allocation of the household budget to a number of product classes. In the second stage, the budget allocation for each product class is divided among a number of subclasses. In the third stage, subject to a number of minor factors, the final choice is made within a subclass. In Section 3.1, evidence in the literature to support these ideas is discussed. The meaning of a product class for consumers is discussed because it is probable that consumers use product classes to structure their choice problems. In Section 3.2, the stages of a multistage choice process for the purchase of flowers and plants are discussed, and in Section 3.3 a model is proposed in which each of the stages is distinguished.

A multistage choice process is considered to start with either the allocation of the household income to various products or product classes, such as in the economic theory of consumer behaviour, or with problem recognition at the product level, such as in theories of consumer behaviour developed by Howard and Sheth (1969), Engel and Blackwell (1982), and Bettman (1979).

Multistage choice processes beginning at the level of spending the household income have been devised by Strotz (1957), Pratt (1965), and Gredal (1966). Strotz, working in the context of the economic theory of consumer behaviour, assumed that the choice process for households consists of two steps. The first is the optimal allocation of income to a number of broad product groups. In the second, the optimal allocation is made of the budget for the product class to various products within that class. Pratt distinguished several stages in buying behaviour: competition for allocation of household income to the major categories (products, services, and savings); collection of information by means of general shopping; allocation of income to major categories; intention to purchase a specific product; collection of information on brand and store; actual purchase; and reactions to purchase. Starting with a household budget, the choices become increasingly more specific in the course of time (Figure 3.1).

Gredal (1966) distinguished a general purchasing or budgeting decision, the skeleton decision in which the items of the budget are determined; a concrete purchasing decision, on the purchase of a specific product but not implying that a decision is made for the purchase of a specific brand or make within a product

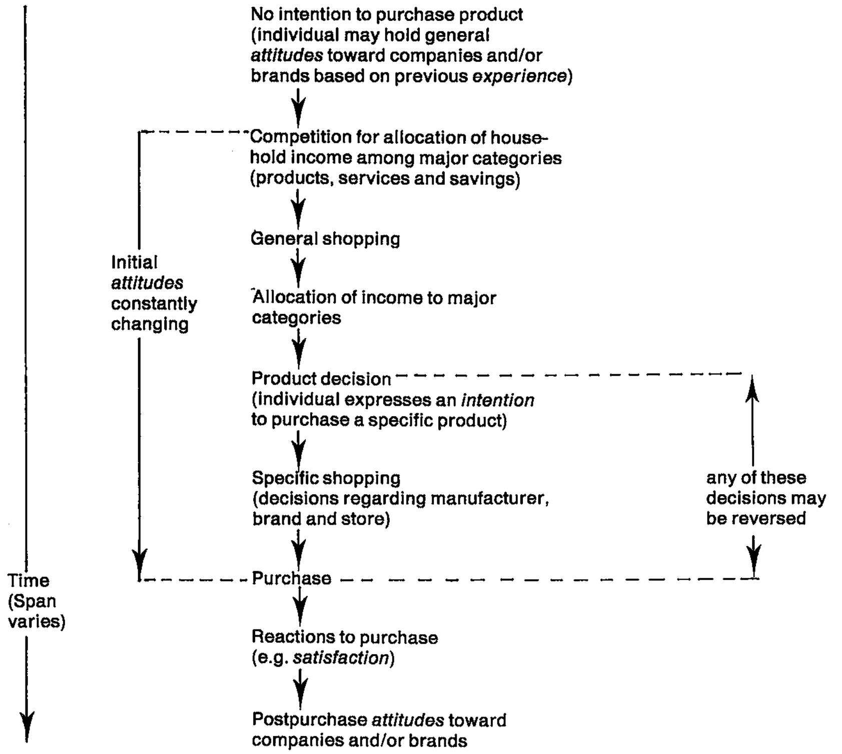



FIG. 3.1 Paradigm of the purchase process according to Pratt (1965).

class; a selection decision, which consists of a great number of subdecisions, for example, on price, quality, brand, type, and location of outlet; and finally, the technical purchasing action.

Thus, for multistage choice processes beginning with problem recognition, alternatives may vary from different brands of the same product to different products within a product class. In these theories, product choice is related to income by influences, such as, anticipated or unanticipated events or financial status. For example, Engel and Blackwell (1982, p 58) suffice it to say: 'Life, ..., is a continual process of choices among a huge array of goods and services from which some, or even many, but almost never all can be chosen.' From protocols on information processing in consumer buying behaviour (e.g., Bettman 1979) it can be derived that consumers are sometimes concerned about the financial consequences of the choice of a particular product in one product class as opposed to the choice of a product in another class. In many studies there is evidence for phased strategies in which an initial phase of eliminating unacceptable alternatives is followed by a secondary choice phase in which the remaining alternatives are compared in more detail. According to Bettman

(1979), phased strategies occur when the number of alternatives is large. Kalwani and Morrison (1977) assumed that consumers divided markets into a hierarchy of product set structures. For instance, the coffee market may be divided into instant versus ground coffee, and then, within each of these categories, into caffeinated versus decaffeinated brands. In routinized response behaviour, product alternatives may be substituted by consumers within the smallest set to which they belong, for example, all brands within the set of instant, decaffeinated coffee.

As product classes are assumed to play the main role in choice behaviour, the question can be raised as to what a product class means to a consumer. For agricultural products, product classes are formed naturally. Howard (1977) defined a class of nonagricultural products as the subjective meanings attached to similar brands or products. He assumed that the product class concept arises from a process of choice within the existing product classes which the buyer has already encountered. When a consumer observes a new product and tries to identify and evaluate it (extensive problem solving), he first groups it with those which are similar. Having found the appropriate group, the consumer then proceeds to distinguish the product from other brands in that group. Howard suggested that the process of grouping a new brand in a product class may be confined to two levels, the product class level and the brand level. In the stage of extensive problem solving, consumers form ideas about the product class to which a new product or brand may belong. In this way the new brand or product is given a great deal of meaning, which has consequences for the choice of brand or product. Howard further suggested that choice criteria may differ between levels of choice: brands or products as compared to product classes.

A further point related to choice between products is the way in which a decision is reached: by processing information about alternatives or about attributes. According to Bettman (1979), alternative processing tends to occur when there are many alternatives; when it is difficult to calculate differences between product attributes; when the format of available information allows processing by alternatives; or when there is much information about the alternatives. These conditions are relevant for purchasers of cut flowers and pot plants: many alternatives are available; it is difficult to determine differences between attributes, such as, colour, shape, and fragrance; information about the alternatives available (display of flowers and plants) is adequate to allow the choice to be made, and regular buyers may have considerable knowledge about flowers and plants. Thus in this study on consumer behaviour, alternative products, not attributes of the products, are considered.

It was decided to apply three stages in a multistage choice process similar to those proposed by Gredal to the purchase of cut flowers and pot plants. These stages are: the budget stage, allocation of income to the product class of interest;

priority stage, allocation of the budget for this product class to various subclasses; and the choice stage, in which a particular product within a subclass is chosen.

## 3.2 MULTISTAGE CHOICE PROCESS IN THE PURCHASE OF CUT FLOWERS AND POT PLANTS

A necessary but not sufficient condition for the assumption that there is a multistage choice process in the purchase of cut flowers and pot plants is that consumers implicitly (e.g., with a maximum price in mind) or explicitly plan their purchases in advance. Evidence for advance planning was found in a buying behaviour study on cut flowers and pot plants in a sample of 236 consumers carried out in Hannover, West Germany in 1979. Altmann and Von Alvensleben (1982) found that most consumers claimed that their last purchase was planned, the proportion of 'planners' was 72% for cut flowers and 61% for pot plants (Table 3.1)

TABLE 3.1 Proportion of consumers (n=236) in Hannover study (1979) who reported having planned their last purchase of cut flowers and pot plants

| | Cut flowers | | Pot plants | |
|---|---|---|---|---|
| | Proportion (%) | Number | Proportion (%) | Number |
| Planned purchase | 72 | 170 | 61 | 144 |
| Unplanned purchase | 22 | 52 | 23 | 54 |
| Don't know | 6 | 14 | 16 | 38 |

Source: Altmann and Von Alvensleben (1982)

Advance planning for expenditure on cut flowers and pot plants can only be assumed for households in which these products belong to their evoked set, that is, the set of alternatives actually considered at a particular stage in the decision process (Howard and Sheth 1969).

The assumption that there is a budget stage in the choice process only makes sense when households have an operational yardstick for their expenditure on individual purchases of flowers and plants which reflects the size of the budget allocation. One such yardstick is a maximum price which is kept in mind when purchasing flowers and plants. In a survey of 1992 households in the Netherlands in 1966, consumers were asked whether they bought cut flowers throughout the year (Produktschap voor Siergewassen 1966). If the answer was negative in respect of certain periods, they were asked whether price affected their buying behaviour. Of the 29% who did not purchase flowers during certain periods, 45% stated that they considered flowers to be too expensive during such periods. In the Hannover survey, the proportion of consumers claiming to have planned their last purchase in advance with a maximum price in mind was 48% for cut flowers and, 36% for pot plants (Table 3.2). These examples show that it would seem realistic to assume that budget considerations play a role in buying behaviour with regard to flowers and plants.

TABLE 3.2 Proportion of consumers in Hannover study (1979) who reported having planned their last purchase of cut flowers (n = 170) or pot plants (n = 144) with a predetermined maximum price

| Last purchase planned with predetermined maximum price | Cut flowers Proportion (%) | Pot plants Proportion (%) |
|---|---|---|
| Yes | 48 | 36 |
| No | 24 | 23 |
| Don't know | 28 | 41 |

Source: Altmann and Von Alvensleben (1982)

It is assumed that in the second stage, the priority stage, households allocate their budget for cut flowers and pot plants to subclasses because of the broadness of the product class, and because subclasses vary in use and durability. The lasting quality of cut flowers varies from one to two weeks, and from about one month for flowering pot plants to several years for green pot plants. While cut flowers often decorate a table, pot plants are often used to decorate a window sill. Thus, three subclasses may be distinguished: cut flowers; flowering pot plants; and green pot plants. This stage is called the priority stage because households are assumed to determine how much will be spent on each subclass distinguished, and consequently, which subclass will receive priority in expenditure.

In the choice stage, the particular type of cut flower or pot plant to be purchased within a particular subclass is chosen. The number of alternatives in each of the subclasses is still considerable. For analysis of this stage, it is important

TABLE 3.3 Proportion of consumers in Hannover study (1979) who reported having planned their last purchase of cut flowers (n = 170) or pot plants (n = 144) with the type to be purchased decided beforehand

| Last purchase planned with type decided beforehand | Cut flowers Proportion (%) | Pot plants Proportion (%) |
|---|---|---|
| Exactly | 25 | 33 |
| Not exactly | 47 | 28 |
| Don't know | 28 | 39 |

Source: Altmann and Von Alvensleben (1982) to know to what extent consumers have in mind the type to buy prior to actual purchase. In the Hannover survey, the proportion of consumers claiming to have planned their last purchase in advance with the type of flower in mind was 25%, and with the type of pot plant in mind, 33% (Table 3.3).

In the majority of purchases, the unplanned (Table 3.1) and 75% of the planned, consumers decided the type of cut flower to be purchased at the actual place of purchase, and similarly in the case of pot plants. Thus, it may be assumed that a number of minor factors usually affects the final choice of the specific type to be purchased within a subclass.

### 3.3 Proposed model for each stage in the choice process

In this section, a model is proposed for the group of habitual buyers to be defined in Chapter 4 who follow a multistage choice process. Three stages are distinguished in the model: budget; priority; and choice.

In the first two stages, a two-stage maximization procedure similar to that discussed by Strotz (1957) is assumed. Maximization is concerned with a household utility function, which relates quantities of products consumed to satisfaction or utility derived, subject to a budget constraint. Weak separability of the utility function is a prerequisite for the consistency of a two-stage maximization procedure. Separability refers here to the degree of independence of one subset of products from another (Leontief 1947). The first step concerns optimal allocation of a housekeeping allowance to various product classes, such as groceries, bread and bakery products, milk and milk products, vegetables and fruit, and cut flowers and pot plants. These product classes correspond to 'branches' of the utility function. The second step implies the optimal spending of the budget for cut flowers and pot plants in the three subclasses: cut flowers; flowering pot plants; and green pot plants. One particular branch of the utility function is then maximized subject to the budget constraint for that branch. The models proposed for the first and second stage are an unconditional and conditional system of demand functions, respectively. In demand systems, budget and prices are the economic variables which are intended to explain consumer behaviour. These variables have been shown to have affected demand for cut flowers and pot plants in Belgium and West Germany (Section 2.2). Thus, it is suggested that they may also affect such demand in the Netherlands, but there are additional explanatory variables which should be taken into account.

In the choice stage, households make a choice of particular flowers or plants within the subclass already chosen. As it is assumed that there are a variety of small factors, such as display, retailer's advice, price, and weather, which influence the choice of flower or plant, a stochastic model of consumer behaviour is proposed for this stage.

FIGURE 3.2 Proposed model of each stage in the multistage choice process

| Stage | Description | Proposed model |
|---|---|---|
| Budget stage | Allocation of household budget to various product classes including cut flowers and pot plants | Demand system |
| Priority stage | Allocation of budget for cut flowers and pot plants to subclasses: cut flowers; flowering pot plants; and green pot plants | Conditional demand system |
| Choice stage | Choice of a flower or pot plant in a subclass | Stochastic model of consumer behaviour |

The proposed model in each stage of a choice process of a household is given in Figure 3.2. It was not possible to use the model proposed for the budget stage in this study, because data on housekeeping allowance, and budget for product classes and prices paid for products other than cut flowers and pot plants could not be obtained for individual households. Thus, a substitute procedure was sought to explain the size of the budget for cut flowers and pot plants. Therefore, household expenditure in this regard has been related to the variables depicted in Figure 1.1. Ideally, some measure of a household income, such as housekeeping allowance or disposable income, should be included as one of the explanatory variables. As these data were not available, the variables social class and age, which are related to household income, were selected. The occupation, level of education, and age of the male head of household are the main factors that determine the social class of a household. Apart from their effect on the purchase of cut flowers and pot plants, the variables, social class and age, are also assumed to reflect the effect of household income, and therefore, these variables, together with other household characteristics, have been included in a regression model to explain household expenditure.

# 4 FINDING SEGMENTS IN THE CONSUMER MARKET OF CUT FLOWERS AND POT PLANTS

## 4.1 INTRODUCTION

According to Kotler (1980), the aim of market segmentation is to subdivide a market into distinct subsets of consumers, in which any subset may be selected as a market target to be reached with a distinct marketing mix. Market segments must be measurable, accessible, and substantial. Measurability is related to the degree to which information can be obtained on a particular buyer characteristic; accessibility, to the degree to which marketing efforts can be focussed on chosen segments; and substantiality, to the degree to which the segments are large enough, profitable enough, or both to be worthy of consideration for a separate marketing approach. Accordingly, if market segments can be traced in the market of cut flowers and pot plants, the flower industry in the Netherlands may be able to adapt its marketing policy better to the consumer needs. In this study, two approaches are taken to find segments. Firstly, market segments are defined in advance on the basis of differences in a particular buying characteristic being relevant to marketing policy. However, there is a risk that these market segments may not differ sufficiently in household characteristics, that is, they may not be accessible. Secondly, market segments are distinguished on the basis of the relationship between variation in response parameter estimates between households and variation in household characteristics (accessibility). However, segments found in this way, still need to be examined for substantiality.

In Section 4.2 market segments are defined in advance, whereas the procedure for tracing subsegments in a predefined market segment is discussed in Section 4.3.

## 4.2 MARKET SEGMENTS DEFINED IN ADVANCE

### *4.2.1 Market segments defined on the basis of buying intensity*

Taking buying intensity as the main criterion, the sample of 1000 households has been divided into three market segments as shown in Figure 4.1. Firstly, a distinction has been made between households that reported no more than ten purchases of cut flowers and pot plants in the period December 1972 to November 1974, and households that reported more than ten purchases in the same period. The first category referred to as occasional buyers consisted of 213 households of which 59 reported no purchases. The second category referred

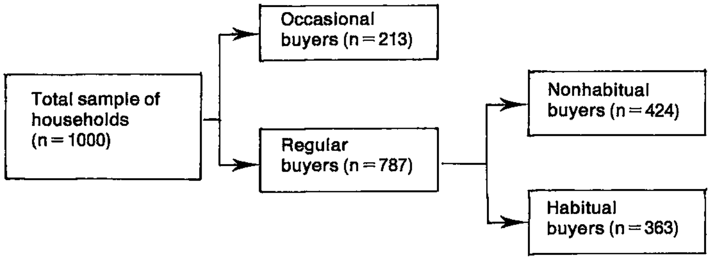



FIG. 4.1 Market segments defined with buying intensity as main criterion.

to as regular buyers consisted of 787 households, and was further subdivided into habitual and nonhabitual buyers. Habitual buyers were considered to be those who liked flowers and plants, and consequently, made frequent purchases. For this group it was assumed that expenditure on flowers and plants was either explicitly or implicitly taken into account in housekeeping expenditure, and also that they purchased according to a multistage choice process.

Habitual and nonhabitual buyers have been distinguished on the basis of two criteria; firstly, the household mean interpurchase period (ipp), that is the average period of time between purchases of cut flowers and pot plants, and secondly, the proportion of such purchases for the home rather than as gifts outside the home.

From Figures 4.2 and 4.3, it can be derived that the ipp tended to cluster around periods of one, two, and three weeks. This corresponds with the finding that 72% of purchases by all households in the sample were made on Fridays (27%) and Saturdays (45%). A mean ipp of less than three weeks was decided upon as one criterion for habitual buyers. Households purchasing flowers and plants less frequently were considered to be not overfond of such items. The second criterion used to distinguish habitual from nonhabitual buyers, namely the proportion of purchases for the home, was chosen to establish that habitual buyers had a personal interest in flowers and plants. For all regular buyers, the mean and standard deviation of this proportion were 0.72 and 0.21, respectively. Households which made more than 50% of their purchases of flowers and plants for the home were considered to have a personal interest in these products. When the two criteria were applied to all 787 regular buyers (Table 4.1), 363 were classified as habitual buyers, and 424 as nonhabitual buyers. For habitual buyers, the mean proportion of purchases for home use was 78%, and for nonhabitual buyers this was 61%. Habitual buyers spent on average 2.71 guilders per week on cut flowers and pot plants, of which 2.12 guilders were spent on purchases for home use and 0.58 guilders on gifts. Nonhabitual buyers spent on average 1.05 guilders per week of which 0.63 guilders were for home use and 0.41 guilders for gifts.

The distinction between habitual and nonhabitual buyers can be further illus-

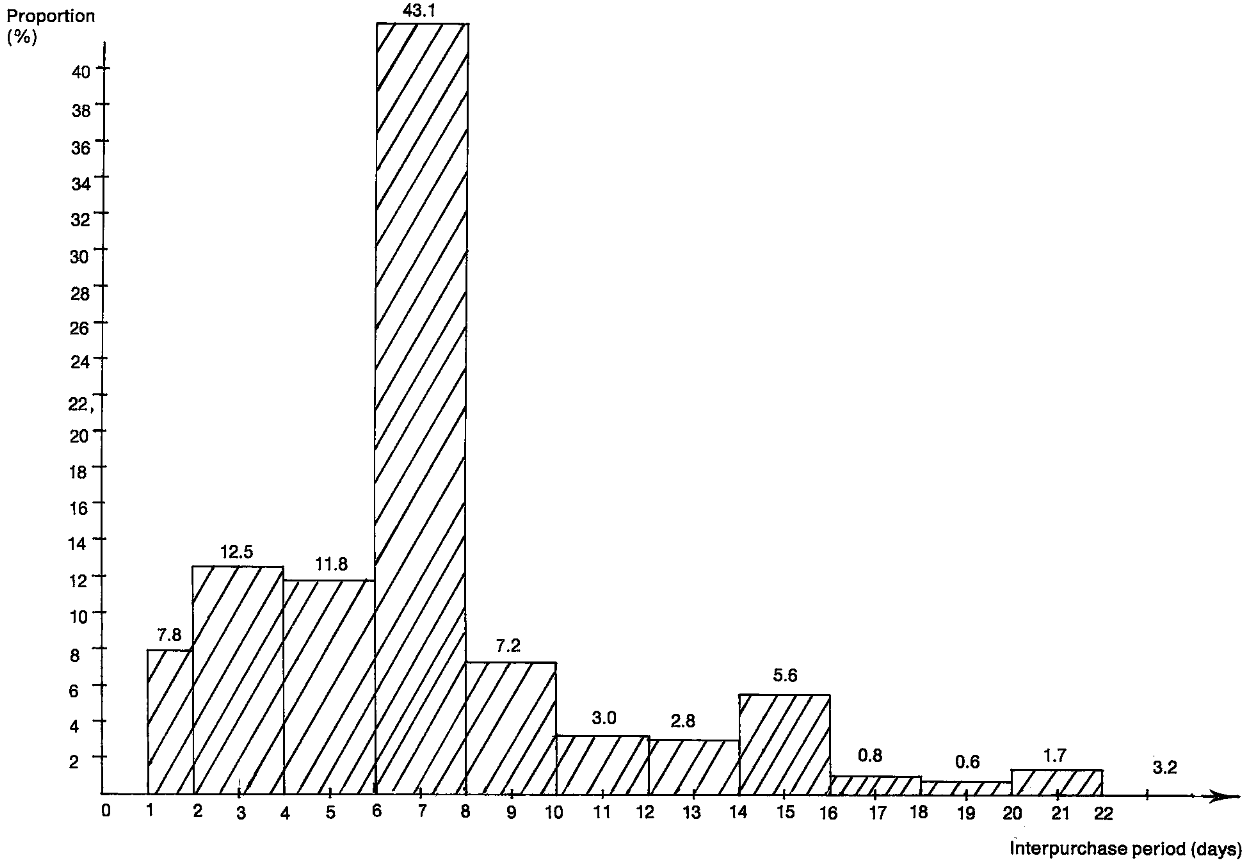



FIG. 4.2 Distribution of interpurchase periods (ipp) for cut flowers and pot plants, based on data obtained from 122 out of 1000 households with a mean ipp less than 10 days in the period December 1972 – November 1974

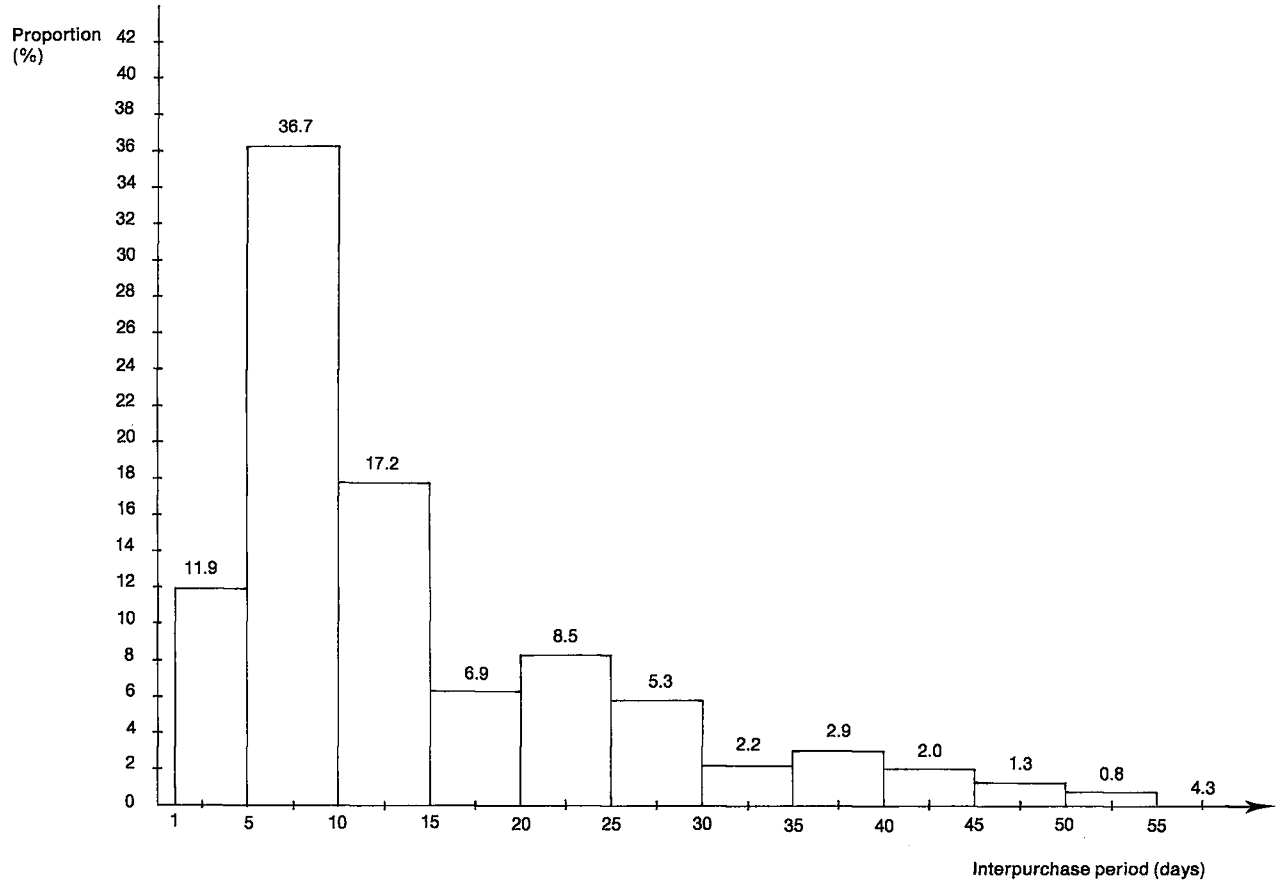



FIG. 4.3 Distribution of interpurchase periods (ipp) for cut flowers or pot plants, based on data obtained from 433 out of 1000 households with a mean ipp between 10 and 30 days ($10 \leq$ ipp $< 30$).

TABLE 4.1 Mean expenditure (guilders) by regular buyers (n = 787) for home use and gifts on the basis of average interpurchase period and proportion of purchases for home use

| Expenditure category | Mean interpurchase period per household | | Proportion of purchases for home use (%) |
|---|---|---|---|
| | Less than three weeks | Three weeks or more | |
| | (n=39) | (n=61) | |
| Home use | 1.06 | 0.28 | |
| Gifts | 1.87 | 0.59 | ≦50 |
| Total | 2.93 | 0.88 | |
| | (n=363) | (n=324) | |
| Home use | 2.12 | 0.65 | |
| Gifts | 0.58 | 0.20 | >50 |
| Total | 2.71 | 0.85 | |

trated with the classification of repetitive choice behaviour of Sheth and Raju (1973). Four categories of purchases are distinguished: reflected purchases; impulse purchases; habitual purchases; and curiosity-based purchases. A reflected purchase involves an evaluation of several alternatives, and this may be the case when a flower or plant is bought for the first time or when purchased as an important gift. An impulse purchase is made solely as the result of the motivational impact of the situational stimuli. This type of purchase may be made when an attractive display of flowers and plants is encountered, for example, on a street stall. Habitual purchases are based on rewarding experiences with the particular product. Curiosity-based purchases can be labelled as novel, curiosity, or exploratory behaviour on the part of a consumer whose enjoyment of the product he usually purchases is sated. The assumed relationship between these four types of choice behaviour and the two categories of regular buyers is depicted in Figure 4.4. In this figure, it is assumed that nonhabitual buyers mainly make reflected purchases, for example, on occasions, such as, Mother's Day and anniversaries, when some deliberation before purchase can be expected.

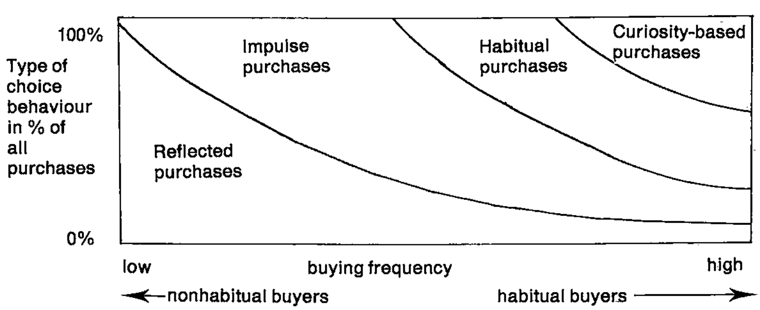



FIG. 4.4 Assumed relationship between type of choice behaviour and buying frequency for cut flowers and pot plants.

Occasionally, an impulse purchase is made. Habitual buyers are expected to buy regularly and to be among the first to buy flowers or plants that are presented as new.

On the basis of the foregoing discussion, the total sample of 1000 households has been divided into 213 occasional and 787 regular buyers, and the latter group has been further subdivided into 363 habitual and 424 nonhabitual buyers.

In Chapter 5, differences in buying behaviour are examined in relation to differences in household characteristics for all 1000 households. In addition, the segment of the 787 regular buyers and the subsegments distinguished are analysed in more detail, because the buying frequency of these segments was found to be higher than for occasional buyers.

### *4.2.2 Market segments defined on the basis of socio-economic and demographic characteristics*

Another procedure which may be used to determine market segments is the definition of a set of 'standard' households and analysis of their buying behaviour. A standard household is characterized by a set of socio-economic and demographic variables, and each pair of households differs by at least one variable. Each standard household is considered to be representative of households having approximately the same characteristics. Variables selected to define each standard household are geographical area, age, household size, and social class. Buying behaviour on cut flowers and pot plants has been shown to differ between geographical areas in several countries, for example in Belgium (Nicolaus 1975, 1976), and France (CNIH 1980). In addition, geographical area and degree of urbanization are often related. Age was chosen as a variable, because it is assumed that buying behaviour as to flowers and plants changes in the course of the life cycle. Social class was chosen as a substitute for income. A relationship between buying behaviour on cut flowers or pot plants and social class has been found in several countries, for example, Belgium (Nicolaus 1975), and West Germany (Ostendorf 1975). Four geographical areas, three age groups, and four social classes have been distinguished, giving in total 48 standard households (Table 4.2).

Characteristics of buying behaviour of standard households were established by inserting the socio-economic and demographic characteristics as presented in Table 4.2 in the models of consumer behaviour to be set out in Chapters 5 to 7. If these characteristics of buying behaviour differ significantly among the standard households, then segments in the flower and plant market can be defined which are both measurable and accessible, but the degree of substantiality of these segments has yet to be determined.

TABLE 4.2 Characteristics of the 48 standard households distinguished

| Age group and household size | Social class | Geographical area | | | |
|---|---|---|---|---|---|
| | | north | south | east | west |
| | AB | 1 | 13 | 25 | 37 |
| ≧65 | C | 2 | 14 | 26 | 38 |
| (2) | $D_1$ | 3 | 15 | 27 | 39 |
| | $D_2$ | 4 | 16 | 28 | 40 |
| | AB | 5 | 17 | 29 | 41 |
| 30-64 | C | 6 | 18 | 30 | 42 |
| (4) | $D_1$ | 7 | 19 | 31 | 43 |
| | $D_2$ | 8 | 20 | 32 | 44 |
| | AB | 9 | 21 | 33 | 45 |
| <30 | C | 10 | 22 | 34 | 46 |
| (2) | $D_1$ | 11 | 23 | 35 | 47 |
| | $D_2$ | 12 | 24 | 36 | 48 |

## 4.3 MARKET SEGMENTS DEDUCED FROM THE ANALYSIS OF CONSUMER BEHAVIOUR

An attempt has been made to define subsegments within the market segment of habitual buyers, which are measurable, accessible, and substantial. It was assumed that habitual buyers select their purchases according to a multistage choice process consisting of budget, priority, and choice stages. For each stage, variation in a household's buying behaviour in the course of time has been related to market stimuli. In this way, a number of characteristics of buying behaviour, such as, level of expenditure, price elasticity, and advertising sensitivity could be determined (measurability). According to Assael (1976), the sensitivity of consumer response to variation in marketing stimuli can be of equal importance as a variable in determining market segments as the level of expenditure. Thus, for each household, a set of estimated response parameters and a set of household characteristics were required.

Several procedures may be used to define market segments which differ in response parameter estimates and household characteristics. These procedures are: cluster analysis, including automatic interaction detection; canonical correlation; and regression analysis (Figure 4.5).

For cluster analysis, it is necessary to define a distance or similarity measure between each pair of households. This measure represents the relationship between two households in response parameter estimates and household characteristics. The cluster method to be used must be selected and the number of clusters required specified in advance. Thus, the composition of the clusters will depend on these two factors. In addition, it is quite possible that spurious classifications are picked up as a result of distortion in a particular data set. Application of cluster analysis did not result in the definition of stable market segments for cut flowers and pot plants from the data set used in this study.

With automatic interaction detection (AID) which is a form of monothetic cluster analysis, each response parameter estimate can be related to a set of household characteristics as follows. AID is essentially a series of one-way analyses of variance on a particular variable. The values for each household characteristic are divided into two exclusive and exhaustive categories which account for the largest variation in the response parameter estimate between categories. The characteristic accounting for the largest variance is selected, and the sample is split into two groups on the basis of this characteristic. This procedure is repeated until one of the stopping criteria is met. AID was applied with expenditure

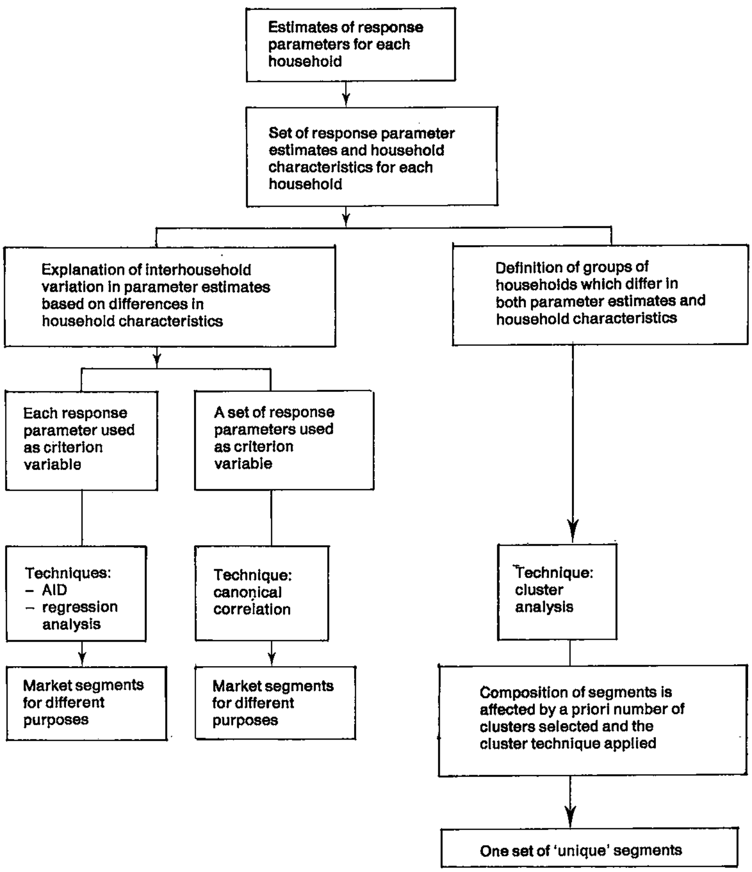



FIG. 4.5 Alternative procedures for defining segments in the consumer market of cut flowers and pot plants.

on cut flowers and pot plants as variable to be explained to both an analysis sample and a control sample. As the relationships found in the analysis sample could not be reproduced in the control sample, this method was rejected.

In canonical correlation a set of response parameter estimates can be related to a set of household characteristics. If one or more canonical coefficients are significant, this may lead to a conclusion, such as a particular combination of response parameter estimates is highly correlated with a linear combination of household characteristics. If certain coefficients are high, then they may be used to define market segments. However, since the interpretation of the results can be difficult, this procedure was also rejected.

The relationship between each response parameter estimate and a set of household characteristics may be determined using regression analysis, and on the basis of the significant relationships found, market segments may be defined. This method was chosen because of its simplicity.

# 5 BUDGET STAGE: AMOUNT TO BE SPENT ON CUT FLOWERS AND POT PLANTS

## 5.1 INTRODUCTION

Expenditure on cut flowers and pot plants varied considerably between households during the period December 1972 to November 1974. Of the sample of 1000 households, 49 households reported no expenditure , whereas the highest expenditure claimed by a single household was 1335 guilders during the period, that is, a weekly average of 12.84 guilders.

Implicitly or explicitly, every household knew approximately how much was spent per month on these items. For habitual buyers the proportion of the household budget to be spent on cut flowers and pot plants can be worked out by means of a budget allocation model. Since the data required, that is household income and expenditure on other product classes, were not available for the sample population, a model was developed in which expenditure on cut flowers and pot plants is related to marketing and market variables in order to obtain response parameter estimates which can then be related to household characteristics. This model was applied to the segment regular buyers. Flowers and plants were purchased so infrequently by the segment of occasional buyers that the effect of marketing and market variables on buying behaviour could not be measured. Consequently, their expenditure on flowers and plants was related directly to household characteristics.

Analysis of the consumer behaviour of the market segments, occasional buyers and nonhabitual buyers, was limited to explanation of the size of the budget spent on flowers and plants. The buying frequency of households in these market segments was too small to warrant further analysis. For the segment habitual buyers, the budget stage is the first in the multistage choice process model. The priority stage and choice stage for this market segment are dealt with in Chapters 6 and 7, respectively.

In the present chapter, the model for the budget stage is specified in Section 5.2. The relationship between household characteristics and expenditure on flowers and pot plants for the entire sample is discussed in Section 5.3. The consumer behaviour of households in the market segment, regular buyers, is discussed in Section 5.4. Expenditure is considered firstly in relationship to market and marketing variables, in order to obtain response parameter estimates for each household in this segment. The response parameter estimates obtained are then considered in relationship to household characteristics in an attempt to explain variation in response to marketing variables between households. Differences in results between habitual and nonhabitual buyers are discussed.

*5.2.1 Choice of a model*

Data from the NIAM consumer panel have shown that buying behaviour as to cut flowers and pot plants varied within households and between households in the course of time. Several models developed for the analysis of panel data (e.g., Maddala 1977) have been reviewed by Bass and Wittink (1975). Most of the models were developed to incorporate variables that vary themselves in all cross-sectional units and the time periods distinguished. The selection of the particular type of model for use in the present study depended on the extent to which buying behaviour in the sample could be assumed to be homogeneous. If buying behaviour is assumed to be identical for all households, then the same model with fixed coefficients can be specified for all households. However, if homogeneity between households is assumed, then there is still some variation in buying behaviour between households. The random coefficient regression model (Swamy 1971) can then be specified, in which, for each household, the model parameters are a random sample from a multivariate probability distribution. In the random coefficient regression model, the mean and the variance of each parameter must be estimated. If there is no homogeneity in household buying behaviour, then the model must be specified in such a way that the coefficients can vary between households. Wansbeek (1980) has proposed a model to take account of all sources of variation in panel data. This model, as applied to the purchase of flowers and pot plants, is described by the equation

$$e_{ht} = \sum_{j=1}^{n} \beta_j x_{htj} + \sum_{j=1}^{p} \alpha_{1tj} z_{1hj} + \sum_{j=1}^{q} \alpha_{2hj} z_{2tj} + u_{ht} \tag{5.1}$$

for $h = 1,2,\ldots..,H$ households

$t = 1,2,\ldots..,T$ periods

where $e_{ht}$ = household h expenditure on cut flowers and pot plants in period t; $x_{htj}$, $z_{1hj}$, and $z_{2tj}$ are explanatory variables; vector $\beta$ is invariant between households over time; $\alpha_{1tj}$ varies over time but for all households in the same way (systematic change); $\alpha_{2hj}$ differs between households but is constant over time (variation between households); and $u_{ht}$ is a random disturbance term which varies over time and between households.

This model has two disadvantages. Firstly as observed by Wansbeek, there is a linear dependence between the regressors, because there are $n + Tp + Hq$ columns in the matrix of explanatory variables. The rank of this matrix is at most $n + Tp + Hq - pq$, because of the special structure of the explanatory variables. This can be illustrated by the following example with no observations for $x_{htj}$, $p = q = 1$, and $H = T = 2$, then the matrix Z of explanatory variables has the form

$$Z = \begin{bmatrix} z_{11} & o & z_{21} & o \\ z_{12} & o & o & z_{21} \\ o & z_{11} & z_{22} & o \\ o & z_{12} & o & z_{22} \end{bmatrix} \tag{5.2}$$

in which in the first row, h = t = 1; in the second row, h = 2, t = 1; in the third row, h = 1, t = 2; and in the fourth row, h = t = 2. The four columns of Z are linearly dependent. Thus, if $s' = (z_{21}\ z_{22}\ {-z_{11}}\ {-z_{12}})$, then Zs = 0. Not all linear combinations of the parameters can be identified, which means that in general, it is difficult to interpret individual regression coefficients.

Secondly, when this model is used to explain expenditure on cut flowers and pot plants, the first term in Equation 5.1 will be absent because there are no explanatory variables available which vary over both h and t. This implies that the number of regressors would become Tp + Hq. This number would still be too high for existing computer capacity, because T is 104 (weeks), H is at least 363 (habitual buyers), the number of household characteristics to be specified more than 10 (p), and the number of market or marketing variables to be specified more than 5 (q). Consequently, the Wansbeek model was not used in the analysis of data on buying behaviour as to cut flowers and pot plants.
Households reactions on market or marketing variables were estimated using Equation 5.3

$$e_{ht} = \sum_{j=1}^{q} \alpha_{hj} z_{tj} + v_{ht} \tag{5.3}$$

for h = 1,2,.....,H households
t = 1,2,.....,T periods
where $Ev_{ht} = 0$
$Ev_{ht}^2 = \sigma_h^2$
$E\, v_{ht} \cdot v_{ht'} = 0$ for $t \neq t'$

A test of homogeneity in reaction parameters between households was then carried out. If no homogeneity could be established, then the differences between households in reaction parameters would be related to differences in household characteristics with Equation 5.4

$$\hat{\alpha}_{hj} = \sum_{l=o}^{p} \beta_{jl} z_{hl} + w_{hj} \tag{5.4}$$

for h = 1,2,.....,H households
where $Ew_{hj} = 0$
$Ew_{hj}^2 = \sigma^2$
$E\, w_{hj} \cdot w_{h'j} = 0$ for $h = h'$

Ideally, all Hq parameters in the H expressions of Equation 5.3 should be estimated in one model. However, because of unknown explanatory variables not included in these relationships, E $v_{ht} \cdot v_{h't}$ may not be equal to zero for h $\neq$ h'. Therefore, the most appropriate technique to estimate parameters is that of 'seemingly unrelated regression' (Maddala 1977). However, as the explanatory variables in the H expressions of Equation 5.3 are equal for all households h, this technique is reduced to ordinary least-squares analysis of the data for each individual household.

*5.2.2 Test of homogeneity between households in their responses to marketing and market variables*

The test of homogeneity between households in their estimated response parameters has been specified by Swamy (1971, pp 124-126). Let the null hypothesis be

$$e_h = Z_h \alpha + v_h \tag{5.5}$$

where $e_h$ is a $(T * 1)$ vector of elements $e_{ht}$
$Z_h$ is a $(T * q)$ matrix of elements $z_{tj}$
$v_h$ is a $(T * 1)$ vector of elements $v_{ht}$
with $Ev_h = 0$
$E\, v_h v_h' = \sigma_h^2 I$

Let the alternative hypothesis be

$$e_h = Z_h \alpha_h + v_h^* \tag{5.6}$$

with $Ev_h^* = 0$
$E\, v_h^* v_h^{*\prime} = \sigma_{hh}^2 I$

The matrix representation of Equation 5.3 is presented in Equation 5.6. When the estimator for $\alpha_h$ is defined as

$$a_h = (Z_h' Z_h)^{-1} Z_h' e_h \tag{5.7}$$

and the estimator for $\sigma_{hh}^2$ and $\sigma_h^2$ as

$$s_h^2 = (1/(T-q))\, \hat{v}_h^{*\prime}\, \hat{v}_h^* \tag{5.8}$$

and the estimator for $\alpha$ as

$$\hat{\alpha} = [\sum_h (Z_h' Z_h / s_h^2)]^{-1} [\sum_h (Z_h' e_h / s_h^2)] \tag{5.9}$$

then

$$X_\alpha = \sum_h [(a_h - \hat{\alpha})' Z_h' Z_h (a_h - \hat{\alpha}) / s_h^2] \tag{5.10}$$

Under the null hypothesis, the asymptotic distribution for large T of

$$\frac{X_\alpha}{(H-1)q} \tag{5.11}$$

is the F-distribution with $(H-1)q$ and $H(T-q)$ degrees of freedom.

The constant term in Equation 5.6 can be expected to vary greatly between households because $e_{ht}$, that is the level of expenditure on the product class by household h in period t, varied considerably and the variables, $z_{tj}$ ($j = 2,.....,q$) are market and marketing variables, which are the same for all households. Consequently, the null hypothesis will always be rejected if the constant term is included in the model. To eliminate this effect in Equations 5.5 and 5.6, all variables were expressed as deviations from their respective means.

### *5.2.3 Specifications of the model*

The model described by Equation 5.3 can be specified as follows

$$\begin{aligned} e_{ht} = {} & \alpha_{h1} + \alpha_{h2}t + \alpha_{h3}p_t + \alpha_{h4}\ln r_t + \alpha_{h5}\ln \bar{r}_t + \alpha_{h6}m_t + \alpha_{h7}as_t \\ & + \alpha_{h8}c_t + \alpha_{h9}w_t + \alpha_{h10}sp_t + \alpha_{h11}v_t + \alpha_{h12}au_t + u_{ht} \end{aligned} \tag{5.12}$$

for $t = 1,2,.....,T$ weeks

where $\alpha_{hj}$ are parameters to be estimated ($j = 1,2,.....,12$)

$e_{ht}$ = household h expenditure on cut flowers and pot plants in week t

$t$ = a trend variable ($t = 1,2,.....,T$; $T = 104$)

$p_t$ = average price in guilders paid for a bunch of cut flowers or one pot plant in week t

$r_t$ = index of expenditure on national advertising for cut flowers and pot plants in week t (Appendix III.1)

$\bar{r}_t$ = index in week t of average expenditure on national advertising for cut flowers and pot plants in preceding three months (Appendix III.1)

$m_t$ = 1 in the week before Mother's Day (week 19 of the year)
= 0 in other weeks

$as_t$ = 1 in the weeks around All Soul's Day (week 44 and 45)
= 0 in other weeks

$c_t$ = 1 in the week before Christmas (week 51)
= 0 in other weeks

$w_t$ = 1 in December, January and February (week 49 to 9)
= 0 in other months

$sp_t$ = 1 in March, April, and May (week 10 to 22)
= 0 in other months

$v_t$ = 1 during summer holidays (week 27 to 31)
= 0 in other weeks

$au_t$ = 1 in September, October, and November (week 36 to 48)
= 0 in other months

It was assumed that $u_{ht}$ is a normally distributed disturbance term (for household h in week t), with $Eu_{ht} = 0$, $Eu_{ht}^2 = \sigma_h^2$ and $E\, u_{ht} \cdot u_{ht'} = 0$ for $t \neq t'$. A test on first-order autocorrelation in the disturbances was carried out using a procedure described by Durbin and Watson (1951). See Appendix III.2.

Further, it was assumed that the variables specified in Equation 5.12 affect household buying behaviour on cut flowers and pot plants during the course of time. For example, in the flower industry, the price received by the producer is determined by supply and demand at flower auctions, and as a result, prices vary almost daily. Consumer prices are derived from those paid at the flower auctions.

The sign of the coefficients to be estimated in Equation 5.12 was expected to be positive for the variables concerning present and past advertising, and for the dummy variables for Mother's Day, All Souls' Day, Christmas, winter, spring, and autumn, and to be negative for the dummy variable for summer holidays. The sign of the coefficient of the price variable is negative, if the demand for the product class is elastic, or zero if the demand for the product class is inelastic. The sign of the coefficient of the trend variable depends on the long-term development in a household's expenditure on cut flowers and pot plants.

**Price elasticities.** To estimate price elasticities of the number of purchases of cut flowers and pot plants, the following equation is specified

$$\begin{aligned} q_{ht} = {} & \alpha_{h1} + \alpha_{h2} t + \alpha_{h3} p_t + \alpha_{h4} \ln r_t + \alpha_{h5} \ln \bar{r}_t + \alpha_{h6} m_t + \alpha_{h7} as_t + \\ & \alpha_{h8} c_t + \alpha_{h9} w_t + \alpha_{h10} sp_t + \alpha_{h11} v_t + \alpha_{h12} au_t + u_{ht} \end{aligned} \qquad (5.13)$$

with t = 1,2,.....,T weeks, where $q_{ht}$ is the number of purchases of cut flowers and pot plants by household h in week t, and the other variables are the same as those in Equation 5.12. The assumptions on the disturbances $u_{ht}$ are the same as those for $u_{ht}$ in Equation 5.12. The test on first-order autocorrelation is described in Appendix III.2. The sign of the coefficients in Equation 5.13 was expected to be the same as that in Equation 5.12, except for the sign of the variable price which was expected to be negative.

Variables included in the Equation 5.12, $p_t$, $r_t$, and $\bar{r}_t$, were not corrected for price inflation, because expenditure was the variable to be explained. However, in Equation 5.13, these variables had to be corrected, because price inflation was between 9% and 10% in both 1973 and 1974 ('Centraal Bureau voor de Statistiek'/Netherlands Central Bureau of Statistics, Pocket Year book).

**Trend.** A trend variable has been included in the relationships to measure whether there is an autonomous increase or decrease in the variable to be explained. Further, the natural logarithm of the trend was tried as an explanatory variable in order to express the increasing saturation of the market.

**Advertising.** Data on expenditure on national advertising of flowers and plants were obtained for: periodicals and newspapers; radio and television; and other media, such as placards (Table I.4, Appendix I). Expenditure on national advertising during the period of the study was on average 58 000 guilders per month in September 1972 to April 1973, 143 000 guilders per month in the period May to November 1973, 69 000 guilders per month in the period December 1973 to April 1974, and 108 000 per month in the period May to November 1974. The advertising policy seems to have been to increase advertising in periods of ample supply and relatively low demand. However, this policy did not take into account seasonal changes in the demand for flowers and plants during the summer months, especially, in the period May to July when many families spend a part of the weekend outside the home. As 44.5% of all flowers and plants were purchased on Saturdays during this two-year period, recreational activities, such as camping and sailing, seem to have disturbed the household buying pattern frequently. Other factors which may have affected the buying pattern were the summer holidays and the availability of flowers in household gardens. The distribution of flower and plant purchases and expenditure on advertising during this period are given in Table 5.1.

TABLE 5.1 Frequency distributions of the number of purchases and the expenditure on flowers and plants for 1000 households and the frequency distribution of expenditure on advertising for flowers and plants (1972-1974)

| Four-weekly periods | Proportion of purchases (%) | | Proportion of expenditure (%) | | Proportion of the advertising budget (%) | | Month |
|---|---|---|---|---|---|---|---|
| | 1972/1973 | 1973/1974 | 1972/1973 | 1973/1974 | 1972/1973[a] | 1973/1974[a] | |
| 13 | 7.0 | 6.2 | 8.1 | 7.3 | 4.4 | 6.5 | Dec. |
| 1 | 7.2 | 7.0 | 7.4 | 7.0 | 4.9 | 7.3 | Jan. |
| 2 | 8.6 | 8.4 | 8.8 | 8.0 | 3.8 | 5.1 | Feb. |
| 3 | 9.7 | 9.4 | 9.1 | 8.4 | 4.7 | 6.7 | Mar. |
| 4 | 10.5 | 11.1 | 9.9 | 9.4 | 3.3 | 6.0 | Apr. |
| 5 | 10.1 | 10.3 | 11.0 | 11.4 | 17.8 | 10.3 | May |
| 6 | 8.1 | 7.6 | 7.7 | 7.6 | | | |
| 7 | 5.7 | 6.1 | 4.9 | 6.0 | 9.5 | 11.4 | Jun. |
| 8 | 6.1 | 5.7 | 5.9 | 5.4 | 9.2 | 10.1 | Jul. |
| 9 | 6.7 | 7.1 | 5.9 | 6.5 | 7.6 | 9.0 | Aug. |
| 10 | 7.1 | 7.2 | 6.7 | 7.1 | 13.4 | 10.3 | Sep. |
| 11 | 7.1 | 7.3 | 7.8 | 8.2 | 9.1 | 8.9 | Oct. |
| 12 | 6.2 | 6.5 | 6.8 | 7.7 | 12.5 | 8.5 | Nov. |

[a] Monthly data

A question could be raised as to whether expenditure on national advertising for flowers and plants was anticyclic, that is, too high in periods of low demand and too low in periods of high demand. Theoretically, if advertising does not irritate, it can be assumed that it positively affects purchases. In their consumer behaviour model, Engel and Blackwell (1982) described advertising as one source of incoming information, which is processed through successive stages: exposure; attention; comprehension; and retention. A consumer may or may not be exposed to an advertisement. If exposed, then the next step is attention, that is the active processing of the stimulus to which he has been exposed. This stage is highly selective and many stimuli are completely filtered out. Comprehension embraces organizing and interpreting the stimuli, and retention is the storage of information in long-term memory. If advertising messages affect the intention to purchase in this way, then advertising efforts can be expected to have a positive effect on purchases of flowers and plants.

The practice of spending several weekends in May to July outside the house can be considered to have a negative effect on household flower purchases. Therefore, the positive effect of advertising during these months may be counterbalanced by that negative effect.

It was assumed that the advertising of flowers and plants on television and radio affects buying behaviour for a shorter period than advertising in periodicals and on placards. Therefore, it was decided to measure separately the short-term and medium-term effects of national advertising on buying behaviour. The definitions of both advertising variables are similar to those used by Nerlove and Waugh (1961) in their study on advertising for oranges. They specified a multiplicative model which included one variable for advertising in period t and another variable for advertising before that period. The latter variable was represented by the arithmetic mean of the amounts spent in the ten preceding periods. In the present study, advertising was assumed to be effective for three months, which is in accordance with the results of other studies. For example, studies on milk demand indicate a sales-advertising lag of two to six months duration (Kinnucan and Forker 1982). In Equation 5.12 advertising variables have been specified in an additive way.
If for $i \neq j$,

$$e_{ht} = \dots\dots + \alpha_i r_t + \alpha_j \bar{r}_t + \dots\dots \qquad (5.14)$$

then a permanent increase in advertising expenditure of x guilders per period t gives in the short-term an increase in $e_{ht}$ of $\alpha_i x$, and in the long-term an increase of $(\alpha_i + \alpha_j)x$. It was assumed that the more spent on advertising, the more difficult it becomes to increase expenditure on a product class further, because consumers have either already spent a considerable amount on that product class, or become conditioned to the advertising message. This assumption is expressed in Equation 5.12 by taking the natural logarithm of both the variables $r_t$ and $\bar{r}_t$.

**Seasonal variation.** The dummy variable $as_t$ has been introduced in Equation 5.12 mainly because of the custom in Roman Catholic households in the south of the Netherlands of placing flowers or a flowering pot plant on the graves of relatives in the period around All Souls' Day. The variables $c_t$ and $m_t$ have been introduced because of the custom of buying flowers or plants during the week prior to Christmas and to Mother's Day. The variables $w_t$, $sp_t$, $v_t$, and $au_t$ have been included to measure the effect on flower and plant purchases of seasonal variation in the assortment offered and the effect of the season itself on expenditure on cut flowers and pot plants. For many households, the summer is a slack period for purchasing flowers and plants; expenditure being lowest in July, the month in which most people take their holidays. Dummy variables were defined for seasons of the year with approximately the months June and August as period of reference.

*5.2.4 Variation in response parameter estimates in households related to household characteristics*

It was assumed that the sizes of response parameters $\alpha_{hi}$ (i = 1,2,.....,12) in Equation 5.12 or 5.13 is related to the following household characteristics: social class; geographical area, size of the residential municipality, access to a garden, household size, age of wife, attitude to housekeeping, price consciousness; proportion of household expenditure on flowers and plants for home use; and proportion spent at the florist, or the market or street stall.

Not all household characteristics specified in Appendix I were included in the model because of the intercorrelations between variables and because of doubts about the relevance of some characteristics to buying behaviour on cut flowers and pot plants. Social class instead of occupation was included as an explanatory variable, because the variable social class was derived from the occupation of the main wage earner, the managerial level of his work, his level of education, and age. The age of youngest member of the household was not included because this was closely related to the household size and age (Table 5.2). The relationships between expenditure on flowers and pot plants and the following variables were tested: regularity in housekeeping; attitude to housekeeping; loyalty to particular retail outlets, and the amount of time spent by wife in employment outside the house. Only attitude to housekeeping was found to be significantly related to expenditure on flowers and plants (Spearman rank correlation coefficient is .193; $P < 0.001$; $n = 1000$); and this variable was in-

TABLE 5.2 Spearman rank correlation between two pairs of household characteristics [a] for all 1000 households

| | Family size | Age group of youngest household member |
|---|---|---|
| Age group youngest household member | -.803[a] | |
| Wife's age group | | .784[b] |

[a] For definition, sea Appendix I, Table I.3; [b] $P < 0.001$

cluded as an explanatory variable. The frequency distribution for household characteristics in the whole sample and for the market segments specified are given in Table III.2 in Appendix III.

The specification of Equation 5.4 for each parameter $\hat{\alpha}_{hj}$ (j = 1,2,.....,q) becomes

$$\begin{aligned}\hat{a}_{hj} = {} & \beta_{j0} + \beta_{j1} Y_{1h} + \beta_{j2} Y_{2h} + \beta_{j3} Y_{3h} + \beta_{j4} D_{1h} + \\ & \beta_{j5} D_{2h} + \beta_{j6} D_{3h} + \beta_{j7} U_{1h} + \beta_{j8} U_{2h} + \\ & \beta_{j9} G_h + \beta_{j10} HS_h + \beta_{j11} AC_{1h} + \beta_{j12} AC_{2h} + \\ & \beta_{j13} HK_h + \beta_{j14} PC_h + \beta_{j15} OH_h + \\ & \beta_{j16} FL_h + \beta_{j17} MS_h + w_{hj} \qquad \text{with } h = 1,2,....,H\end{aligned} \tag{5.15}$$

were $\beta_{jl}$ are parameters to be estimated (l = 0,1,2,.....17)

$\hat{\alpha}_{hj}$ = the j-th response parameter estimate of household h in Equation 5.12

$w_{hj}$ = the disturbance term for household h related to response parameter estimate $\hat{\alpha}_{hj}$

It was assumed that $w_{hj}$ is normally distributed with $Ew_{hj} = 0$, $Ew_{hj}^2 = \gamma_{hj}^2$ and $E\, w_{hj} \cdot w_{h'j} = 0$ for $h \neq h'$. Whether or not heteroscedasticity should be taken into account in parameter estimation in Equation 5.15 is discussed in Appendix III.2.

The explanatory variables in Equation 5.15 are defined as follows

$Y_h$ is a variable representing social class, specified as

$Y_{1h}$ = 1 for the highest social class AB
= 0 for other social classes

$Y_{2h}$ = 1 for the next highest social class $C_1$ and $C_2$
= 0 for other social classes

$Y_{3h}$ = 1 for the second lowest social class $D_1$
= 0 for other social classes

The lowest social class $D_2$ is the social class of reference. As discussed in Section 3.3, this variable was also assumed to represent partly the effect of household income.

$D_h$ is a variable representing the geographical area of the household with

$D_{1h}$ = 1 in the case of geographical area I or II (west of the Netherlands)
= 0 for other areas

$D_{2h}$ = 1 in the case of geographical area IV (east of the Netherlands)
= 0 for other areas

$D_{3h}$ = 1 in the case of geographical area V (south of the Netherlands)

The north (III) is the area of reference.

$U_h$ is a variable representing the size of the municipality in which the household lives with

$U_{1h}$ = 1 for municipalities of 100000 or more inhabitants
= 0 for other municipalities
$U_{2h}$ = 1 for municipalities of 30000 to 99999 inhabitants
= 0 for other municipalities

Urbanized municipalities of less than 30000 inhabitants, urbanized rural municipalities and rural municipalities are the municipalities of reference.

$G_h$ = 1 for households having access to a garden at home or elsewhere
= 0 no garden

The variable $HS_h$, the size of household h, represents the number of people who eat the main meal of the day together at home at least four times a week. The effect of the age of household members is assumed to be represented by the age of the wife.

$AC_h$ represents wife's age group with

$AC_{1h}$ = 1 if the wife is 30 to 65 years of age
= 0 for other age groups
$AC_{2h}$ = 1 if the wife is 65 years of age or older
= 0 for other age groups

Households in which the wife is less than 30 years of age form the group of reference. As discussed in Section 3.3, this variable was also assumed to be partly representative of the household's income.

$HK_h$ = 1 if the wife has a positive attitude to housekeeping (code 1 + 2)
= 0 in other cases

$PC_h$ = 1 if the wife is price conscious (code 1 + 2)
= 0 in other cases

According to the definition of the Netherlands Institute for Agricultural Marketing Research (NIAM), price consciousness is a measure of household sensitivity to price differences between retail outlets at a given time. Price elasticities, determined with estimates of Equation 5.13, measure the result of a household's decision process in respect of variation in flower and plant prices during the course of time. As both concepts measure household sensitivity to variations in price, the relationship between these variables was tested (Table 5.10).

$OH_h$ represents the proportion of household h expenditure on cut flowers and pot plants for home use in the period December 1972 to November 1974. Obviously, the higher proportion spent for home use, the lower the proportion available for gifts.

Three variables were defined to represent household choice of retail outlet during the period December 1972 to November 1974

- $FL_h$ represents the proportion of household h expenditure at florists
- $MS_h$ represents the proportion of household h expenditure at the weekly market and street stall.
- $SG_h$ represents the proportion of household h expenditure at the supermarket, garden centre or house-to-house selling.

As these three variables are dependent, the first two variables were included in the model.

As no sign of the coefficients in Equation 5.15 could be put forward, the null hypothesis of zero coefficients was tested against a two-sided alternative hypothesis.

In order to incorporate the differences in the relationship between the response parameter estimate $\hat{\alpha}_{hj}$ and household characteristics between market segments, Equation 5.4 was reformulated

$$\hat{\alpha}_{hj} = \beta_{j0} + \sum_{l=1}^{p} \beta_{jl} z_{hl} + w_{hj} \text{ for } h = 1, 2, ..., H \tag{5.16}$$

Equation 5.16 applied to the market segments, habitual (1) and nonhabitual (2) buyers can be specified in matrix notation as follows

$$\begin{pmatrix} \hat{\alpha}_1 \\ \\ \hat{\alpha}_2 \end{pmatrix} = \begin{pmatrix} \iota_1 Z_1 & o & 0 \\ \\ o\,0 & \iota_2 & Z_2 \end{pmatrix} \begin{pmatrix} \beta_{01} \\ \beta_{11} \\ \beta_{02} \end{pmatrix} + \begin{pmatrix} w_1 \\ \\ w_2 \end{pmatrix} \tag{5.17}$$

where $\hat{\alpha}_k$ = a $(H_k * 1)$ column vector with elements $\hat{\alpha}_{hj}$ for households $h = 1,2,.....,H_k$ in segment k

$\iota_k$ = a $(H_k * 1)$ column vector with numbers one

$Z_k$ = a $(H_k * p)$ matrix consisting of p column vectors of size $(H_k * 1)$ of household characteristics $z_{hl}$

$w_k$ = a $(H_k * 1)$ column vector of disturbances $w_{hj}$

$\beta_{0k}$ = a regression coefficient (constant term) for segment k

$\beta_{1k}$ = a vector of regression coefficients for segment k

When $\beta_{02} = \beta_{01} + \delta_0$ and $\beta_{12} = \beta_{11} + \delta_1$, then differences in regression coefficients between market segments can be estimated in an equivalent equation

$$\begin{pmatrix} \hat{\alpha}_1 \\ \\ \hat{\alpha}_2 \end{pmatrix} = \begin{pmatrix} \iota_1 Z_1 & o & 0 \\ \\ \iota_2 Z_2 & \iota_2 & Z_2 \end{pmatrix} \begin{pmatrix} \beta_{01} \\ \beta_{11} \\ \delta_0 \\ \delta_1 \end{pmatrix} + \begin{pmatrix} w_1 \\ \\ w_2 \end{pmatrix} \tag{5.18}$$

In particular, it is necessary to know which particular estimate of $\delta_0$ or element in the vector $\delta_1$ differs significantly from zero. If the estimate of $\delta_0$ or an element in the vector $\delta_1$ differs significantly from zero, then it can be concluded that the relationship between the corresponding household characteristic and the response parameter estimate differs significantly between the market segments habitual and nonhabitual buyers.

Results obtained with Equation 5.18 (see Table III.9 in Appendix III.5) are interpreted as follows. The estimates of the regression coefficients for habitual buyers: $\beta_{01}$ and $\beta_{11}$ are given and also their corresponding absolute t values. The estimates of the regression coefficients for nonhabitual buyers, $\beta_{02} = \beta_{01} + \delta_0$ and $\beta_{12} = \beta_{11} + \delta_1$, are also given, so that corresponding estimates between the two segments can be compared easily. From the absolute t values of the estimates of the differences between corresponding regression coefficients, $\delta_0$ and $\delta_1$, it is possible to judge whether these differences between habitual and nonhabitual buyers were significant.

*5.2.5 Applicability of the specified models to the whole sample*

The models specified could not be applied to households which rarely purchased cut flowers and pot plants, because individual household responses to marketing or market variables showed too little variation. Thus, the models specified are considered to be valid only for the 787 regular buyers. However, in order to estimate the relationship between expenditure on flowers and plants and household characteristics for the entire sample of 1000 households, a separate model, without marketing variables, has been specified, and which is described by the following equation

$$\begin{aligned} \bar{e}_h = {} & \delta_1 + \delta_2 Y_{1h} + \delta_3 Y_{2h} + \delta_4 Y_{3h} + \delta_5 D_{1h} + \\ & \delta_6 D_{2h} + \delta_7 D_{3h} + \delta_8 U_{1h} + \delta_9 U_{2h} + \\ & \delta_{10} G_h + \delta_{11} HS_h + \delta_{12} AC_{1h} + \delta_{13} AC_{2h} + \\ & \delta_{14} HK_h + \delta_{15} PC_h + u_h \end{aligned} \tag{5.19}$$

It was assumed that $u_h$ is normally distributed with $Eu_h = 0$, $Eu^2_h = \sigma^2$ and $E\ u_h \cdot u_{h'} = 0$ for $h \neq h'$. The variable to be explained is the average weekly expenditure for household h over the period December 1972 to November 1974: $\bar{e}_h = (1/T)\ \Sigma_t e_{ht}$ · The explanatory variables in Equation 5.19 have already been specified in Section 5.2.4. The purchase characteristics, $OH_h$, $FL_h$, and $MS_h$, were not included as explanatory variables, because they would have been based on too few purchases. For tests on heteroscedasticity of the disturbance term, see Appendix III.2.

*5.2.6 Parameter estimation and hypothesis testing*

The parameters in all models specified were estimated using the method of least-squares. For Equation 5.12 and 5.13, a check was made as to whether multiplicative specification would give better results than additive specification. The latter gave better results in terms of standard errors and $R^2$. The development represented in a trend variable was checked to see whether it should be linear or less than linear. This was done by specifying the variable ln t after results were obtained with the variable t. The specification with ln t gave better results in terms of statistical significance. Thus, t was replaced by ln t in Equations 5.12 and 5.13. The absence of first-order autocorrelation in Equations 5.12 and 5.13 was tested (Appendix III.2). The null hypothesis of no autocorrelation was not rejected at a 1% significance level for Equation 5.12 when applied to the market segments habitual and nonhabitual buyers. The results of this equation were used in further analysis except for price elasticity which was estimated with Equation 5.13. The null hypothesis of no autocorrelation was not rejected for Equation 5.13 when applied to nonhabitual buyers, but was rejected for habitual buyers. Correction was not made for autocorrelation in Equation 5.13 for one of the two market segments, because it was considered an advantage to compare the results for two segments obtained in the same way. The noncorrected estimates are unbiased, but less efficient than the corrected estimates.

Heteroscedasticity was tested in Equation 5.15 (see Appendix III.2) and it was concluded that correction for heteroscedasticity would only reduce the quality of the parameter estimates.

The number of degrees of freedom in estimating Equations 5.15 and 5.19 is at least 300. Therefore, the significance levels for testing whether or not the parameter estimates differ significantly from zero were approximated by significance levels at an infinite number of degrees of freedom.

There was no need to test whether parameter estimates with Equations 5.12 and 5.13 differed significantly from zero, because for use in relationship to household characteristics in Equation 5.15, they are considered to be transformations of original data.

## 5.3 HOUSEHOLD EXPENDITURE ON CUT FLOWERS AND POT PLANTS FOR HOME USE AND FOR GIFTS RELATED TO HOUSEHOLD CHARACTERISTICS

Between December 1972 and November 1974, 76% of expenditure on cut flowers and pot plants was for home use and 24% for gifts (n = 1000). Those who purchased mainly for home use can be considered to appreciate flowers and pot plants more than those who made such purchases mainly to fulfil some social obligation. Total expenditure, expenditure for home use and for gifts were all found to be related to household characteristics for both the whole sample and the market segment habitual buyers. Expenditure was found to be significantly related to social class, geographical area, size of residential municipality, and age in both expenditure categories (Table 5.3). Expenditure on gifts was also found to be related to household size and attitude to housekeeping.

A positive relationship was found between social class and expenditure for home use and for gifts. The difference in average weekly expenditure on cut

TABLE 5.3 Relationship between household characteristics, and total expenditure, expenditure for home use, and for gifts on cut flowers and pot plants for the entire sample (n = 1000)

| Household characteristics | Total expenditure | | Expenditure for home use | | Expenditure on gifts | |
|---|---|---|---|---|---|---|
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | | | |
| AB (high) | .815 | 4.57 | .452 | 3.11 | 364 | 5.40 |
| C | .408 | 2.83 | .267 | 2.29 | .140 | 2.58 |
| $D_1$ | .211 | 1.54 | .148 | 1.33 | .062 | 1.20 |
| Geographical area | | | | | | |
| west | .723 | 5.06 | .607 | 5.23 | .115 | 2.14 |
| east | .531 | 3.34 | .436 | 3.37 | .095 | 1.59 |
| south | -.016 | 0.10 | -.006 | 0.04 | -.010 | 0.17 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | .429 | 4.01 | .277 | 3.19 | .152 | 3.75 |
| 30000–100000 | .403 | 3.26 | .351 | 3.49 | .052 | 1.12 |
| Access to a garden | -.083 | 0.79 | -.096 | 1.12 | .012 | 0.31 |
| Household size | -.030 | 1.00 | .007 | 0.30 | -.037 | 3.32 |
| Age of wife (years) | | | | | | |
| 30–64 | .279 | 2.23 | .235 | 2.31 | .044 | 0.94 |
| ≧ 65 | -.254 | 1.57 | -.155 | 1.17 | .100 | 1.62 |
| Attitude to housekeeping | -.202 | 2.29 | -.060 | 0.84 | -.142 | 4.26 |
| Price consciousness | -.083 | 0.90 | -.058 | 0.78 | -.024 | 0.71 |
| Constant | .652 | | .306 | | .346 | |
| $R^2$ | .158 | | .130 | | .124 | |
| Average weekly expenditure (guilders) | 1.40 | | 1.02 | | 0.38 | |

flowers and pot plants between households belonging to social class AB and those belonging to social class $D_2$ amounted to 60% of the average weekly expenditure of all households. This figure was 45% for flowers and plants for the home, and 95% for gifts. Thus, expenditure on gifts seemed to vary more with social class than did expenditure for the home.

Living in the west of the country was found to have a positive effect on expenditure on flowers and plants. This was also found to be the case, although to a lesser extent, for households in the east of the country. The question could be raised as to why households in these areas spent more than those in the south or the north. To this end, the number of retail outlets for flowers and plants in each of the 129 economic-geographic areas distinguished in the Netherlands were related to population size, degree of urbanization, and geographical area. The number of retail outlets as at 1 January 1974, including both sedentary and ambulatory trade, was obtained from the 'Centraal Registratie Kantoor Detailhandel-Ambacht' (Central Registry of Retail Traders), The Hague. Population size and area in square kilometers of the economic-geographic areas were obtained from the Netherlands Central Bureau of Statistics ('Bevolking der Gemeenten van Nederland').

The model specified is described by the following equation

$$N_i = \gamma_0 PS_i^{\ \gamma_1} \left(\frac{PS_i}{AR_i}\right)^{\gamma_2} \exp\left[\gamma_3 DW_i + \gamma_4 DE_i + \gamma_5 DS_i + U_i\right] \qquad (5.20)$$

for

$i$ = 1,2,.....,129 economic-geographic areas

where $N_i$ = number of flower or plant outlets in economic-geographic area i

$PS_i$ = population size in economic-geographic area i

$AR_i$ = area in square kilometers of economic-geographic area i

$DW_i$ = 1 if area i is situated in the western part of the country

= 0 for other parts of the country

$U_i$ = a random disturbance term, $U_i = N(0,\sigma^2)$.

$DE_i$ and $DS_i$ are dummy variables similar to $DW_i$ for the east and south of the country, respectively. The north is the area of reference.

The variable $PS_i / AR_i$ is a proxy variable for degree of urbanization. The multiplicative form guarantees that $N_i = 0$ when $PS_i = 0$. Thus, Equation 5.20 can be written as

$$\begin{aligned} \ln N_i = \alpha_0 + \alpha_1 \ln PS_i + \alpha_2 \ln AR_i + \gamma_3 DW_i + \gamma_4 DE_i + \\ \gamma_5 DS_i + U_i \end{aligned} \qquad (5.21)$$

with $\alpha_0 = \ln \gamma_0$, $\alpha_1 = \gamma_1 + \gamma_2$ and $\alpha_2 = -\gamma_2$

Regression coefficients and absolute t values for the relationship between economic-geographic areas and number of retail outlets for cut flowers and pot

TABLE 5.4 Relationship between characteristics of economic-geographic areas and number of retail outlets for cut flowers and pot plants in the Netherlands as at 1 January 1973

| Characteristics | All retail outlets | | Sedentary trade | | Ambulatory trade | |
|---|---|---|---|---|---|---|
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Population size (ln PS) | 1.181 | 22.38 | 1.143 | 29.71 | 1.180 | 14.65 |
| Size of area in $km^2$ (ln AR) | -0.179 | 3.71 | -0.074 | 2.11 | -0.294 | 3.99 |
| Geographical area | | | | | | |
| west (DW) | 0.374 | 2.80 | -0.021 | 0.22 | 0.852 | 4.17 |
| east (DE) | 0.251 | 1.82 | -0.002 | 0.00 | 0.504 | 2.39 |
| south (DS) | -0.054 | 0.41 | -0.039 | 0.40 | -0.124 | 0.62 |
| Constant | -9.065 | | -9.577 | | -9.645 | |
| $R^2$ | .826 | | .883 | | .723 | |
| Parameter in Equation 5.20 | | | | | | |
| $\gamma_1$ | 1.002 | | 1.069 | | 0.886 | |
| $\gamma_2$ | .179 | | .0074 | | .294 | |

plants in the Netherlands as at 1 January 1974 are given in Table 5.4.

It can be concluded from Table 5.4 that both population size of an economic-geographic area and degree of urbanization are positively related to the number of retail outlets for both the sedentary trade and the ambulatory trade. However, the ambulatory trade was better represented in both the west and east of the country than in the south and the north. Most probably, this is the main reason consumers in the west and east spent more on cut flowers and pot plants. In turn, the relatively large number of street stalls, market stalls, and door-to-door traders in the west and east may be explained by the fact that, traditionally, the provinces of North and South Holland (western area), and Gelderland (eastern area) were, respectively, the largest flower and plant producing areas in the Netherlands (Netherlands Central Bureau of Statistics/ Agricultural Economics Research Institute 1974).

Size of residential municipality was positively related to household expenditure (Table 5.3), and also to the number of ambulatory traders in the economic-geographic area (Table 5.4). Again, there is evidence of the important role of the ambulatory trade (street stalls, market stalls, and door-to-door traders) in the sale of cut flowers and pot plants. Living in municipalities of 30000 to 100000 inhabitants had a more positive effect on expenditure for the home than did living in municipalities of more than 100000 inhabitants. However, the reverse was found to be the case for expenditure on gifts.

The smaller the household was, the greater the expenditure on cut flowers and pot plants for gifts, especially households of only one person. This relationship in particular could be observed for nonhabitual buyers, where the correlation coefficient between the number of persons in the household and the proportion of expenditure for home use during the two-year period was 0.21 ($P < 0.001$; $n = 424$), whereas the figure was only 0.09 for habitual buyers ($p < 0.05$; $n = 363$). Of the 875 households which made at least one purchase of plants during the two-year period, the one-person households ($n = 97$) spent, on average, 150% of the average amount on gifts, as against the figure of 94% for the other households ($n = 778$). For cut flowers (919 households), these figures were 134% for one-person households ($n = 99$) and 96% for other households ($n = 820$). It is possible that one-person households visited other households with some frequency taking flowers or plants as gifts.

The wife being in the age group 30 to 64 years tended to have a positive effect on expenditure on flowers and plants for the home, this was partly because of the relationship between age and household income. On average, households with a yearly income of 21 000 guilders or more were older than those earning less ('Netherlands Central Bureau of Statistics' 1974/1975). In addition, those who were 65 years of age or older often received gifts of flowers or pot plants (Mr. F.J. Bruggeman, personal communication). Households in which the wife was 65 years of age or more spent relatively little on such items for gifts.

Expenditure on cut flowers and pot plants for the home was not found to be related to attitude to housekeeping. However, a negative attitude to housekeeping was found to have a positive effect on expenditure for gifts. This may well be because women with a negative attitude to housekeeping seem to have more interests outside the house.

Price consciousness did not seem to be related to expenditure, although price conscious households spent significantly ($P < 5\%$) less on flowers (92.28 guilders) than did other households (108.92 guilders) during this two-year period.

In this study, much attention has been paid to the market segment referred to as habitual buyers, those who made at least 50% of their purchases of flowers and pot plants for the home. The extent to which the expenditure of habitual buyers for the home or gifts was related to household characteristics has also been examined (Table 5.5). Social class, size of residential municipality and household size were found to be significantly related to expenditure for gifts, and geographical area and age group significantly related to expenditure for the home. Expenditure on gifts, other household characteristics being equal, was found to be greater in the higher social classes, in larger municipalities, and in small households. Habitual buyers in the west and east of the country, or in the age group 30 to 64 years, other household characteristics being equal, spent more on cut flowers and plants for home use than did other habitual buyers.

TABLE 5.5 Relationships between household characteristics, and total expenditure, expenditure for home use, and for gifts on cut flowers and pot plants for habitual buyers

| Household characteristics | Expenditure on cut flowers and pot plants | | | | | |
|---|---|---|---|---|---|---|
| | Total (n = 363) | | For the home (n = 363) | | For gifts (n = 363) | |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | | | |
| AB (high) | .760 | 2.17 | .393 | 1.29 | .368 | 3.06 |
| C | .351 | 1.16 | .167 | 0.64 | .184 | 1.77 |
| $D_1$ | .144 | 0.48 | .086 | 0.33 | .057 | 0.56 |
| Geographical area | | | | | | |
| west | .658 | 1.91 | .641 | 2.15 | .017 | 0.14 |
| east | .919 | 2.37 | .773 | 2.29 | .146 | 1.10 |
| south | .252 | 0.63 | .191 | 0.54 | .062 | 0.44 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≥ 100 000 | .198 | 1.04 | .048 | 0.29 | .151 | 2.30 |
| 30 000–100 000 | .294 | 1.33 | .169 | 0.88 | .126 | 1.65 |
| Access to a garden | .030 | 0.17 | -.048 | 0.32 | .078 | 1.29 |
| Household size | -.074 | 1.19 | -.027 | 0.49 | -.047 | 2.21 |
| Age of wife (years) | | | | | | |
| 30–64 | .559 | 2.36 | .509 | 2.47 | .050 | 0.61 |
| ≥ 65 | .003 | 0.00 | .110 | 0.39 | -.107 | 0.97 |
| Attitude to housekeeping | -.001 | 0.00 | .083 | 0.58 | -.084 | 1.47 |
| Price consciousness | -.058 | 0.34 | -.092 | 0.62 | .033 | 0.57 |
| Constant | 1.426 | | 1.022 | | .403 | |
| $R^2$ | .077 | | .060 | | .096 | |
| Average weekly expenditure (guilders) | 2.61 | | 2.04 | | 0.56 | |

## 5.4 EXPENDITURE OF REGULAR BUYERS ON CUT FLOWERS AND POT PLANTS RELATED TO MARKETING VARIABLES AND HOUSEHOLD CHARACTERISTICS

### *5.4.1 Introduction*

From a marketing point of view, it is of interest to know how consumers react to variation in variables of the marketing mix, such as price and advertising. Expenditure of individual households during the course of time was related to market and marketing variables (Equation 5.12). If there is heterogeneity in households in their reaction to these variables, then it is of interest to ascertain to what extent differences between households in response parameter estimates are related to variation in household characteristics.

It was of no value to estimate response parameters for households making very few purchases of flowers and plants. Consequently, the analysis in this section is limited to the market segment of regular buyers (Figure 4.1). Since a multistage choice process was assumed for habitual buyers, the significant differences found between habitual and nonhabitual buyers in the relationship between response parameter estimates (Equation 5.18) and household characteristics are also discussed.

Relationships found between weekly expenditure of individual regular buyers on flowers and plants and marketing, and market variables for individual households, are summarized in Table 5.6. The frequency distributions of each response parameter estimate are given in this table for both the market segment regular buyers, and the subsegments, habitual and nonhabitual buyers. The relationships between each of the response parameter estimates of the main variables and household characteristics are given in Table 5.8 to 5.12. Where the relationship between the estimates of a particular response parameter and household characteristics differed significantly between habitual and nonhabitual buyers, the regression coefficients for each of these segments are discussed, otherwise, only the results for regular buyers are given.

### *5.4.2 Estimation of response parameters of individual households*

Apart from price elasticity, all response parameters of individual regular buyers were estimated with Equation 5.12. Price elasticity was estimated with Equation 5.13.

The test for homogeneity described in Section 5.2.2, when applied separately to habitual and to nonhabitual buyers, revealed that the response parameter estimates in Equation 5.12 were heterogeneous between households. For the habitual buyers the value of the test statistic $F[(H-1)q, H(T-q)] \approx F_{\infty,\infty}$ was 3.77, and for the nonhabitual buyers, 2.58. This means that the null hypothesis of homogeneity of the slope parameters in Equation 5.12 between households was rejected at a 1% significance level. Thus, it is of value to discuss the frequency distribution of each response parameter estimate in Equation 5.12, and to try to relate the variation in a response parameter estimate between households to household characteristics.

In Appendix III.4, the following statistics are given for each distribution of parameter estimates for households in a particular market segment: minimum value; maximum value; mean ($\bar{x}$); standard deviation ($\sigma$); and Kurtosis or peakedness; and skewness, which are discussed in Appendix III.3. As the frequency distribution of the parameter estimates is not bounded, the spread of the distribution of parameter estimates may give a false impression of the variation between households because of outliers. To bypass the influence of outliers, the frequency distribution was described in terms of: first octile, first quartile, median, third quartile, and seventh octile, which are the 12.5th, 25th, 50th, 75th and 87.5th percentile, respectively (Table 5.6). The 100p-th percentile means that a fraction p of the parameter estimates is less than or equal to the value specified in the Table 5.6.

The median (mean) of the distribution of the estimated trend parameters was 0.20 (0.25) for habitual and 0.05 (0.04) for nonhabitual buyers. The mean of the two distributions differed significantly (Mann-Whitney or Wilcoxon test, critical level $P < 0.001$). This means that, on average, expenditure on cut flowers and pot plants by habitual buyers increased more than that by nonhabitual buyers. The variation between households in the trend parameter was greater for habitual than for nonhabitual buyers: for habitual buyers, 75% of the parameter estimates came within the interval -0.41, 0.95; and for nonhabitual buyers, 75% of parameter estimates came within the interval -0.45, 0.50.

The price elasticity of the number of purchases of flowers and plants was derived from the price parameter estimated in Equation 5.13. The median (mean) of the distribution of price elasticities was -0.73 (-0.81) for habitual and -0.32 (-0.28) for nonhabitual buyers. Habitual buyers were more price elastic than nonhabitual buyers ($P < 0.005$), and the variation between households in price elasticity was less for habitual than for nonhabitual buyers. For habitual buyers, 75% of the estimates of this elasticity came within the interval -2.81, 1.21 and for 75% of nonhabitual buyers, the interval was -3.44, 3.53. Apparently, many households bought flowers and plants more often when prices were high. This may be caused by a preference for flowers which are relatively new in a particular season and thus expensive.

The mean of the distribution of response parameter estimates for present advertising, as estimated with Equation 5.12, was -0.53 for habitual and -0.19 for nonhabitual buyers, whereas the mean of the distribution of response parameter estimates for past advertising was -0.48 and -0.20 for habitual and nonhabitual buyers respectively (see Appendix III.4). These negative values were contrary to expectation. In Section 5.2.3, it was suggested that spending weekends outside the house may well affect consumer behaviour in May to June. Expenditure on flowers and plants was relatively low during these months even though expenditure on advertising was rather high. These negative means of the distributions can only be explained by the assumption that the advertising variables acted as 'continuous' seasonal variables.

As an alternative for the advertising variables included in Equation 5.12, the following terms were inserted

$$\ldots\ldots + \alpha_{h5} \ln [r_t(1 - d_t x)] + \alpha_{h6} \ln [\bar{r}_t(1 - d_t x)] + \ldots\ldots \qquad (5.22)$$

TABLE 5.6 Frequency distribution of parameter estimates obtained in regression analyses to explain expenditure on cut flowers and pot plants of individual households by marketing and market variables, by market segment

| Parameter | Market segment | First octile | First quartile | Median | Third quartile | Seventh octile |
|---|---|---|---|---|---|---|
| Average expenditure (guilders) | Habitual[a] | 1.37 | 1.63 | 2.23 | 3.02 | 3.90 |
| | Nonhabitual[b] | 0.44 | 0.54 | 0.79 | 1.16 | 1.46 |
| | Regular[c] | 0.53 | 0.75 | 1.34 | 2.31 | 3.05 |
| Trend (Equation 5.12) | Habitual | -0.41 | -0.16 | 0.20 | 0.58 | 0.95 |
| | Nonhabitual | -0.45 | -0.22 | 0.05 | 0.26 | 0.50 |
| | Regular | -0.44 | -0.20 | 0.11 | 0.43 | 0.69 |
| Price (Equation 5.13, deflated prices) | Habitual | -0.85 | -0.57 | -0.21 | 0.07 | 0.33 |
| | Nonhabitual | -0.36 | -0.21 | -0.04 | 0.15 | 0.27 |
| | Regular | -0.61 | -0.35 | -0.09 | 0.12 | 0.29 |
| Price elasticity (Equation 5.13, deflated prices) | Habitual | -2.81 | -1.88 | -0.73 | 0.23 | 1.21 |
| | Nonhabitual | -3.44 | -2.14 | -0.32 | 1.59 | 3.53 |
| | Regular | -3.20 | -1.98 | -0.62 | 0.86 | 2.12 |
| Present advertising (Equation 5.12 with alternative specification 5.22, where x = 0.95) | Habitual | -0.42 | -0.21 | 0.05 | 0.29 | 0.47 |
| | Nonhabitual | -0.30 | -0.16 | 0.03 | 0.17 | 0.32 |
| | Regular | -0.37 | -0.17 | 0.03 | 0.22 | 0.38 |
| Past advertising (Equation 5.12 with alternative specification 5.22, where x = 0.95) | Habitual | -1.20 | -0.74 | -0.05 | 0.81 | 1.35 |
| | Nonhabitual | -0.89 | -0.48 | -0.07 | 0.44 | 0.73 |
| | Regular | -1.03 | -0.62 | -0.06 | 0.56 | 1.03 |
| Mother's Day (Equation 5.12) | Habitual | -1.39 | -0.32 | 1.52 | 4.53 | 7.14 |
| | Nonhabitual | -1.31 | -0.56 | 0.90 | 3.63 | 6.11 |
| | Regular | -1.37 | -0.51 | 1.27 | 4.11 | 6.73 |
| All Souls' Day (Equation 5.12) | Habitual | -1.78 | -0.84 | 0.10 | 1.24 | 2.41 |
| | Nonhabitual | -0.98 | -0.62 | -0.05 | 0.70 | 1.62 |
| | Regular | -1.25 | -0.69 | 0.02 | 1.02 | 2.01 |
| Christmas (Equation 5.12) | Habitual | -2.45 | -1.41 | 0.03 | 2.22 | 4.21 |
| | Nonhabitual | -1.40 | -0.73 | -0.04 | 1.36 | 2.97 |
| | Regular | -1.91 | -1.04 | -0.01 | 1.72 | 3.61 |
| Winter (Equation 5.12) | Habitual | -1.44 | -0.65 | 0.29 | 1.19 | 1.93 |
| | Nonhabitual | -1.04 | -0.63 | -0.00 | 0.54 | 1.10 |
| | Regular | -1.16 | -0.64 | 0.11 | 0.84 | 1.50 |
| Spring (Equation 5.12) | Habitual | -1.39 | -0.64 | 0.38 | 1.49 | 2.24 |
| | Nonhabitual | -1.12 | -0.34 | 0.22 | 0.80 | 1.35 |
| | Regular | -1.27 | -0.45 | 0.28 | 1.11 | 1.74 |
| Summer holidays (Equation 5.12) | Habitual | -1.90 | -1.10 | -0.26 | 0.36 | 0.95 |
| | Nonhabitual | -1.02 | -0.68 | -0.18 | 0.21 | 0.68 |
| | Regular | -1.33 | -0.83 | -0.20 | 0.27 | 0.81 |
| Autumn (Equation 5.12) | Habitual | -1.04 | -0.42 | 0.27 | 1.03 | 1.58 |
| | Nonhabitual | -0.92 | -0.49 | -0.01 | 0.43 | 0.85 |
| | Regular | -0.97 | -0.48 | 0.07 | 0.73 | 1.21 |

[a] Habitual, n = 363; [b] Nonhabitual, n = 424; [c] Regular, n = 787

where $d_t$ = 1 for each week in May to July
= 0 in all other weeks

and x is a factor in the interval (0,1). The effect of advertising in May to July tends to disappear as x tends to 1. The following values of x were tried: 0.6, 0.8, and 0.95. With increasing x, the mean of the distribution of the estimates of the present or past advertising parameter became less negative, or slightly positive. The assumption that the advertising variables acted as seasonal variables was confirmed because the mean of the distribution of the parameter estimates for spring, autumn, and winter varied with x.

The median (mean) of the distribution of the new response parameter estimate for present advertising with x = 0.95 was 0.05 (0.02) for habitual buyers and 0.03 (0.01) for nonhabitual buyers. The median (mean) of the distribution of the new response parameter estimate for past advertising with x = 0.95 was -0.05 (-0.02) for habitual buyers, and -0.07 (-0.08) for nonhabitual buyers. The mean of these distributions did not differ between habitual and nonhabitual buyers at a 10% significance level, but the shape of these distributions differed significantly (Kolmogorov-Smirnov two-sample test; $P < 0.01$ for the present and $P < 0.001$ for the past advertising parameter estimates).

It can be concluded from this analysis that households were more responsive to advertising in periods of high demand than in periods of low demand. It could be implied that expenditure on advertising follows the seasonal pattern of demand for flowers and plants. For an example for milk, see Kinnucan and Forker (1982).

From the medians of the distributions of the seasonal parameter estimates (Table 5.6), it seems that the parameter for Mother's Day was by far the most important. The proportion of households purchasing flowers and pot plants in the week prior to Mother's Day in 1973, and in 1974, was highest in the segment of habitual buyers (88%), followed by the segment of nonhabitual buyers (68%), and lowest in the segment of occasional buyers (29%). This is not in accordance with the assumption that consumer behaviour of habitual and nonhabitual buyers is similar during the week preceding Mother's Day. The average amount spent during that week did not vary greatly between the segments distinguished but seemed to be related to buying intensity (Table 5.7). The median of the distribution of the estimated parameters for Mother's Day was 1.52 for habitual buyers and 0.90 for nonhabitual buyers. The mean of the two distributions differed significantly ($P < 0.05$).

### *5.4.3 Variation in response parameter estimates for regular buyers related to household characteristics*

**Social class.** Apart from the response parameter estimate for present advertising, variation in response parameter estimates for regular buyers was not found to be related to social class. The response parameter estimate for present advert-

TABLE 5.7 Proportion of households purchasing cut flowers and pot plants in the week before Mother's Day in 1973 and in 1974

| Market segment | Number of households | Proportion of households purchasing in the week before Mother's Day (%) | Average expenditure (guilders) of buying households |
|---|---|---|---|
| All households | 1000 | 65 | 10.87 |
| Habitual buyers | 363 | 88 | 12.37 |
| Nonhabitual buyers | 424 | 68 | 9.64 |
| Occasional buyers | | | |
| purchased | 154 | 29 | 8.04 |
| did not purchase | 59 | 0 | 0.00 |

ising was relatively high in social class AB (Table 5.11), thus suggesting that regular buyers in this social class were, on average, more sensitive to advertising than those in lower social classes.

**Geographical area.** Variation in the estimate for price elasticity and the parameter for present advertising was found to be related to the geographical area of the Netherlands in which the household lived. Habitual buyers living in the east of the country were relatively less price elastic in their purchases than those living in the north, and nonhabitual buyers living in the east were relatively more price elastic in their purchases than those living in the north. However, it should be remembered that purchases by habitual buyers were more price elastic than those of nonhabitual buyers (Table 5.10). Further, regular buyers living in the east had a higher response parameter estimate for present advertising than those living in other parts of the country (Table 5.11).

**Size of residential municipality.** For regular buyers, variation in the estimate for the trend and price parameter, and the parameter for Mother's Day was found to be related to size of the residential municipality. Growth in expenditure on cut flowers and pot plants was higher (Table 5.8) and the number of purchases was more price elastic (Table 5.10) in larger municipalities than in smaller ones. Living in municipalities of 30000 to 100000 inhabitants seemed to have a positive effect on expenditure for Mother's Day (Table 5.12). This suggests that the small difference in expenditure between regular buyers living in municipalities of 30000 to 100000 inhabitants and those living in larger municipalities (Table III.9, Appendix III.5) was also related to the higher expenditure of the first group in the week prior to Mother's Day.

**Age of the wife.** The variation in the estimate of the parameter for Mother's Day for regular buyers was found to be related to the variable, age of the wife. Other household characteristics being equal, the lower her age was, the higher the expenditure on flowers and plants during the week before Mother's Day. This is probably because the younger the wife is, the greater the probability that she has a mother on this day of observance.

TABLE 5.8 Relationship between household characteristics and the estimated trend parameter for regular buyers (n = 787)

| Household characteristics | Regression coefficient | Absolute t value |
|---|---|---|
| Social class | | |
| AB (high) | -.044 | 0.47 |
| C | -.005 | 0.06 |
| $D_1$ | -.042 | 0.56 |
| Geographical area | | |
| west | .036 | 0.44 |
| east | -.078 | 0.89 |
| south | -.081 | 0.93 |
| Size of residential municipality (inhabitants) | | |
| ≧ 100000 | .136 | 2.48 |
| 30000–100000 | .114 | 1.79 |
| Access to a garden | .051 | 0.96 |
| Household size | .011 | 0.69 |
| Age of wife (years) | | |
| 30–64 | -.023 | 0.36 |
| ≧ 65 | -.025 | 0.28 |
| Attitude to housekeeping | .035 | 0.77 |
| Price consciousness | .058 | 1.21 |
| Proportion of expenditure | | |
| for own home | .046 | 0.42 |
| from florist | -.043 | 0.47 |
| from market or street stall | .144 | 1.52 |
| Constant | -.073 | |
| $R^2$ | .033 | |

**Proportion of expenditure for home use.** The proportion of expenditure by regular buyers on flowers and plants for the home as opposed to gifts, was found to be positively related to a higher response parameter estimate for both present ($P < 0.10$) and past advertising ($P < 0.01$). These relationships did not differ significantly between habitual and nonhabitual buyers (Table 5.11), suggesting that households which frequently purchased flowers and plants for home use were more sensitive to advertising than were other households.

## 5.5 CONCLUSIONS

The level of expenditure on flowers and plants for all households in the sample was found to be positively related to social class and size of residential municipality, and was higher in the west and east of the country than in other areas mainly because of the strong ambulatory trade (market stalls, street stalls, door-to-door traders). The fact of being in the age group 30 to 64 years was found to have a positive effect on expenditure, whereas a positive attitude to housekeeping was found to have a negative effect. A result specific for expenditure on flowers

TABLE 5.9 Relationship between household characteristics and estimated parameter for price (Equation 5.13, deflated prices) for all regular buyers, and for habitual and nonhabitual buyers

| Household characteristics | Equation (5.15) | | Equation (5.18) | | | |
|---|---|---|---|---|---|---|
| | Regular buyers (n=787) | | Habitual buyers (n = 363) | | Nonhabitual buyers (n = 424) | Absolute t value of difference |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | |
| Social class | | | | | | |
| AB (high) | -.006 | 0.09 | .034 | 0.34 | .056 | 0.16 |
| C | .028 | 0.52 | .136 | 1.61 | .000 | 1.25 |
| $D_1$ | .066 | 1.28 | .108 | 1.29 | .069 | 0.37 |
| Geographical area | | | | | | |
| west | -.023 | 0.41 | .054 | 0.55 | -.034 | 0.73 |
| east | .004 | 0.06 | .141 | 1.30 | -.087 | 1.74 |
| south | .088 | 1.44 | .154 | 1.36 | .026 | 0.96 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | -.125 | 3.25 | -.120 | 2.18 | -.075 | 0.59 |
| 30000–100000 | -.124 | 2.81 | -.125 | 1.99 | -.063 | 0.70 |
| Access to a garden | .025 | 0.66 | .026 | 0.52 | .009 | 0.23 |
| Household size | .011 | 0.98 | .018 | 1.05 | .003 | 0.67 |
| Age of wife (years) | | | | | | |
| 30–64 | -.006 | 0.13 | .083 | 1.24 | -.046 | 1.46 |
| ≧ 65 | -.014 | 0.23 | .076 | 0.84 | -.079 | 1.27 |
| Attitude to housekeeping | .028 | 0.90 | .093 | 2.01 | -.006 | 1.56 |
| Price consciousness | .014 | 0.43 | .046 | 0.97 | -.009 | 0.83 |
| Proportion of expenditure | | | | | | |
| for own home | -.078 | 1.03 | .193 | 1.28 | -.020 | 1.22 |
| from florist | .083 | 1.31 | .038 | 0.39 | .067 | 0.23 |
| from market or street stall | -.063 | 0.96 | -.152 | 1.71 | .045 | 1.51 |
| Constant | -.146 | | -.687 | | -.015 | 2.77 |
| $R^2$ | | .064 | | | .124 | |

TABLE 5.10 Relationship between household characteristics and estimated price elasticities of the number of purchases (deflated prices) for all regular buyers, and for habitual and nonhabitual buyers

| Household characteristics | Equation (5.15) | | Equation (5.18) | | | |
|---|---|---|---|---|---|---|
| | Regular buyers (n = 787) | | Habitual buyers (n = 363) | | Nonhabitual buyers (n = 424) | Absolute t value of difference |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | |
| Social class | | | | | | |
| AB (high) | .327 | 0.85 | .233 | 0.39 | .635 | 0.51 |
| C | .223 | 0.70 | .518 | 1.02 | .047 | 0.72 |
| $D_1$ | .518 | 1.70 | .411 | 0.82 | .641 | 0.36 |
| Geographical area | | | | | | |
| west | -.111 | 0.34 | .528 | 0.90 | -.290 | 1.13 |
| east | -.243 | 0.67 | .862 | 1.32 | -.780 | 2.07 |
| south | .274 | 0.76 | .652 | 0.96 | .186 | 0.58 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | -.531 | 2.35 | -.316 | 0.95 | -.586 | 0.59 |
| 30000–100000 | -.559 | 2.14 | -.172 | 0.46 | -.783 | 1.16 |
| Access to a garden | .116 | 0.53 | .050 | 0.16 | .137 | 0.19 |
| Household size | .078 | 1.15 | .056 | 0.53 | .055 | 0.00 |
| Age of wife (years) | | | | | | |
| 30–64 | -.185 | 0.71 | .386 | 0.96 | -.604 | 1.86 |
| ≧ 65 | -.377 | 1.05 | .201 | 0.37 | -.972 | 1.60 |
| Attitude to housekeeping | .103 | 0.55 | .222 | 0.79 | .117 | 0.27 |
| Price consciousness | .093 | 0.47 | .138 | 0.48 | .054 | 0.21 |
| Proportion of expenditure | | | | | | |
| for own home | -.622 | 1.40 | .568 | 0.63 | -.871 | 1.36 |
| from florist | .647 | 1.73 | .240 | 0.41 | .892 | 0.84 |
| from market or street stall | .128 | 0.33 | -.298 | 0.56 | .521 | 1.04 |
| Constant | -.652 | | -2.734 | | 2.795 | 1.92 |
| $R^2$ | .041 | | | | .066 | |

TABLE 5.11 Relationship between household characteristics and estimated response parameter for present advertising for regular buyers (n = 787)

| Household characteristics | Regression coefficient | Absolute t value |
|---|---|---|
| Social class | | |
| AB (high) | .144 | 2.42 |
| C | .069 | 1.42 |
| $D_1$ | .047 | 1.01 |
| Geographical area | | |
| west | .096 | 1.89 |
| east | .145 | 2.61 |
| south | .110 | 1.99 |
| Size of residential municipality (inhabitants) | | |
| ≧ 100000 | -.031 | 0.90 |
| 30000–100000 | -.061 | 1.52 |
| Access to a garden | -.055 | 1.62 |
| Household size | -.001 | 0.05 |
| Age of wife (years) | | |
| 30–64 | .011 | 0.28 |
| ≧ 65 | .015 | 0.27 |
| Attitude to housekeeping | .019 | 0.66 |
| Price consciousness | .003 | 0.11 |
| Proportion of expenditure | | |
| for own home | .128 | 1.87 |
| from florist | .050 | 0.87 |
| from market or street stall | -.032 | 0.53 |
| Constant | -.209 | |
| $R^2$ | .027 | |

and plants for gifts was that the larger the household, the smaller the amount spent on gifts. Apparently, one-person households visited other households relative often and gave flowers or a plant as a present.

Growth in the expenditure on cut flowers and pot plants by regular buyers was found to be related to the size of the residential municipality. Households in municipalities of more than 30000 inhabitants increased their expenditure on flowers and plants during the period of the study to a greater extent than other households.

Household response differed as to variation in prices of flowers and plants. Regular buyers in urbanized municipalities (> 30000 inhabitants) were more sensitive to price variation than others. Habitual buyers were more price elastic in their purchases than nonhabitual buyers, and in addition, habitual buyers with a positive attitude to housekeeping were less price sensitive than others.

During the period of the study, the flower industry attempted to counter the decline in sales of flowers in May to August by an intensive advertising campaign (e.g., Volle Vazen Plan 1973). According to the analysis in this study, the campaign was not successful. National advertising seemed to be relatively effective

TABLE 5.12 Relationship between household characteristics and estimated parameter for Mother's Day in Equation 5.12 for regular buyers (n = 787)

| Household characteristics | Regression coefficient | Absolute t value |
|---|---|---|
| Social class | | |
| AB (high) | .182 | 0.25 |
| C | .408 | 0.67 |
| $D_1$ | .201 | 0.34 |
| Geographical area | | |
| west | -.735 | 1.16 |
| east | .080 | 0.11 |
| south | -.560 | 0.81 |
| Size of residential municipality (inhabitants) | | |
| ≥ 100000 | .056 | 0.13 |
| 30000–100000 | 1.101 | 2.20 |
| Access to a garden | -.450 | 1.07 |
| Household size | .058 | 0.45 |
| Age of wife (years) | | |
| 30–64 | -.849 | 1.70 |
| ≥ 65 | -1.550 | 2.24 |
| Attitude to housekeeping | -.101 | 0.28 |
| Price consciousness | -.054 | 0.14 |
| Proportion of expenditure | | |
| for own home | .314 | 0.37 |
| from florist | .730 | 1.02 |
| from market or street stall | .132 | 0.18 |
| Constant | 2.936 | |
| $R^2$ | .025 | |

for regular buyers in social class AB, for those living in the eastern part of the Netherlands, and for those who spent a relatively large proportion of their flower budget for home use rather than for gifts.

A relationship was established between high expenditure on cut flowers or pot plants and a ready access to retail outlets such as market stalls and street stalls. This seemed to be especially marked in towns and in the western or eastern part of the country. Although it is difficult to separate cause from effect, the phenomenon known in the Dutch flower industry as impulse buying, that is the sight of flowers stimulating people to purchase, seems to play a role.

For regular buyers, expenditure on flowers and plants in the week prior to Mother's Day was negatively related to their age group. The proportion purchasing flowers and plants during the week prior to Mother's Day was 88% of habitual buyers, 68% of nonhabitual buyers, and 29% of occasional buyers. In addition, the average amount spent seemed to be related to buying intensity and was about 12.50 guilders for habitual buyers, 9.50 guilders for nonhabitual buyers, and 8.00 guilders for occasional buyers.

# 6 PRIORITY STAGE: BUDGET ALLOCATION TO SUBCLASSES OF FLOWERS AND PLANTS BY HABITUAL BUYERS

## 6.1 Introduction

The analysis in this chapter is based on the hypothesis that habitual buyers have a fixed budget for cut flowers and pot plants and that the budget is allocated to three main subclasses: cut flowers; flowering pot plants; and green pot plants.

The adequacy of the subclasses distinguished has been investigated by determining which combinations of cut flowers and of pot plants were most frequently purchased by the same household during the period, December 1972 – November 1974 (Appendix IV.1). The results suggest that the subclasses correspond to preferences shown by households in their buying behaviour.

The model used for the allocation of the budget to the three subclasses, together with its stochastic specification and the way in which the parameters are estimated, are discussed in Section 6.2. The characteristics of budget and price elasticities derived from these parameters are also discussed in this section. In Section 6.3, the subclasses considered by habitual buyers in their choice of flowers and plants purchased (that is, their evoked set) are examined. Each subgroup of habitual buyers with a different evoked set is analysed separately. The relationship between household characteristics and response parameter estimates, and also budget and price elasticities, are examined in Section 6.4 for those with an evoked set of two, and in Section 6.5 for those with an evoked set of three subclasses.

## 6.2 Model specification

### *6.2.1 Choice of a conditional demand system*

A conditional demand system was chosen for the budget allocation made by habitual buyers to the subclasses of cut flowers and pot plants defined. A demand system is referred to as conditional when it is used to allocate the budget for a particular product class to subclasses or products within that class, when the size of the budget has already been determined during a preceding stage in the budget allocation process. The mathematical specification of a conditional demand system and an unconditional demand system is the same. Of the various demand systems available, the Linear Expenditure System, the Rotterdam Model, and the Indirect Addilog Model are most often used. These three models are considered in this section. Define

$q_{hkt}$ = the quantity of subclass k purchased in period t by household h with $k = 1,2,\ldots, K$

$p_{kt}$ = the price of a product in subclass k in period t

$m_{ht}$ = household h budget to be allocated in period t

$m_{hkt}$ = $q_{hkt} \cdot p_{kt}$ = household h expenditure on subclass k in period t

$y_{ht}$ = the utility derived by household h from the quantities $q_{hkt}(k = 1,2, \ldots, K)$ in period t.

If the direct utility function $U_{ht} = g(q_{h1t}, q_{h2t}, \ldots, q_{hKt})$ is maximized under the budget restriction $\sum_{k=1}^{K} q_{hkt} \cdot p_{kt} = m_{ht}$, then a demand system can be derived

$$q_{kt} = f(p_{1t}, \ldots, p_{Kt}, m_{ht})$$

The Linear Expenditure System (e.g., Phlips 1974; Powell 1974; and Lluch, Powell and Williams 1977) is based on an additive direct utility function. A utility function is additive if one member of the class of utility functions representing the same preference order is additive (Phlips 1974, p 58). Such a function is expressed in the equation

$$z_{ht} = \ln U_{ht} = \sum_{k=1}^{K} \beta_{hk} \ln (q_{hkt} - c_{hkt}) \tag{6.1a}$$

under the restriction that

$$q_{hkt} > c_{hkt} \text{ and } \beta_{hk} > 0 \text{ for } k = 1,2,\ldots, K \text{ and } \sum_{k=1}^{K} \beta_{hk} = 1$$

The Linear Expenditure System is specified as

$$q_{hkt} = c_{hkt} + \frac{\beta_{hk}}{p_{kt}}(m_{ht} - \sum_{j=1}^{K} c_{hjt} p_{jt}) \qquad \text{for } k = 1, 2, \ldots, K \tag{6.1b}$$

where $c_{hkt}$ and $\beta_{hk}$ are parameters to be estimated.

The Rotterdam model (e.g., Barten 1966, Theil 1975, 1976) which is based on an unspecified direct utility function, is described by the equation

$$\Delta q_{hkt} = \sum_{j=1}^{K} s_{hkj} \Delta p_{jt} + \frac{\gamma_{hk}}{p_{kt}} \left[ \Delta m_{ht} - \sum_{j=1}^{K} q_{hjt} \Delta p_{jt} \right] \text{ for } k = 1, 2, \ldots, K \tag{6.2}$$

under the restrictions

$$\sum_{j=1}^{K} s_{hkj} = 0$$

$$s_{hkj} = s_{hjk}$$

$$\sum_{j=1}^{K} \gamma_{hk} = 1$$

$$S = [s_{hkj}] = \text{semidefinite}$$

where $s_{hkj}$ and $\gamma_{hk}$ are parameters to be estimated for $k = 1,2, \ldots, K$

The Indirect Addilog Model (e.g., Somermeyer and Langhout 1972) is based on an additive indirect utility function which is specified as

$$y^{o}_{ht} = g\left(\frac{p_{1t}}{m_{ht}}, \frac{p_{2t}}{m_{ht}}, \ldots, \frac{p_{Kt}}{m_{ht}}\right) \tag{6.3a}$$

where $y^{o}_{ht}$ is the utility obtained by household h from the quantities $q_{hkt}$ ($k = 1, 2, \ldots, K$) in the optimum of the constrained maximization of the direct utility function. In particular, the indirect utility function is

$$y^{o}_{ht} = \sum_{k=1}^{K} c_{hkt} \left(\frac{p_{kt}}{m_{ht}}\right)^{\alpha_{hk}} \qquad \text{with } c_{hkt} > 0$$

By means of Roy's identity (e.g., Phlips 1974), the Indirect Addilog Model results

$$q_{hkt} = \frac{c_{hkt}\left(\frac{p_{kt}}{m_{ht}}\right)^{\alpha_{hk}-1}}{\sum_{j=1}^{K} c_{hjt}\left(\frac{p_{jt}}{m_{ht}}\right)^{\alpha_{hj}}} \text{ for } k = 1, 2, \ldots, K \tag{6.3b}$$

under the restrictions

$$c_{hkt} > 0$$
$$\alpha_{hk} < 1$$
$$\alpha_{hk} \neq 0$$

where $c_{hkt}$ and $\alpha_{hk}$ are parameters to be estimated.

**Considerations in the choice of model.** Firstly, consideration was given to whether a conditional demand system based on an additive direct utility function is an advantage or a disadvantage for the analysis regarding cut flowers and pot plants. This point was raised because the Linear Expenditure System is derived from an additive direct utility function. Generally, an additive direct utility function is considered to be defensible only for product classes and not for individual products, because in such a function complementarity between product classes and inferiority of product classes are both ruled out. This characteristic of the utility function is invariant under any monotonic increasing transformation of this function. Since at most, three subclasses within the product class of cut flowers and pot plants are distinguished, substitutability between these subclasses rather than complementarity can be expected. Inferiority of a product, which is often observed, for example, when a basic food is partly replaced by that which is more luxurious when income increases, is not likely to be the case for flowers and plants. This can be illustrated with the positive income elasticities for cut flowers and pot plants estimated by Nicolaus (1975, 1976) for Belgium, and Ostendorf (1975) for West Germany; and the positive relationship between social class and habitual buyers' expenditure suggested in the present study (Table 5.5). These arguments suggest that a demand system based on an additive direct utility function can be applied to the budget allocation to subclasses of cut flowers and pot plants.

Secondly, the ease with which variables other than budget and prices can be incorporated in the demand system was considered. Such variables include expenditure on advertising on each subclass distinguished, and lagged endogeneous variables. In the Linear Expenditure System and the Indirect Addilog Model, the parameters $c_{hkt}$ ($k = 1,2,..., K$) can be used for this purpose. For flowers and plants the model can be specified as

$$c_{hkt} = f(r_{kt}, r_{kt-1}, q_{hk,t-s}) \tag{6.4}$$

where $r_{kt}$ = expenditure on advertising for subclass k in period t

$q_{hk,t-s}$ = quantity of product class k purchases by household h in period $t-s$ ($s$ = time lag)

Since it is difficult to incorporate variables other than budget and prices in the Rotterdam model, that system was not considered further. Thus, the choice of model was between the Linear Expenditure System and the Indirect Addilog Model.

The third consideration was the extent to which the model met the restrictions set by the utility theory. In other words, the robustness of the demand system for deviations from the utility theory was considered. To this end, parameters were estimated in both the Linear Expenditure System (Equation 6.1b) and in the Indirect Addilog Model (Equation 6.3b). However, before conclusions can be drawn about the robustness of these systems, it is necessary to specify the length of period t and to specify $c_{hkt}$.

It would have been logical to have used the same period in the priority stage as in the budget stage. However, a period of one week was considered to be insufficient in length to determine preferences for each subclass of cut flowers or pot plants because of the actual interpurchase period (Figures 4.2 and 4.3). The length of t had to be such that sufficient purchases could be made in each of the subclasses distinguished. While on the other hand, the period t had to be as short as possible so that sufficient data were left to estimate the parameters in the model. The length of the observation period chosen was three months. The periods distinguished are the same as those in Chapter 5: December to Feb-

TABLE 6.1 Alternative specifications of $c_{hkt}$ in the Linear Expenditure System and in the Indirect Addilog Model, in which $e_{hk}$ and $_{hk}$ are parameters to be estimated

| Linear Expenditure System | Indirect Addilog Model |
|---|---|
| $e_{hk}$ | $e_{hk}$ |
| $e_{hk} + \gamma_{hk}q_{hk,t\text{-}s}$ | $e_{hk}q_{hk,t\text{-}s}^{\gamma_{hk}}$ |
| $\gamma_{hk}q_{hk,t\text{-}s}$ | $q_{hk,t\text{-}s}^{\gamma_{hk}}$ |

ruary (winter); March to May (spring); June to August (summer) and September to November (autumn). A time series was established for every household consisting of eight periods each of three months.

Alternative specifications of $c_{hkt}$ with lagged versions of $q_{hkt}$ as explanatory variable were proposed (Table 6.1). Data on advertising, specific to each subclass of flowers and plants were not available.

The parameters $\gamma_{hk}$ in Table 6.1 which are a measure of habit formation (Pollak and Wales 1969), require that $\gamma_{hk} > 0$ for $k = 1,2,\ldots,K$.

The variable $c_{hkt}$ included in the Linear Expenditure System and in the Indirect Addilog Model can be specified as follows

$$c_{hkt} = f(m_{hk,t-s}/p_{k,t-s}) \tag{6.5}$$

As the variable $q_{hkt}$ represents either a number of bunches of cut flowers or a number of pot plants, Equations 6.1b and 6.3b were redefined with expenditure on a subclass as the variables to be explained. If $p_{kt}$ is included in both sides of Equation 6.1b, then

$$m_{hkt} = c_{hkt}p_{kt} + \beta_{hk}(m_{ht} - \sum_j c_{hjt}p_{jt}) \tag{6.6}$$

As $c_{hkt}$ is a measure of quantity, it should be specified as in Equation 6.5, and insertion in Equation 6.6 gives

$$m_{hkt} = f\left(\frac{m_{hk,t-s}}{p_{k,t-s}}\right)p_{kt} + \beta_{hk}[m_{ht} - \sum_{j=1}^{K} f\left(\frac{m_{hj,t-s}}{p_{j,t-s}}\right)p_{jt}] \tag{6.7}$$

To test the Linear Expenditure System and the Indirect Addilog Model for robustness on deviations from the utility theory, parameters in the Linear Expenditure System and the Indirect Addilog Model were estimated for the alternative specifications for $c_{hkt}$ given in Table 6.1. A time lag s of one 3-month period (number of observations $K*(T\text{-}s) = 3*7 = 21$), or four 3-month periods (12 observations) was chosen. A time lag of four 3-month periods means that $m_{hkt}/p_{kt}$ for the corresponding period in the previous year becomes an explanatory variable in the model. The procedure for the estimation of parameters in the Indirect Addilog Model was described by Van Driel (1974), and that for the estimation of parameters in the Linear Expenditure System by Pollak and Wales (1969). The third alternative given in Table 6.1, with a time lag of four 3-month periods gave by far the best results in both demand systems. Results were often obtained with the Linear Expenditure System, in which all constraints $q_{hkt} > c_{hkt}$, $\beta_{hk} > 0$ ($k=1,2,....,K$) and $\sum_k \beta_{hk} = 1$ were met, but the Indirect Addilog Model never fulfilled the requirements $\alpha_{hk} < 1$ ($k=1,2,...K$). The Linear Expenditure System was, therefore, selected to explain household behaviour in the choice of subclasses.

### *6.2.2 Linear Expenditure System*

**Interpretation of the parameters in the Linear Expenditure System.** In this system, described by Equation 6.6, the parameters $\beta_{hk}$ ($k=1,2,...K$) are marginal budget shares. A set of marginal budget shares divide each additional guilder in the flower and plant budget among the K subclasses in fixed proportions $\beta_{h1},..., \beta_{hK}$. In literature on the Linear Expenditure System, $c_{hkt}$ is often interpreted as the 'necessary', 'committed' or 'minimum required' quantity of k which the consumer purchases without regard to price, or as the 'subsistence', 'permanent', or 'threshold' level of demand. This interpretation is only possible when $c_{hkt} > 0$ for $k=1,2, ..., K$. In this application $c_{hkt} > 0$ since $\gamma_{hk} > 0$. Equation 6.6 can now be interpreted as follows. A habitual buyer h purchases threshold quantities $c_{hkt}$ ($k=1,2, ...,K$), irrespective of the price levels for the subclasses k and divides the remainder of the budget $m_{ht} - \sum_j c_{hjt}p_{jt}$ among the subclasses k ($k=1,2, ...,K$) in fixed proportions $\beta_{h1}, ...,\beta_{hK}$.
For given $m_{hk,t-4}/p_{k,t-4}$ and $0<\gamma_k<1$, the equation

$$c_{hkt} = \gamma_{hk} m_{hk,t-4}/p_{k,t-4} \tag{6.8}$$

can be interpreted as follows.

The greater or smaller the similarity in demand between corresponding 3-month periods in two subsequent years, the greater or smaller are $\gamma_{hk}$ and $c_{hkt}$. According to the utility function (Equation 6.1a), the greater or smaller $c_{hkt}$ is, the smaller or greater the contribution of $q_{hkt}$ to the utility attributed to the product class. This means that more utility is due to variation (low value for $\gamma_{hk}$) than to stability (high value of $\gamma_{hk}$) in demand for subclass k in corresponding 3-month periods in two subsequent years. Households become accustomed to purchasing a certain quantity of flowers. This seemed to be a reasonable assumption for habitual buyers of cut flowers and pot plants.

An increase in the threshold level for subclass k means that more products will be bought in that subclass, and less in other subclasses, because in Equation 6.1b

$$dq_{hkt}/dc_{hkt} = 1 - \beta_{hk} > 0$$

and

$$dq_{hjt}/dc_{hkt} = -\beta_{hj}p_{kt}/p_{jt} < 0 \text{ for } j \neq k$$

The notion of a threshold level of consumption before utility can be derived differs from the law of diminishing marginal utility in which it is assumed that most utility is derived from the first quantity consumed. It is quite reasonable to assume that habitual buyers of cut flowers and pot plants are accustomed to purchasing certain minimum quantities, and that they consider these purchases as a part of their customary way of life. This means in terms of Equation 6.1a that optimalization of utility derived from purchased products only starts after the threshold level has been reached.

**Stochastic specification.** In empirical research with the Linear Expenditure System, two methods are used to specify a stochastic term in Equation 6.1b. One method is to add a stochastic term $u_{hkt}$ to the equation with mean zero and covariance $\sigma_{hjk}$ for $k = 1,2,\ldots,K$ (e.g.,Lluch, Powell and Williams 1977). Let $\Omega_h$ be the (K*K)-covariance matrix for household h, then $\Omega_h$ is singular because of the budget constraint. Another procedure is to include a stochastic term in the utility function (Equation 6.1a). These random shocks are introduced to take into account effects other than budget and prices on buying behaviour (e.g., Pollak and Wales 1969; Barten 1966, 1968; and Theil 1975). It is assumed that the stochastic component in the utility function is independent of budget and prices.

Pollak and Wales (1969) specified a utility function with random shock $a_{hkt}$ as

$$z_{ht} = \sum_{k=1}^{K} \beta_{hk} \ln (q_{hkt} - (c_{hkt} + a_{hkt})) \tag{6.9}$$

$$\text{with } \beta_k > 0, \sum_k \beta_k = 1$$

$$\text{and } q_{hkt} - (c_{hkt} + a_{hkt}) > 0$$

Maximization of this utility function under the budget restriction gives

$$q_{hkt} = (c_{hkt} + a_{hkt}) + \frac{\beta_{hk}}{p_{kt}} (m_{ht} - \sum_{j=1}^{K} p_{jt} (c_{hjt} + a_{hjt}))$$

or

$$q_{hkt} = c_{hkt} + \frac{\beta_{hk}}{p_{kt}} (m_{ht} - \sum_j p_{jt} c_{hjt}) + u_{hkt} \tag{6.10}$$

$$\text{with } u_{hkt} = a_{hkt} - \frac{\beta_{hk}}{p_{kt}} \sum_{j=1}^{K} p_{jt} a_{hjt}$$

Parameters are estimated in the system ($k = 1,2,\ldots,K$)

$$m_{hkt} = c_{hkt} p_{kt} + \beta_{hk} (m_{ht} - \sum_j p_{jt} c_{hjt}) + v_{hkt} \tag{6.11}$$

$$\text{with } v_{hkt} = p_{kt} u_{hkt} = p_{kt} a_{hkt} - \beta_{hk} \sum_{j=1}^{K} p_{jt} a_{hjt}$$

The (K*1) disturbance vector $v_{hkt}$ can be written in matrix notation as follows

$$v_{ht} = (\dot{p}_t - \beta_h p_t') a_{ht} = N_t a_{ht} \tag{6.12}$$

where $\dot{p}_t$ is a diagonal matrix with $p_{kt}$ on the main diagonal (k = 1,2,....,K).

Assume $E\, a_{ht} = 0$ and $E\, a_{ht} a_{ht}' = \sigma_h^2 \Omega_h$,

$$\text{then } E\, v_{ht} = 0 \text{ and } E\, v_{ht} v_{ht}' = \sigma_h^2 N_t \Omega_h N_t' \tag{6.13}$$

As $\iota' v_{ht} = \sum_{k=1}^{K} v_{hkt} = 0$, $E\, v_{ht} v_{ht}'$ is singular.

Theil (1975) and Barten (1966, 1968) have also specified a utility function with random shocks (Appendix IV.2).

In Equation 6.13, heteroscedasticity between the subclasses distinguished means that the elements of the main diagonal of $E\, v_{ht} v_{ht}'$ are different. Elements on the main diagonal differ even if $\Omega_h$ is equal to $I_K$. If $\Omega_h$ is equal to $I_K$, then the main diagonal is specified in advance, which may or may not correspond with heteroscedasticity in reality. Since, however, the number of observations and thus the number of degrees of freedom for parameter estimation is very small, the specification $\Omega_h = I_K$ was chosen.

In empirical research in which parameters are estimated with demand systems by means of a time-series analysis, the autocorrelation in each equation for k = 1,2,....,K may be tested (e.g., Lluch, Powell and Williams 1977). In the present study, the number of observations for each k is eight 3-month periods. A time-lag in the specification of $c_{hkt}$ of four 3-month periods gave by far the best results, so therefore the number of observations was reduced to four, which is too few to test for autocorrelation. Inclusion of lagged variables often reduces autocorrelation, thus the autocorrelation between $v_{hkt}$ and $v_{hk,t-1}$ in Equation 6.11 was expected to be small (e.g., Pollak and Wales 1969, p 618). The parameter estimates obtained from this analysis were used as an independent variable in an analysis of the relationship between parameter estimates and household characteristics.

**Parameter estimation.** Parameters in the Linear Expenditure System were estimated with a maximum likelihood estimation procedure. Let $v_{ht}$ in Equation 6.13 have a multivariate normal distribution with mean 0 and covariance $\sigma_h^2 N_t N_t'$. Since the covariance matrix is singular, to obtain maximum likelihood estimates of the system of demand equations (k = 1,2,...K), one equation must be dropped and the likelihood function of the reduced system maximized. This procedure yields maximum likelihood estimates for the full system (e.g., Pollak and Wales 1969) and the estimates obtained are independent of the equation omitted, if autocorrelation is absent (e.g., Berndt and Savin 1975).

Assume that $v_{h1}, v_{h2}, \ldots\ldots, v_{hT}$ are independently distributed, then the likelihood function for Equation 6.11 is

$$-\tfrac{1}{2}\left[\sum_{t=s+1}^{T} \ln |\sigma_h^2 N_t^* N_t^{*\prime}| + \sum_{t=s+1}^{T} v_{ht}^{*\prime} (\sigma_h^2 N_t^* N_t^{*\prime})^{-1} v_{ht}^*\right] \qquad (6.14)$$

where $N_t^*$ is $N_t$ with the Kth row deleted and $v_{ht}^*$ is $v_{ht}$ with the Kth element deleted (e.g., Pollak and Wales 1969).

The function (Equation 6.14) to be optimized was supplied as input in a non-linear optimization programme (OPTPACK 3, 1977). For optimization of Equation 6.14 a quasi-Newton method, the Davidon-Fletcher-Powell (DFP) method was chosen (e.g., Walsh 1975). This procedure needs a gradient vector of first derivatives as input, which was difficult to obtain and was, therefore, approximated by the numerical differentiation subprogramme of OPTPACK. If this optimization procedure converges, then asymptotic standard errors of the parameter estimates can be obtained as follows. Optimum parameter values acquired with the DFP method are supplied as input in the Newton-Fiacco-McCormick (NFM) optimization method. This method works particularly well when a close initial estimate of the optimal point can be supplied. Then, in addition to the gradient, the Hessian matrix of second derivatives is required as input. The Hessian was also approximated by numerical differentiation. From the Hessian that resulted from the NFM optimization procedure, asymptotic standard errors of the parameter estimates in Equation 6.14 were derived.

In all applications, $c_{hkt}$ in the Linear Expenditure System was replaced by $\gamma_{hk}\, m_{hk,t-4}/p_{k,t-4}$. The parameters to be estimated for each household h were $\beta_{h1}$, $\beta_{h2}, \ldots\ldots, \beta_{h,K-1}, \gamma_{h1}, \gamma_{h2}, \ldots, \gamma_{h,K}$ and $\sigma_h$. Since it is possible in OPTPACK to restrict the parameters to be optimized to certain intervals, the following restrictions were introduced as input to the optimization procedure. The number of alternatives K may vary between 2 and 3, and this will be discussed in Section 6.3.

If $K = 3$, then $0.01 \leqq \hat{\beta}_{hk} \leqq 0.98$

and

if $K = 2$, then $0.01 \leqq \hat{\beta}_{hk} \leqq 0.99$ for $k = 1,2,\ldots,K\text{-}1$.

The restrictions, $0.01 \leqq \hat{\gamma}_{hk} \leqq 1.25$ and $\hat{\sigma}_h \geqq 0$ , do not depend on the size of K. The parameter $\hat{\beta}_{hK}$ is obtained by $\hat{\beta}_{hK} = 1 - \sum_{k=1}^{K} \hat{\beta}_{hj}$, but for $K = 3$ it is not guaranteed that $\hat{\beta}_{hK} > 0$.

Asymptotic standard errors of $\hat{\beta}_{hK}$ were obtained using the procedure described by Lluch, Powell and Williams (1977, p 30). The parameter $\gamma_{hk}$ measures the degree of habit formation (Pollak and Wales 1969) in subclass k, then $\hat{\gamma}_{hk}$ must be greater than zero. If a large number of observations is available, $\gamma_{hk}$

will often be less than 1, because of irregularity in buying behaviour. However, because purchases in only two subsequent years were analysed, several households purchased more products in subclass k in period t than in period t-4 because of either irregularity in demand or an annual increase (trend) in demand. Therefore, $\hat{\gamma}_{hk} > 1$ is permissible. To prevent $\hat{\gamma}_{hk}$ becoming too high, which implies that the constraint $\hat{q}_{hkt} > \hat{\gamma}_{hkt}$ will not be met, the requirement $\gamma_{hk} \leqq 1.25$ has been added. This does not imply that $\hat{q}_{hkt}$ will always be greater than $\hat{c}_{hkt}$ (Equation 6.1a). The requirement that $\hat{q}_{hkt} > \hat{c}_{hkt}$ for each k and t is replaced by a necessary but not sufficient condition $\sum_j (\hat{q}_{hjt} - \hat{c}_{hjt})\, p_{jt} > 0$. However, the consequence is that the theoretical boundaries which hold for price and budget elasticities can be violated. Finally, by definition $\sigma_h$ must be greater than zero.

Parameters in the demand system Equation 6.11 with specification Equation 6.13 for the disturbance term were estimated with the likelihood function Equation 6.14. This maximization procedure always converged on the same parameter values, irrespective the choice of starting values. This was not true for the Linear Expenditure System with a disturbance term corresponding to the utility function with random shocks of Theil (1975) and Barten (1966, 1968). Consequently, the demand system specified in Equation 6.11 with Equation 6.13 as the disturbance term was chosen to estimate the parameters.

A statistic $R_h^2$ was calculated as a descriptive indicator of the goodness of fit.

$$R_h^2 = 1 - \frac{\sum_k \sum_t (m_{hkt} - \hat{m}_{hkt})^2}{\sum_k \sum_t (m_{hkt} - \bar{m}_h)^2} \tag{6.15}$$

where $\hat{m}_{hkt}$ is the estimated expenditure of household h in subclass k in period t

and

$$\bar{m}_h = \frac{1}{K.T} \sum_k \sum_t m_{hkt} \tag{6.16}$$

**Budget and price elasticities.** A demand system based on utility maximization subject to a budget constraint implies that the system has several characteristics; one of which is that every demand equation is homogeneous of degree zero in budget and prices, implying that

$$\sum_{l=1}^{K} E(q_k, p_l) = -EE(q_k, m) \tag{6.17}$$

where

$E(q_k, p_l)$ = the uncompensated price elasticity of the responsiveness of the quantity demanded in subclass k to a price change in subclass l;

$EE(q_k, m)$ = the budget elasticity of the responsiveness of the quantity demanded in subclass k to a change in the flower and plant budget m.

Another characteristic is the Slutsky equation, which means that the reaction of the quantity demanded of subclass k to a price change, or the price of any other subclass l can be broken down into a substitution effect and a budget effect. This implies that

$$E(q_k, p_l) = E^*(q_k, p_l) - w_l EE(q_k, m) \tag{6.18}$$

where $w_l$ is the budget share for subclass l,

and

$E^*(q_k, p_l)$ = the compensated price elasticity of the responsiveness of quantity demanded of subclass k to a price change in subclass l.

It can be derived from Equation 6.17 and 6.18 that

$$\sum_{l=1}^{K} E^*(q_k, p_l) = 0 \tag{6.19}$$

It can be derived from the Linear Expenditure System

$$q_{hkt} = c_{hkt} + \frac{\beta_k}{p_{kt}}(m_{ht} - \sum_j c_{hjt}p_{jt}) + u_{hkt} \text{ for } k = 1,2,\ldots,K. \tag{6.20}$$

that the budget elasticity $EE(q_k, m) = \beta_k/w_k$ for $k = 1,2,\ldots,K$, and the uncompensated and compensated price elasticities are given in Table 6.2.

Table 6.2 Uncompensated and compensated price elasticities derived from the Linear Expenditure System (Equation 6.20)

| | | $E(q_k, p_l)$ | $E^*(q_k, p_l)$ |
|---|---|---|---|
| $k = l$ | | $-1 + \frac{c_k p_k}{w_k m}(1-\beta_k)$ | $\frac{\beta_k}{w_k}(\beta_k - 1)\frac{m - \sum_j c_j p_j}{m}$ |
| | or | $-1 + \frac{(1-\beta_k)}{w_k}\frac{c_k p_k}{m}$ | |
| $k \neq l$ | | $-\frac{\beta_k}{w_k}\frac{c_l p_l}{m}$ | $\frac{\beta_k}{w_k}\beta_l\frac{m - \sum_j c_j p_j}{m}$ |

From the budget elasticity, the price elasticities in Table 6.2, the requirements specified for Equation 6.1a and the requirement $c_{hkt} > 0$ for all k (habit formation), the following can be deduced

$EE(q_k,m) > 0$, which implies exclusion of inferiority for products in each subclass. This seems to be a reasonable assumption for cut flowers and pot plants. If the value of $E(q_k,m)$ is in the interval (0,1), then products in the subclass k are considered to be necessities. If this value is greater than one, then the products in subclass k are considered to be luxury products.

$-1 < E(q_k,p_k) < 0$, which implies exclusion of a price elastic demand for products in subclass k. As already discussed in Chapter 5, the mean price elasticity of the number of flower and plant purchases was $-0.81$ for habitual buyers. This does not imply, however, that price elasticities for the subclasses k are in the interval $(-1,0)$.

$E*(q_k,p_k) < 0$, the compensated own price elasticity for subclass k must be negative.

$E(q_k,p_l) < 0$ and $E*(q_k,p_l) > 0$ for $k \neq l$, implying that products in subclasses k and l are gross complements or net substitutes (e.g., Powell 1974, p 41). The larger $E*(q_k,p_l)$ is, the more subclasses k and l are net substitutes, whereas the smaller this elasticity is, the more subclasses k and l are independent. It can be deduced from Equation 6.18 and $E(q_k,p_l) < 0$, that the budget effect of a price change is greater than the substitution effect.

In Sections 6.4 and 6.5, the following aspects of the budget and price elasticities are discussed: the degree to which individual products in a particular product class are considered to be necessary or luxury products; the extent to which individual products in a particular product class are considered to be price elastic (generally, expensive products are more price elastic than less expensive products); and the extent to which products in various product classes are net substitutes.

From the mathematical expectation of $q_{hkt}$ in Equation 6.10, it can be derived that the price elasticities in Table 6.2 are identical to those in Table 6.3 in which PE is an uncompensated and PE* is a compensated price elasticity.

Table 6.3 Uncompensated and compensated price elasticities derived from the Linear Expenditure System, in which $q_{ht}$ is replaced by its mathematical expectation

| | $PE(q_k,p_l)$ | $PE^*(q_k,p_l)$ | $w_l\ EE(q_k, m)$ |
|---|---|---|---|
| $k = l$ | $-\frac{\beta_k}{w_k}(1 - \sum_{j\neq k} \frac{p_jc_j}{m})$ | $-\frac{\beta_k}{w_k}\sum_{j\neq k}(w_j - \frac{p_jc_j}{m})$ | $w_k \cdot \frac{\beta_k}{w_k} = \beta_k$ |
| $k \neq l$ | $-\frac{\beta_k}{w_k}\frac{p_lc_l}{m}$ | $\frac{\beta_k}{w_k}(w_l - \frac{p_lc_l}{m})$ | $w_l \cdot \frac{\beta_k}{w_k}$ |
| $\sum_{l=1}^{K}$ | $-\frac{\beta_k}{w_k}$ | 0 | $\frac{\beta_k}{w_k}$ |

Note: PE is the uncompensated price elasticity
PE* is the compensated price elasticity

For the budget and price elasticities specified in Table 6.3 (e.g., Parks and Barten 1973), Equations 6.17 to 6.19 hold exactly, irrespective of whether $u_{hkt}$ is equal or not to zero for $k = 1,2,...,K$. This is not true for the price elasticities given in Table 6.2. If $u_{hkt}$ for $k = 1,2,....K$ is not equal to zero, then three of the four price elasticities specified in the Table 6.2 and 6.3 differ as follows

$$PE(q_{kt}, p_{kt}) - E(q_{kt}, p_{kt}) = \frac{u_{kt}}{q_{kt}} = \frac{v_{kt}}{m_{kt}} \tag{6.21a}$$

$$PE^*(q_{kt}, p_{kt}) - E^*(q_{kt}, p_{kt}) = \beta_k \frac{u_{kt}}{q_{kt}} = \beta_k \frac{v_{kt}}{m_{kt}} \tag{6.21b}$$

$$PE^*(q_{kt}, p_{lt}) - E^*(q_{kt}, p_{lt}) = \beta_k \frac{u_{lt}}{q_{kt}} = \beta_k \frac{v_{lt} p_{kt}}{m_{kt} p_{lt}} \tag{6.21c}$$

where $v_{kt}$ is defined in Equation 6.11 and the subscript h is deleted for the present. The better $q_{hkt}$ can be explained with the Linear Expenditure System, the smaller the differences will be between the elasticities specified in Equations 6.21a-6.21c.

A further complication has already been indicated in the previous section. If the requirement $\hat{q}_{hkt} > \hat{c}_{hkt}$ is replaced by the weaker condition

$$d_{ht} = m_{ht} - \sum_j \hat{c}_{hjt} p_{jt} = \sum_j p_{jt} (q_{hjt} - \hat{c}_{hjt}) > 0, \tag{6.22}$$

then some of the boundaries of the price elasticities specified above may be violated. The boundaries of the price elasticities that are maintained with $d_{ht} > 0$ are specified in Table 6.4.

Table 6.4 Theoretical boundaries for the price elasticities with the requirement that $d_{ht} > 0$, but with some $\hat{q}_{hkt}$ smaller than $\hat{c}_{hkt}$

| E | PE | E = EP? |
|---|---|---|
| $E(q_k, p_k) > -1$ | $PE(q_k, p_k) < 0$ | no |
| $E(q_k, p_l) < 0$ | $PE(q_k, p_l) < 0$ | yes |
| $E^*(q_k, p_k) < 0$ | $PE^*(q_k, p_k) \lesseqgtr 0$[a)] | no |
| $E^*(q_k, p_l) > 0$ | $PE^*(q_k, p_l) > 0$ if $q_l > c_l$<br>$= 0$ if $q_l = c_l$<br>$< 0$ if $q_l < c_l$ | no |

a) Sign is dependent on size of $\hat{q}_j$ compared to $\hat{c}_j$ for $j = 1,2,..., K$ and $j \neq k$.

The price elasticities in Table 6.3 are reported in Sections 6.4 and 6.5. In order to determine the differences between $E(q_k,p_k)$ and $PE(q_k,p_k)$ and between $E^*(q_k,p_k)$ and $PE^*(q_k,p_k)$, the values of $E(q_k,p_k)$ and $E^*(q_k,p_k)$ are also given (Appendices IV.5 and IV.6).

If a habitual buyer did not purchase in a particular subclass in period t ($t = 5$ to 8), then elasticities were not calculated for that household. If a habitual buyer did not purchase in a subclass k in a period t ($t = 1$ to 4), then $c_{hk,t+4} = 0$ and $E(q_k,p_k) = PE(q_k,p_l) = 0$ in $t+4$ for $k \neq 1$. These observations have not been included in the frequency distributions of the budget and price elasticities.

*6.2.3 Model explaining differences in response parameters*

In this section, a model is specified to explain differences between households in corresponding parameter estimates in the Linear Expenditure System, and the budget and price elasticities, calculated with these estimates. The explanatory variables are the household characteristics as defined in Section 5.2.4. The parameters in the Linear Expenditure System have their own interpretation, but they also affect the size of the budget and price elasticities (Table 6.3).

The general form of the model to explain differences between households in parameter estimates $\hat{\beta}_{hk}$ is

$$E\,\hat{\beta}_{hk} = f_k(x_{h1}, \ldots\ldots, x_{hL}) \quad \text{for } h = 1, 2, \ldots, H. \tag{6.23}$$

where

$\hat{\beta}_{hk}$ is the estimate of household h's marginal budget share for subgroup k (Equation 6.11);
$x_{hl}$ is the lth characteristic of household h ($l = 1,2,\ldots,L$).

Each observation of $\hat{\beta}_{hk}$ is subject to a disturbance term $\varepsilon_{hk}$ which is the disturbance for household h in respect of class k. It is assumed that $\varepsilon_{hk}$ is normally distributed with $E\varepsilon_{hk} = 0$ and $E\varepsilon^2_{hk} = \sigma_{kk}$. It is further assumed that

$$E\varepsilon_{hk} \cdot \varepsilon_{hk'} = \sigma_{kk'} \text{ for } k \neq k'$$

because

$\sum_{j=1}^{K} \hat{\beta}_{hj} = 1$, and that $E\varepsilon_{hk} \cdot \varepsilon_{h'k'} = 0$ for $h \neq h'$ and all combinations of k and k'. This means that the disturbance in any single equation is homoscedastic, that the value of the constant variance can differ between equations, and that for a given household the disturbances in various equations are dependent. This means that the covariance matrix $E(\varepsilon\varepsilon')$ of a system of K Equations 6.23 has the form

$$\Omega_{23} = \begin{bmatrix} \sigma_{11} & 0 & \sigma_{12} & 0 & \sigma_{13} & 0 \\ 0 & \sigma_{11} & 0 & \sigma_{12} & 0 & \sigma_{13} \\ \sigma_{21} & 0 & \sigma_{22} & 0 & \sigma_{23} & 0 \\ 0 & \sigma_{21} & 0 & \sigma_{22} & 0 & \sigma_{23} \\ \sigma_{31} & 0 & \sigma_{32} & 0 & \sigma_{33} & 0 \\ 0 & \sigma_{31} & 0 & \sigma_{32} & 0 & \sigma_{33} \end{bmatrix} \text{ for K} = 3 \text{ and H} = 2. \quad (6.24)$$

Generally, the covariance matrix E ($\varepsilon\varepsilon'$) must be estimated before the parameters in a particular specification of Equation 6.23 can be estimated.

As it is required that the response parameter estimates $\hat{\beta}_{hk}$ are positive for $k = 1,2,...,K$ and $\sum_{j=1}^{K} \hat{\beta}_{hj} = 1$, consideration should be given to whether provision should be made in Equation 6.23 to take these conditions into account. The attraction model of Nakanishi and Cooper (1974) satisfies these conditions. Let

$$z_{hk} = \exp\{\sum_{l=0}^{L} \alpha_{kl} x_{hl}\} \exp \varepsilon_{hk}, \quad (6.25a)$$

where $\alpha_{kl}(l = 0, 1, 2, ..., L)$ are parameters to be estimated and $x_{ho} = 1$ for all h.

Then Nakanishi and Cooper's model can be defined as

$$\hat{\beta}_{hk} = \frac{z_{hk}}{\sum_{j=1}^{K} z_{hj}} \quad (6.25b)$$

Equation 6.25 can be linearized according to the procedure described by Nakanishi and Cooper which implies that the parameters can be estimated with linear regression analysis. However, the covariance matrix $\Omega$ is also transformed by this linearization.

Alternatively, Equation 6.23 can be defined as

$$\hat{\beta}_{hk} = \sum_{l=0}^{L} \alpha_{kl} x_{hl} + \varepsilon_{hk} \quad (6.26)$$

with $x_{ho} = 1$ for all h. This equation can be written in matrix notation as follows

$$\hat{\beta}_k = X\alpha_k + \varepsilon_k$$

The whole system for $k = 1,2,...,K$ can be written as

$$\begin{bmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ | \\ | \\ | \\ \hat{\beta}_K \end{bmatrix} = \begin{bmatrix} X & 0 & 0 \\ 0 & X & 0 \\ | & \ddots & | \\ 0 & 0 & X \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ | \\ | \\ | \\ \alpha_K \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ | \\ | \\ | \\ \varepsilon_K \end{bmatrix} \quad (6.27)$$

or simply as $\hat{\beta} = X^*\alpha + \varepsilon$ with $E(\varepsilon\varepsilon') = \Omega_{HK}$, where the first and last term are $(HK \times 1)$-vectors,
$X^*$ is a $(HK \times KL)$-matrix, $\alpha$ is a $(KL \times 1)$-vector and
$\Omega_{HK}$ is a $(HK \times HK)$-matrix.

The parameter $\alpha$ can be estimated as follows

$$\hat{\alpha} = (X^{*\prime}\, \Omega_{HK}^{-1}\, X^*)^{-1}\, (X^{*\prime}\, \Omega_{HK}^{-1}\, \hat{\beta}) \tag{6.28}$$

It can be proved that $\sum_{k=1}^{K} \hat{\alpha}_{kl} = 0$ for $l \neq 0$,

and $\sum_{k=1}^{K} \hat{\alpha}_{ko} = 1$ ,

which implies $\sum_{k} \hat{\hat{\beta}}_{hk} = 1.$

However, the condition $\hat{\hat{\beta}}_{hk} > 0$ is not quaranteed.

As X in Equation 6.27 is the same for each k, Equation 6.28 reduces to ordinary least squares estimators for each of the $\alpha_k$ ($k=1,2,\ldots,K$), whatever the structure of the covariance matrix of the disturbances (e.g., Johnston 1972, pp 238-241). In this special case, the application of generalized least squares to the whole system is equivalent to the application of ordinary least squares to the individual equations. This means that in $\Omega_{HK}$ all non-zero elements outside the main diagonal may be assumed to be zero. Since the difficulty of estimating $\Omega_{HK}$ can thus be circumvented, Equation 6.26 was preferred for estimating the parameters $\alpha_{kl}$, even though there was some risk of obtaining negative values for $\hat{\hat{\beta}}_{hk}$.

Whether or not parameter estimates in Equation 6.26 should be corrected for heteroscedasticity is discussed in Appendix IV.3. It was decided not to correct for heteroscedasticity because any correction would in turn probably decrease the quality of the parameter estimates.

As there are also restrictions on the elasticities (Equations 6.17-6.19), the same type of model was chosen to explain differences in estimates of elasticities between households by differences in household characteristics. Since the parameters $\gamma_{hk}$ are not dependent, ordinary least squares can be used to explain the relationship between these parameters and household characteristics.

## 6.3 Classification of habitual buyers according to the size of the evoked set

In this section, flower and plant subclasses, distinguished by habitual buyers in their evoked set, are examined. The evoked set consists of the subclasses actively considered before making purchases of flowers and plants. As purchases for gifts may reflect the preference of the receiver and not that of the purchaser, a particular subclass was assumed to belong to the evoked set of a household, if at least 5% of expenditure between December 1972 and November 1974 was spent on that subclass.

The Linear Expenditure System requires that products were purchased in all K subclasses considered in the model. The model was therefore applied only to the subclasses which were assumed to belong to a household's evoked set. If, however, expenditure on a particular subclass exceeded 90% of expenditure on flowers and plants in the period, it cannot be reasonably assumed that budget allocation to subclasses took place, and therefore the budget allocation model was not applied to that household.

Habitual buyers are classified in Figure 6.1 according to the proportion of their flower and plant budget spent on each of the subclasses. During the period of the study, December 1972 to November 1974, about 15% of habitual buyers spent more than 90% of their total flower and plant budget on the subclass, cut flowers, but none spent more than 90% of their budget on pot plants. About 25% bought cut flowers and pot plants, that is predominantly flowering plants, and about 5% cut flowers and pot plants, that is predominantly green plants; while about 55% bought cut flowers and both flowering and green pot plants.

The Linear Expenditure System, in which cut flowers, flowering pot plants, and green pot plants are distinguished as separate classes, was applied to the data for each of the 200 habitual buyers. For 12 of the 200, the condition $\hat{\beta}_{hK} > 0$ did not hold, and for a further 61 the condition $d_{ht} > 0$ ($t = 5$ to 8) did not hold (Table 6.5). Results obtained with $\hat{\beta}_{hK} < 0$ or $d_{ht} \leqq 0$ were caused by strong variation in household buying behaviour between corresponding seasons of the two years of the study. The sample means of the household characteristics of the remaining 127 habitual buyers did not differ significantly from those of the 73 with either $\hat{\beta}_{hK} < 0$ or $d_{ht} \leqq 0$ at a 5% significance level (Hotelling's $T^2$ test).

The Linear Expenditure System, in which two subclasses, cut flowers and pot plants are distinguished, was applied to the data for each of the 93 habitual

TABLE 6.5 Extent to which constraints set by utility theory were met or approximated for habitual buyers ($n = 309$) with two or three subclasses in their evoked set

| Alternative subclasses considered | Number of habitual buyers | $\hat{\beta}_{hK} > 0$ | Both $\hat{\beta}_{hK} > 0$ and $d_{ht} > 0$ for $t = 5$ to 8 |
|---|---|---|---|
| Cut flowers, flowering plants, and green plants | 200 | 188 | 127 |
| Cut flowers and predominantly flowering pot plants | 93 | 93 | 58 |
| Cut flowers and predominantly green pot plants | 16 | 16 | 10 |

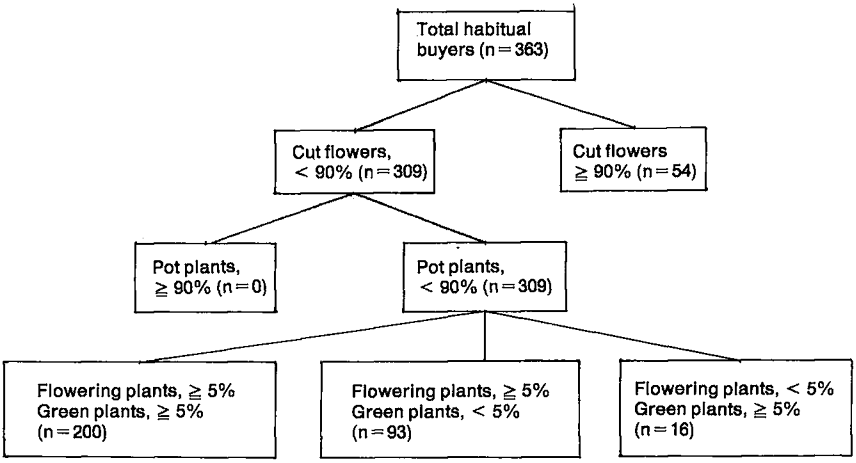



FIG. 6.1 The proportion (%) of flower and plant budget allocated by habitual buyers to cut flowers, flowering pot plants, and green plants (December 1972 – November 1974).

buyers purchasing cut flowers and pot plants, that is predominantly flowering plants, and to the data for each of the 16 habitual buyers purchasing cut flowers and pot plants, that is predominantly green plants. For these habitual buyers, negative $\hat{\beta}_{hK}$ could not be obtained because of the constraint $0.01 \leqq \hat{\beta}_{hl} \leqq 0.99$ (Table 6.5). For about one third, the condition $d_{ht} > 0$ ($t = 5$ to 8) did not hold. The sample means of household characteristics of those with $d_{ht} > 0$ and with $d_{ht} \leqq 0$ did not differ significantly at a 5% level.

Results for 58 habitual buyers with two subclasses in their evoked set are discussed in Section 6.4, and for 127 habitual buyers with three alternatives in their evoked set in Section 6.5. The relationship between choice for a subclass and household characteristics for all habitual buyers (n = 363), analysed outside the Linear Expenditure System framework, is discussed in Section 6.6.

## 6.4 Response parameter estimates for habitual buyers with two subclasses in their evoked set

In this section, the response parameter estimates of habitual buyers with two subclasses in their evoked set, cut flowers and pot plants, that is predominantly flowering plants, are discussed. For 58 of the 93 habitual buyers, the necessary condition $d_{ht} > 0$ for $t = 5$ to 8 was fulfilled (Table 6.5). Characteristics of the distributions of the parameter estimates, obtained with the Linear Expenditure System, and the budget and price elasticities derived from these estimates are given in Tables 6.6 and 6.7. The mean of the measure of goodness of fit, $\bar{R}^2$, of the estimated model was 0.90 . This high value may be explained partly by the low number (4) of degrees of freedom (see also Appendix IV.4).

The mean of the distribution of the estimated marginal budget shares for cut flowers was 0.72 with parameter estimates skewed more to the right than to the left of the mean. It therefore follows that, on average, of each additional guilder spent on flowers and pot plants, 72 cents were spent on cut flowers and 28 cents on flowering pot plants. These results can be interpreted with the aid of the budget elasticities for cut flowers and flowering pot plants. It depends on the ratio between the marginal and average budget share ($EE(q_k,m) = \beta_k/w_k$), whether the relative importance of a subclass decreases, remains stable, or increases during the course of time. If $EE(q_k,m) < 1$, then the relative importance of subclass k decreases; if $EE_k = 1$, then the relative importance of subclass k remains the same; and if $EE_k > 1$, then subclass k becomes relatively more important during the course of time. From the budget elasticities $EE(q_k,m) = \beta_k/w_k$ (Table 6.7), it can be derived that in this segment the budget share for cut flowers in all seasons and for flowering plants during winter, could be expected to remain stable, because $\beta_k \approx w_k$, but it could be expected that the budget share for flowering pot plants would increase in the other seasons of the year ($\beta_k > w_k$).

The means of the habit formation parameters (Table 6.6) were rather low: 0.29 for cut flowers, and 0.25 for flowering pot plants with the distribution

TABLE 6.6 Frequency distribution of parameters estimated in the Linear Expenditure System for individual households to explain the choice between cut flowers and predominantly flowering pot plants

| Parameter | Condition on parameters in the LES | Size | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| Marginal budget share for cut flowers ($\hat{\beta}_{h1}$) | whole segment | 93 | 0.01 | 0.99 | 0.68 | 0.25 | 0.26 | -0.88 |
| | $d_{ht} > 0$ | 58 | 0.01 | 0.99 | 0.72 | 0.20 | 1.96 | -1.28 |
| Marginal budget share for flowering pot plants ($\hat{\beta}_{h2}$) | whole segment | 93 | 0.01 | 0.99 | 0.32 | 0.25 | 0.26 | 0.88 |
| | $d_{ht} > 0$ | 58 | 0.01 | 0.99 | 0.28 | 0.20 | 1.96 | 1.28 |
| Habit formation for cut flowers ($\hat{\gamma}_{h1}$) | whole segment | 93 | 0.01 | 1.25 | 0.52 | 0.49 | -1.47 | 0.35 |
| | $d_{ht} > 0$ | 58 | 0.01 | 1.25 | 0.29 | 0.41 | 0.44 | 1.36 |
| Habit formation for flowering plants ($\hat{\gamma}_{h2}$) | whole segment | 93 | 0.01 | 1.25 | 0.36 | 0.46 | -0.53 | 0.99 |
| | $d_{ht} > 0$ | 58 | 0.01 | 1.25 | 0.25 | 0.38 | 0.99 | 1.47 |
| $\hat{\sigma}_h$ | whole segment | 93 | 0.02 | 6.44 | 1.18 | 0.92 | 10.22 | 2.25 |
| | $d_{ht} > 0$ | 58 | 0.07 | 3.18 | 1.27 | 0.68 | -0.25 | 0.44 |
| $R_h^2$ | whole segment | 93 | 0.54 | 1.00 | 0.91 | 0.10 | 3.31 | -1.77 |
| | $d_{ht} > 0$ | 58 | 0.54 | 1.00 | 0.90 | 0.10 | 3.43 | -1.78 |

skewed more to the left than to the right of the mean. This indicates that there was considerable variation in buying behaviour in the corresponding seasons in 1973 and 1974.

The mean budget and price elasticities are given in Table 6.7 for each period: winter 1973-1974, and spring, summer, and autumn 1974. Budget and price elasticities were not calculated for households not purchasing cut flowers or pot plants in a particular season. From the budget elasticities it can be inferred that flowering pot plants were considered to be more luxury products than cut flowers during spring, summer, and autumn 1974. In winter 1973-1974, the budget elasticities were similar for both product classes, most probably because of the relative scarcity of cut flowers during the winter. Given the assumption of a fixed budget for flowers and plants, either $EE(q_1,m)$ or $EE(q_2,m)$ should be greater than one. This condition is violated for winter 1973-1974 because of estimation errors.

Demand for cut flowers or pot plants by habitual buyers was reasonably price elastic in the four seasons distinguished, as can be deduced from the uncompensated own price elasticities in Table 6.7. The demand for cut flowers was more price elastic than that for flowering pot plants during winter 1973-1974, and did not differ very much in spring 1974. In summer and autumn 1974, the demand for cut flowers was less price elastic than that for pot plants because of the ample supply of relatively cheap cut flowers during this period.

The compensated cross-price elasticities $PE^*(q_k,p_l)$ indicate the extent to which the subclasses k and l were substitutes; for example, the mean of $PE^*(q_1,p_2) = 0.21$ and that of $PE^*(q_2,p_1) = 0.70$ in spring 1974. This means that cut flowers were more readily substituted for flowering pot plants than was the reverse. This was particularly so in spring, summer and autumn 1974.

The number of habitual buyers ($n = 58$) with $d_{ht} > 0$ was found to be too small to determine the relationships between parameter estimates or budget and price elasticities and household characteristics.

## 6.5 RESPONSE PARAMETER ESTIMATES FOR HABITUAL BUYERS WITH THREE SUBCLASSES IN THEIR EVOKED SET

### *6.5.1 Parameter estimates, and budget and price elasticities*

In this section, the results are discussed of the 200 habitual buyers with three subclasses in their evoked set, cut flowers, flowering pot plants, and green pot plants (Figure 6.1); in particular, the results of the 127 of these habitual buyers for which the conditions $\hat{\beta}_{hK} > 0$ and $d_{ht} > 0$ for $t = 5$ to 8 were fulfilled (Table 6.5). Frequency distributions of parameter estimates are given in Table 6.8; and the mean budget and price elasticities derived from these parameters in Table 6.9. The value of these parameter estimates and of elasticities are assumed to

TABLE 6.7 Mean [a] budget and price elasticities derived from the Linear Expenditure System for habitual buyers (n = 58) with two subclasses in their evoked set and $d_{ht} > 0$ for t = 5 to 8

| | Winter 1973-1974 | | Spring 1974 | | Summer 1974 | | Autumn 1974 | |
|---|---|---|---|---|---|---|---|---|
| | Cut flowers (k=1) | Pot plants (k=2) | Cut flowers (k=1) | Pot plants (k=2) | Cut flowers (k=1) | Pot plants (k=2) | Cut flowers (k=1) | Pot plants (k=2) |
| Budget elasticity $EE(q_k,m)$ | 1.15 | 1.07 | 0.95 | 1.46 | 0.97 | 1.71 | 0.94 | 1.30 |
| | 57 | 50 | 58 | 51 | 58 | 39 | 57 | 41 |
| Uncompensated price elasticity $PE(q_k,p_l)$ | | | | | | | | |
| Cut flowers (l=1) | -1.05 | -0.31 | -0.92 | -0.47 | -0.93 | -0.57 | -0.88 | -0.28 |
| | 57 | 50 | 58 | 51 | 58 | 39 | 57 | 40 |
| Pot plants (l=2) | -0.11 | -0.76 | -0.04 | -0.99 | -0.06 | -1.14 | -0.08 | -1.02 |
| | 52 | 50 | 45 | 51 | 36 | 39 | 44 | 41 |
| Compensated price elasticity $PE^*(q_k,p_l)$ | | | | | | | | |
| Cut flowers (l=1) | -0.33 | 0.46 | -0.21 | 0.70 | -0.26 | 0.82 | -0.17 | 0.73 |
| | 56 | 50 | 55 | 51 | 48 | 39 | 51 | 41 |
| Pot plants (l=2) | 0.33 | -0.46 | 0.21 | -0.70 | 0.26 | -0.82 | 0.17 | -0.73 |
| | 56 | 50 | 55 | 51 | 48 | 39 | 51 | 41 |

[a] Equations 6.17 and 6.19 do not always hold exactly for the means given in this table, because the number of households on which these means are based varies.

TABLE 6.8 Frequency distribution of parameters estimated in the Linear Expenditure System for individual households to explain the choice between cut flowers, flowering pot plants, and green pot plants

| Parameter | Conditions on the parameters | Size | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| Marginal budget share for cut flowers ($\hat{\beta}_{h1}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.01 | 0.98 | 0.52 | 0.27 | -0.84 | -0.30 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.01 | 0.97 | 0.53 | 0.26 | -0.66 | -0.45 |
| Marginal budget share for flowering pot plants ($\hat{\beta}_{h2}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.01 | 0.92 | 0.26 | 0.22 | -0.00 | 0.92 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.01 | 0.92 | 0.25 | 0.22 | 0.11 | 0.94 |
| Marginal budget share for green pot plants ($\hat{\beta}_{h3}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.00 | 0.94 | 0.23 | 0.20 | 1.08 | 1.27 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.00 | 0.94 | 0.21 | 0.19 | 2.52 | 1.56 |
| Habit formation for cut flowers ($\hat{\gamma}_{h1}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.01 | 1.25 | 0.46 | 0.40 | -0.94 | 0.42 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.01 | 1.25 | 0.34 | 0.38 | -0.52 | 0.82 |
| Habit formation for flowering pot plants ($\hat{\gamma}_{h2}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.01 | 1.25 | 0.43 | 0.47 | -1.03 | 0.72 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.01 | 1.25 | 0.34 | 0.42 | -0.20 | 1.08 |
| Habit formation for green pot plants ($\hat{\gamma}_{h3}$) | $\hat{\beta}_{hK} > 0$ | 188 | 0.01 | 1.25 | 0.23 | 0.38 | 2.15 | 1.85 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.01 | 1.25 | 0.17 | 0.33 | 4.27 | 2.28 |
| $\hat{\sigma}_h$ | $\hat{\beta}_{hK} > 0$ | 188 | 0.02 | 6.00 | 1.23 | 0.76 | 7.56 | 1.78 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.15 | 6.00 | 1.29 | 0.79 | 8.96 | 2.07 |
| $R^2_h$ | $\hat{\beta}_{hK} > 0$ | 188 | 0.23 | 1.00 | 0.84 | 0.15 | 2.45 | -1.50 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 127 | 0.23 | 1.00 | 0.83 | 0.16 | 2.33 | -1.48 |

be a function of household characteristics, estimates of which are discussed in Section 6.5.2.

**Marginal budget shares.** The mean marginal budget shares of the 127 habitual buyers was 0.53 for cut flowers, 0.25 for flowering pot plants, and 0.21 for green pot plants. This implies that of each additional guilder in the flower and plant budget 53 cents were spent on cut flowers, 25 cents on flowering pot plants, and 21 cents on green pot plants. In winter 1973-1974 and spring 1974, the budget share for cut flowers and for flowering pot plants was expected to be stable because $\beta_k \approx w_k$ (Table 6.9), but an increase in budget share could be expected for green pot plants ($\beta_k > w_k$). In summer and autumn, a decrease in the budget share for cut flowers could be expected, together with an increase in the budget share for flowering and green pot plants.

**Habit formation parameters.** The mean of the habit formation parameters (Table 6.8) was 0.34 for both cut flowers and flowering pot plants, and 0.17 for green pot plants, with the distribution skewed more to the left than to the right, especially for green pot plants. The low value for green pot plants can probably be explained by the fact that these plants keep better than cut flowers and flowering pot plants. The mean of the measure of goodness of fit ($\bar{R}^2$) of the estimated model was 0.83 with the distribution skewed more to the right than to the left of the mean. This high value may be explained partly by the relatively low number (6) of degrees of freedom (see also Appendix IV.4).

**Budget elasticities.** For habitual buyers with three subclasses in their evoked set, green pot plants can be considered to have been more of a luxury purchase than cut flowers in all seasons distinguished (Table 6.9), but especially during winter 1973-1974. Green pot plants can be considered to have been more of a luxury purchase than flowering pot plants during winter and spring 1974, but the reverse was the case during summer 1974, and flowering pot plants were as much a luxury purchase as green pot plants during autumn 1974. It can be concluded that within the product class of cut flowers and pot plants, cut flowers were considered to be necessities in all seasons; flowering pot plants necessities in winter and spring, but luxury products during summer and autumn; whereas green pot plants were luxury products in all seasons of 1974. Given the assumption of a fixed flower and plant budget, it is not possible that $EE(q_k,m) > 1$ for each $(k=1,2,....,K)$. Violation of this condition is due to estimation errors. The results suggest that in the case of an increase in income, and for given prices, the proportion of the expenditure on flowers and plants spent on cut flowers could be expected to increase to a lesser degree than that for both flowering and green pot plants. This tendency is partly supported by the data presented in Table I.1 in Appendix I, which relates to all households in the Netherlands and not only to habitual buyers with three subclasses in their evoked set. The proportion of the total expenditure on flowers and plants spent on cut flowers decreased from 68% in 1973 to 66% in 1975/1976, and subsequently increased to 75% in 1980.

TABLE 6.9 Mean budget and price elasticities derived from the Linear Expenditure System for habitual buyers (n = 127) with three subclasses in their evoked set, $\hat{\beta}_{hK} > 0$ and $d_{ht} > 0$ for t = 5 to 8

| | Winter 1973-1974 | | | Spring 1974 | | | Summer 1974 | | | Autumn 1974 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cut flowers (k=1) | Flowering pot plants (k=2) | Green pot plants (k=3) | Cut flowers (k=1) | Flowering pot plants (k=2) | Green pot plants (k=3) | Cut flowers (k=1) | Flowering pot plants (k=2) | Green pot plants (k = 3) | Cut flowers (k=1) | Flowering pot plants (k=2) | Green pot plants (k=3) |
| Budget elasticity | | | | | | | | | | | | |
| $EE(q_k,m)$ | 1.05 | 1.04 | 1.90 | 1.03 | 1.06 | 1.33 | 0.88 | 1.55 | 1.29 | 0.97 | 1.34 | 1.37 |
| | 125 | 113 | 63 | 127 | 113 | 95 | 124 | 83 | 70 | 123 | 97 | 80 |
| Uncompensated price elasticity $PE(q_k,p_l)$ | | | | | | | | | | | | |
| Cut flowers (l=1) | -0.87 | -0.27 | -0.44 | -0.87 | -0.24 | -0.28 | -0.83 | -0.51 | -0.27 | -0.86 | -0.44 | -0.46 |
| | 125 | 109 | 61 | 127 | 113 | 95 | 124 | 78 | 67 | 123 | 96 | 79 |
| Flowering pot plants (l=2) | -0.21 | -0.77 | -0.34 | -0.15 | -0.79 | -0.16 | -0.06 | -1.02 | -0.10 | -0.11 | -0.88 | -0.19 |
| | 104 | 113 | 57 | 107 | 113 | 82 | 70 | 83 | 40 | 86 | 97 | 63 |
| Green pot plants (l=3) | -0.01 | -0.03 | -1.17 | -0.05 | -0.04 | -0.92 | -0.03 | -0.08 | -0.98 | -0.04 | -0.04 | -0.77 |
| | 63 | 58 | 63 | 93 | 84 | 95 | 61 | 44 | 70 | 66 | 58 | 80 |
| Compensated price elasticity $PE^*(q_k,p_l)$ | | | | | | | | | | | | |
| Cut flowers (l=1) | -0.34 | 0.41 | 0.68 | -0.34 | 0.36 | 0.40 | -0.32 | 0.58 | 0.49 | -0.34 | 0.40 | 0.36 |
| | 122 | 113 | 63 | 125 | 113 | 95 | 114 | 83 | 70 | 118 | 97 | 80 |
| Flowering pot plants (l=2) | 0.21 | -0.50 | 0.24 | 0.21 | -0.52 | 0.28 | 0.17 | -0.74 | 0.28 | 0.22 | -0.61 | 0.18 |
| | 121 | 113 | 62 | 123 | 113 | 94 | 96 | 83 | 58 | 109 | 97 | 72 |
| Green pot plants (l=3) | 0.18 | 0.12 | -0.92 | 0.15 | 0.17 | -0.68 | 0.21 | 0.19 | -0.72 | 0.16 | 0.24 | -0.52 |
| | 92 | 84 | 63 | 114 | 102 | 95 | 95 | 70 | 70 | 101 | 81 | 80 |

Note: See note in Table 6.7

TABLE 6.10 Correlation coefficients (r) showing the relationships between budget elasticities for habitual buyers (n = 127) with the three subclasses in their evoked set

| | Relationship between budget elasticities for | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cut flowers and flowering pot plants | | | Cut flowers and green pot plants | | | Flowering and green pot plants | | |
| | r | P | n[a] | r | P | n | r | P | n |
| Winter 1973-1974 | -.68 | .01 | 111 | -.29 | .025 | 62 | | >.10 | 57 |
| Spring 1974 | -.36 | .01 | 113 | -.50 | .01 | 95 | | >.10 | 85 |
| Summer 1974 | -.40 | .01 | 81 | -.45 | .01 | 67 | -.23 | .05 | 55 |
| Autumn 1974 | -.66 | .01 | 94 | -.24 | .025 | 78 | | >.10 | 60 |

[a] n is the number of habitual buyers for which elasticities for subgroup k and l were available

TABLE 6.11 Correlation coefficients (r) showing the relationships between uncompensated own price elasticities for habitual buyers (n = 127) with the three subclasses in their evoked set

| | Relationship between uncompensated own price elasticities for | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cut flowers and flowering pot plants | | | Cut flowers and green pot plants | | | Flowering and green pot plants | | |
| | r | P | n[a] | r | P | n | r | P | n |
| Winter 1973-1974 | -.24 | .01 | 111 | -.34 | .01 | 62 | | >.10 | 57 |
| Spring 1974 | -.18 | .05 | 113 | -.31 | .01 | 95 | -.28 | .01 | 85 |
| Summer 1974 | -.21 | .05 | 81 | -.22 | .05 | 67 | | >.10 | 55 |
| Autumn 1974 | -.36 | .01 | 94 | | >.10 | 78 | | >.10 | 60 |

[a] n is the number of habitual buyers for which elasticities for subgroup k and l were available

The budget elasticities of the three subclasses seem to be related (Table 6.10); those of cut flowers and flowering pot plants and those of cut flowers and green pot plants were inversely related in all seasons distinguished. The more habitual buyers considered cut flowers to be a necessity, the more they considered both flowering pot plants and green pot plants to be luxury and the reverse. The budget elasticities for flowering pot plants and green plants were inversely related for summer 1974 only, no significant relationship was found for the other seasons.

**Uncompensated own price elasticities.** The mean uncompensated own price elasticities for cut flowers for the 127 habitual buyers was about -0.85 in all four seasons distinguished (Table 6.9), indicating that the demand for cut flowers was reasonably price elastic. The mean uncompensated own price elasticities for flowering pot plants varied from -0.77 in winter, -0.79 in spring, -0.88 in autumn, to -1.02 in summer 1974, also indicating a reasonably price-elastic demand. Mean uncompensated own price elasticities for green pot plants varied from $-0.77$ to $-1.17$, indicating a price-elastic demand, especially during winter 1973-1974.

The uncompensated own price elasticities of cut flowers and flowering pot plants were inversely related in all seasons distinguished (Table 6.11), suggesting that habitual buyers with a price-elastic demand for cut flowers had an inelastic demand for flowering pot plants, and also the reverse. Except in autumn 1974, the same was also the case for cut flowers and green pot plants, habitual buyers with a price-elastic demand for cut flowers often had an inelastic demand for green pot plants, and again, also the reverse. Uncompensated price elasticities of flowering and green pot plants were inversely related in spring 1974 only, most probably because of Mother's Day. These results correspond with the constraint defined in Equation 6.17.

**Compensated cross-price elasticities.** The compensated cross-price elasticities $PE^*(q_k,p_l)$ indicate the extent to which the subclasses k and l were substitutes. For example, in winter 1973-1974, the mean of $PE^*(q_1,p_2)$ was 0.21 and that of $PE^*(q_2,p_1)$ was 0.41 (Table 6.9), indicating that cut flowers were more readily substituted for flowering pot plants than the reverse; also, the mean of $PE^*(q_1,p_3)$ was 0.18 and that of $PE^*(q_3,p_1)$ was 0.68, indicating that cut flowers were more readily substituted for green pot plants than the reverse. Yet in the same season, flowering pot plants were more readily substituted for green pot plants than the reverse, because the mean of $PE^*(q_2,p_3)$ was 0.12 and that of $PE^*(q_3,p_2)$ was 0.24. These findings were the same for all four seasons distinguished.

From the compensated cross-price elasticities $PE^*(q_k,p_l)$ with $k \neq l$, it can be deduced that for a fixed k ($k=1,2,\ldots,K$), the effect of a 10% price fall in all $p_l$ ($l \neq k$) on the demand for k was likely to be the least for k being cut flowers (Table 6.12), implying that cut flowers were least affected by price fluctu-

TABLE 6.12 Estimated percentage decrease in the demand for one subclass for a 10% decrease in other subclasses and the implicit increase in budget is compensated for

| Subclass | Percentage decrease | | | |
|---|---|---|---|---|
| | Winter 1973-1974 | Spring 1974 | Summer 1974 | Autumn 1974 |
| Cut flowers | -3.9% | -3.6% | -3.8% | -3.8% |
| Flowering plants | -5.3% | -5.3% | -7.7% | -6.4% |
| Green plants | -9.2% | -6.8% | -7.7% | -5.4% |

ations in other subclasses. For example, if the implicit increase in flower and plant budget were to be compensated for, a 10% price decrease in flowering and green pot plants in the summer of 1974 would have resulted in a 3.8% decrease in the demand for cut flowers.

### *6.5.2 Relationship between parameter estimates and elasticities and household characteristics*

**Marginal budget shares and household characteristics.** The estimated relationships between the marginal budget share of each subclass and household characteristics are given in Table 6.13. The parameters of the household characteristics in this table add horizontally to zero (Section 6.2.3). From Table 6.13 the following conclusions can be drawn:

– Belonging to social class AB was related to a relatively low marginal budget share for flowering pot plants, and consequently to a relatively high marginal budget share for cut flowers and green pot plants together.

– Living in a densely populated area was related to a relatively high marginal budget share for green pot plants and a relatively low one for flowering pot plants. Green pot plants often have a more modern image than flowering pot plants (e.g., Altmann and Von Alvensleben 1982, p 19). This may well be one of the reasons that habitual buyers in towns, and those in the highest social class, often preferred green to flowering pot plants.

– Access to a garden was related to a relatively low marginal budget share for cut flowers and a relatively high one for green pot plants. This may be explained by the fact that flowers can be obtained from the garden, or the satisfaction obtained from having flowers in the garden.

– Being in the age group 30 to 64 years was related to a relatively high marginal budget share for flowering pot plants and a relatively low one for green pot plants. Apparently, young households purchased green pot plants relatively often, whereas other households bought relatively often flowering pot plants. Apart from the modern image, green pot plants can also be maintained for a long period with little effort.

– A positive attitude to housekeeping was related to a relatively low marginal

TABLE 6.13 Relationship between household characteristics and the marginal budget share $\hat{\beta}_{hk}$ in the Linear Expenditure System for 127 habitual buyers with three subclasses in their evoked set and $\hat{\beta}_{hK} > 0$, $d_{ht} > 0$ for t = 5 to 8.

| Households characteristics | Marginal budget share | | | | | |
|---|---|---|---|---|---|---|
| | Cut flowers (n = 127) | | Flowering pot plants (n = 127) | | Green pot plants (n = 127) | |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | | | |
| AB (high) | .144 | 1.30 | -.208 | 2.26 | .064 | 0.79 |
| C | .080 | 0.80 | -.121 | 1.45 | .041 | 0.56 |
| $D_1$ | .109 | 1.10 | -.156 | 1.89 | .047 | 0.65 |
| Geographical area | | | | | | |
| west | -.018 | 0.20 | -.019 | 0.25 | .036 | 0.55 |
| east | .026 | 0.25 | -.056 | 0.66 | .030 | 0.41 |
| south | .006 | 0.04 | .012 | 0.12 | -.017 | 0.20 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | -.011 | 0.17 | -.095 | 1.82 | .106 | 2.30 |
| 30000–100000 | -.041 | 0.67 | -.021 | 0.41 | .062 | 1.38 |
| Access to a garden | -.101 | 1.72 | .019 | 0.39 | .082 | 1.91 |
| Household size | .008 | 0.44 | -.016 | 1.00 | .007 | 0.53 |
| Age of wife (years) | | | | | | |
| 30–64 | -.015 | 0.20 | .125 | 2.02 | -.110 | 2.02 |
| ≧ 65 | -.055 | 0.57 | .094 | 1.17 | -.038 | 0.54 |
| Attitude to housekeeping | -.120 | 2.30 | .087 | 2.00 | .033 | 0.88 |
| Price consciousness | -.011 | 0.20 | -.018 | 0.41 | .029 | 0.74 |
| Proportion of expenditure | | | | | | |
| for own home | .438 | 2.49 | -.311 | 2.13 | -.127 | 0.99 |
| from florist | .081 | 0.75 | .045 | 0.50 | -.126 | 1.60 |
| at market or street stall | .077 | 0.70 | -.036 | 0.41 | -.042 | 0.54 |
| Constant | .197 | | .590 | | .213 | |
| $R^2$ | .134 | | .167 | | .135 | |
| Mean marginal budget share | 0.53 | | 0.25 | | 0.21 | |
| Mean budget share (Dec. 1972-Nov. 1974) | 0.70 | | 0.20 | | 0.10 | |

budget share for cut flowers and a relatively high one for flowering pot plants.
– A large proportion of the flower and plant budget for home use was related to a relatively high marginal budget share for cut flowers and a relatively low one for flowering pot plants. Apparently, habitual buyers who made purchases for home use were more interested in flowers than in flowering plants.

**Habit formation parameters and household characteristics.** A habit formation parameter for subclass k reflects the extent to which household h spent the same amount on that subclass in the corresponding three-month periods of 1973 and 1974. The relationship of each of these habit formation parameters to household characteristics was not significant at a 5% significance level; probably because the habit formation parameters were estimated from a short purchase history.

**Elasticities and household characteristics.** The budget and price elasticities of habitual buyers with an evoked set of three subclasses were also found to be related to household characteristics. The constraints set by Equation 6.17-6.19 are, as expected, also reflected in the results of this section. These results hold under the condition 'all other household characteristics being equal'.

**Budget elasticities.** For habitual buyers, in both winter and spring, the budget elasticity for cut flowers was lower for those having access to a garden than for those without a garden ($P < 2\%$); and the same held in spring for the budget elasticity for green plants ($P < 2\%$). This indicates that growth in expenditure on cut flowers and green pot plants outside the gardening season was relatively low for those with access to a garden. This result may be affected by either the purchase of flowering pot plants for the garden in the summer, or active involvement in gardening and flowers during summer and autumn which may, in turn, have stimulated flower buying during that period. For habitual buyers living in the southern part of the Netherlands, the budget elasticity for cut flowers was lower in summer ($P < 5\%$); and in autumn, it was higher for flowering pot plants ($P < 2\%$) than for those living in another part of the Netherlands. This suggests that in the southern part of the country during these seasons the market opportunities for flowering pot plants were relatively better than for cut flowers. In summer, the budget elasticity for flowering pot plants was higher for habitual buyers patronizing the markets or street stalls than for those patronizing other retail outlets ($P < 5\%$). This indicates that market opportunities for flowering pot plants during summer were relatively good for the market and street trade, possibly, because of an active marketing policy for flowering pot plant by this outlet type. In spring, the budget elasticity for green pot plants was higher for habitual buyers having a positive attitude to housekeeping than for those with a negative attitude ($P < 1\%$). Life style and buying behaviour regarding cut flowers and pot plants were, apparently, related.

**Uncompensated own price elasticities.** In the discussion on price elasticities, it should be noted that the demand by habitual buyers for cut flowers and pot plants was more price elastic than that of nonhabitual buyers. In winter, the absolute value of the habitual buyers' price elasticity for cut flowers was lower for those having access to a garden than for those without ($P < 5\%$). The same was also the case for green pot plants in spring ($P < 5\%$); suggesting that those having access to a garden were inclined to buy flowers during the winter, in spite of higher prices (Table 6.14). For habitual buyers living in the southern part of the Netherlands, the absolute value of their price elasticity for cut flowers was lower during summer than for those living in any other part of the country ($P < 5\%$). This suggests that habitual buyers in the southern part purchased flowers less frequently during summer than those in other areas.

TABLE 6.14 Average price (guilders) for one purchase of cut flowers, flowering pot plants, and green pot plants; derived from all purchases in the sample of 1000 households

| Period | Cut flowers | Total pot plants | Flowering pot plants | Green pot plants |
|---|---|---|---|---|
| Winter 1972-1973 | 2.86 | 3.35 | 3.40 | 3.19 |
| Spring 1973 | 2.64 | 3.00 | 3.03 | 2.95 |
| Summer 1973 | 2.53 | 2.78 | 2.74 | 2.84 |
| Autumn 1973 | 2.84 | 3.34 | 3.39 | 3.25 |
| Winter 1973-1974 | 2.97 | 3.44 | 3.49 | 3.26 |
| Spring 1974 | 2.69 | 3.00 | 2.86 | 3.27 |
| Summer 1974 | 2.81 | 3.17 | 2.76 | 3.82 |
| Autumn 1974 | 3.28 | 3.58 | 3.66 | 3.41 |

During summer the absolute value of the price elasticity for flowering pot plants was higher for those of social class AB ($P < 5\%$), social class C ($P < 10\%$) and social class $D_1$ ($P < 2\%$) than for those of social class $D_2$. In other words, those in the lowest social class had a weaker response to price variation for flowering pot plants than others in the season when such plants were relatively cheap (Table 6.14). In spring, the absolute value of the price elasticity for green pot plants was higher for those with a positive attitude to housekeeping ($P < 1\%$) than for those with a negative attitude.

**Compensated cross-price elasticities.** The compensated cross-price elasticities reflect the degree of substitution of one subclass for another. For example, $PE^*(q_1,p_2)$ reflects the change in demand for cut flowers caused by a price change in flowering pot plants, whereas the positive or negative effect of this price change on the size of the flower and plant budget is compensated for. The extent to which the substitution of one subclass for another caused by price changes was found to be related to household characteristics, is summarized below and also in Figure 6.2.

**Substituting flowering pot plants for flowers.** As a result of a price rise in cut flowers in summer, more purchases of flowering plants were made by habitual buyers in the south than in other parts of the country.

FIG. 6.2 Relationship between compensated cross-price elasticities and household characteristics

| Price rise in | Positive shift in demand for | | |
|---|---|---|---|
| | Cut flowers | Flowering pot plants | Green pot plants |
| Cut flowers | | south (summer)[b] | |
| Flowering pot plants | < 100000 inhabitants (spring)[b]; proportion spent for use at home small (spring)[a]; south, north (summer)[b]; proportion at market and street stall low (summer)[b]. | | proportion spent for use at home small (all seasons except winter)[c]; positive attitude to housekeeping (spring)[c]; south, north (summer)[b] |
| Green pot plants | ≥ 100000 inhabitants (summer)[b]; proportion spent for use at home small (summer)[b]; positive attitude to housekeeping (summer)[b]; west, east, north (summer)[b]. | south (autumn)[b] | |

[a] $P < 2\%$; [b] $P < 5\%$; [c] $P < 10\%$.

**Substituting cut flowers for flowering pot plants.** As a result of a price rise in flowering pot plants in spring, more purchases of cut flowers were made by those habitual buyers living in municipalities of less than 100000 inhabitants or spending a relatively small proportion of their budget for home use than by other habitual buyers. In summer, there was a shift to more purchases of cut flowers as a result of a price increase in flowering pot plants by those habitual buyers living in the south or north of the country; or by those spending a low proportion of their flower and plant budget at the market or street stall than by other habitual buyers.

**Substituting green pot plants for flowering pot plants.** As a result of a price rise in flowering plants, more purchases of green pot plants were made by habitual buyers in all seasons except winter spending a small proportion of their budget for home use; and in spring, by those with a positive attitude to housekeeping than by other habitual buyers. In summer, there was a shift to more purchases of green pot plants by habitual buyers living in the south and the north of the Netherlands, than by other habitual buyers.

**Substituting cut flowers for green pot plants.** As a result of a price rise in green pot plants, in summer more purchases of cut flowers were made by those habitual buyers living in municipalities of more than 100000 inhabitants; spending a relatively small proportion of their flower and plant budget for home use; having a positive attitude to housekeeping; living in the west, east, or north of the country than by other habitual buyers.

**Substituting flowering pot plants for green plants.** As a result of a price rise in autumn in green plants, more purchases of flowering pot plants were made by habitual buyers living in the south than in other parts of the country.

## 6.6 Relationship between household characteristics and the proportion of the expenditure on flowers and plants spent on a particular subclass

In the preceding section, parameter estimates obtained with the Linear Expenditure System have been examined in relationship to household characteristics. It was not possible to do this for all habitual buyers as a group. In this section, the proportion of the flower and plant budget spent by habitual buyers in the period December 1972 to November 1974 on cut flowers, flowering pot plants, and green pot plants is related to household characteristics outside the Linear Expenditure System framework (Table 6.15). A relatively high proportion of the budget was spent on cut flowers and a relatively small proportion on flowering pot plants by those living in the west or south of the country, and by those who spent most of their flower and plant budget for home use. A relatively high proportion of the budget was spent on flowering pot plants by those over 65 years of age, and on green pot plants by those under 30 years of age. Relatively little was spent on green pot plants by those who devoted a large proportion of their flower and plant budget to home use.

Differences in expenditure on each subclass in 1973 and 1974 were examined in relation to household characteristics. An increase in the expenditure on cut flowers was relatively high for price-conscious habitual buyers ($P < 2\%$) and an increase in expenditure on green pot plants was relatively high in municipalities of at least 100 000 inhabitants ($P < 2\%$), but relatively low for those who patronized the florist ($P < 2\%$). A change in the expenditure on flowering pot plants was found to be not related to any of the household characteristics.

## 6.7 Conclusions

Three subclasses of cut flowers and pot plants have been distinguished; cut flowers, flowering pot plants, and green pot plants. Habitual buyers were found to differ greatly in their purchases: about 55% made purchases from all three subclasses; about 25%, purchased cut flowers and pot plants, predominantly

TABLE 6.15 Relationship between household characteristics and proportion of total expenditure on flowers and plants spent on each of the three subclasses by habitual buyers (n = 363)

| Households characteristics | Proportion of total expenditure on flowers and plants | | | | | |
|---|---|---|---|---|---|---|
| | Cut flowers | | Flowering pot plants | | Green pot plants | |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | | | |
| AB (high) | -.007 | 0.18 | -.020 | 0.62 | .027 | 1.17 |
| C | -.007 | 0.21 | -.017 | 0.62 | .024 | 1.22 |
| $D_1$ | -.008 | 0.23 | -.006 | 0.22 | .014 | 0.72 |
| Geographical area | | | | | | |
| west | .113 | 2.80 | -.097 | 3.07 | -.015 | 0.67 |
| east | .032 | 0.71 | -.034 | 0.95 | .002 | 0.08 |
| south | .163 | 3.48 | -.115 | 3.14 | -.047 | 1.78 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | .036 | 1.57 | -.011 | 0.61 | -.025 | 1.90 |
| 30000–100000 | -.014 | 0.53 | .017 | 0.86 | -.004 | 0.25 |
| Access to a garden | -.036 | 1.76 | .020 | 1.24 | .016 | 1.38 |
| Household size | .009 | 1.19 | -.004 | 0.65 | -.005 | 1.18 |
| Age of wife (years) | | | | | | |
| 30-64 | .035 | 1.25 | .021 | 0.95 | -.055 | 3.51 |
| ≧ 65 | .014 | 0.36 | .061 | 2.09 | -.075 | 3.51 |
| Attitude to housekeeping | .003 | 0.13 | .001 | 0.09 | -.004 | 0.36 |
| Price consciousness | -.033 | 1.69 | .016 | 1.06 | .017 | 1.51 |
| Proportion of expenditure | | | | | | |
| for own home | .296 | 4.74 | -.159 | 3.24 | -.137 | 3.85 |
| from florist | -.065 | 1.60 | .045 | 1.41 | .020 | 0.86 |
| at market or street stall | .030 | 0.83 | -.026 | 0.91 | -.004 | 0.20 |
| Constant | .359 | | .383 | | .258 | |
| $R^2$ | .188 | | .138 | | .145 | |
| Mean budget share | 0.70 | | 0.20 | | 0.10 | |

flowering plants; about 15% purchased mostly cut flowers; and about 5% cut flowers and pot plants, predominantly green plants. Cut flowers were purchased more frequently by habitual buyers in the west and in the east of the country, and flowering pot plants in the east and north. Flowering pot plants were purchased relatively frequently by habitual buyers over 65 years of age, and green pot plants by those less than 30 years of age.

The Linear Expenditure System was the most appropriate model for analysis of the allocation of the flower and plant budget to the various subclasses for two segments of habitual buyers: the segment purchasing in two subclasses (cut flowers and pot plants, that is predominantly flowering pot plants), and the segment purchasing in all three subclasses. The segment making purchases in two subclasses was found to be more price elastic in their choice of cut flowers than the segment purchasing in three subclasses, and flowering pot plants were more of a luxury than cut flowers, except during winter. For the segment purchasing in three subclasses, during winter and spring, green pot plants were more a luxury than the other two subclasses; whereas in the summer, flowering pot plants were more a luxury than green pot plants, and green pot plants more of a luxury than cut flowers.

The budget elasticities for cut flowers, and flowering, and green pot plants, were shown to be related. The more habitual buyers considered cut flowers to be a necessity, the more they considered flowering or green pot plants to be a luxury, and the reverse. Also, habitual buyers with a price elastic demand for cut flowers tended to have an inelastic demand for flowering or green pot plants, and the reverse. The effect of a price fall in two subclasses on the third was found to be minimal when the third was cut flowers, thus indicating that cut flowers were the least affected by price fluctuations in other subclasses.

The parameter estimates in the Linear Expenditure System for habitual buyers purchasing in three subclasses, and the price and budget elasticities derived from these estimates, were shown to be related to several household characteristics. The characteristics discriminating relatively well between household's marginal budget shares for cut flowers, flowering pot plants, and green pot plants, were: the size of the residential municipality; having access to a garden; age of the wife; attitude to housekeeping; and proportion of the flower and plant budget for home use. The available set of household characteristics did not discriminate between habit formation parameters, possibly, because of the short purchase history on which these parameter estimates were based. No clear relationship was found between estimates of budget and price elasticities and household characteristics, however, such relationships which were found may be of interest to those involved in the retail, wholesale, or producer stage of the flower and plant industry.

# 7 CHOICE STAGE: CHOICE MADE WITHIN A PARTICULAR FLOWER OR PLANT SUBCLASS BY HABITUAL BUYERS

## *7.1 Introduction*

In Chapter 5, the relationship between household characteristics and the budget spent on cut flowers and pot plants was examined for all 1000 households in the sample. For regular buyers consisting of both habitual and nonhabitual buyers, household characteristics were related to response parameter estimates. This analysis included the budget stage in the multistage choice process for the segment habitual buyers. The priority stage in the multistage choice process for the market segment habitual buyers has been analysed in Chapter 6. The third and final stage in this process, the choice stage, that is the choice made within a particular flower or plant subclass, for habitual buyers is analysed in the present chapter. The passage through the various stages in the multistage choice process for habitual buyers is depicted in Figure 7.1. The number of habitual buyers assumed to have gone through the choice stage was 363 for cut flowers, 293 for flowering pot plants, and 216 for green pot plants. The analysis has been limited to the subclass of cut flowers, because the buying frequency of habitual buyers in other subclasses was not sufficiently high to analyse choice behaviour in detail. Of the types of flowers frequently purchased (see Table 7.3), the analysis has been restricted to: carnations, chrysanthemums, freesias, daffodils, tulips, and roses.

Within a subclass, many alternative types are available of which all may serve the same aim. It is assumed that many minor factors affect the choice of a product in a subclass, for example, desire for variation in the types of flowers purchased, the manner in which flowers are displayed, retailer's advice, and price. Therefore, a stochastic model of consumer behaviour was assumed to give the best description of buying behaviour in the choice stage. Stochastic models of consumer behaviour assume stationarity. However, the composition of the assortment of cut flowers varies in the course of the year (Table 7.1). This means that periods of the year need to be selected in which the assortment purchased is reasonably stable. These periods are suggested in Table 7.1 as: January to mid-May; mid-May to September; and September to December.

In this chapter, the type of stochastic model selected is that which best described the choice of flower type made by habitual buyers. Estimates of the parameters of the selected stochastic model are made and the relationship between these parameter estimates and household characteristics assessed.

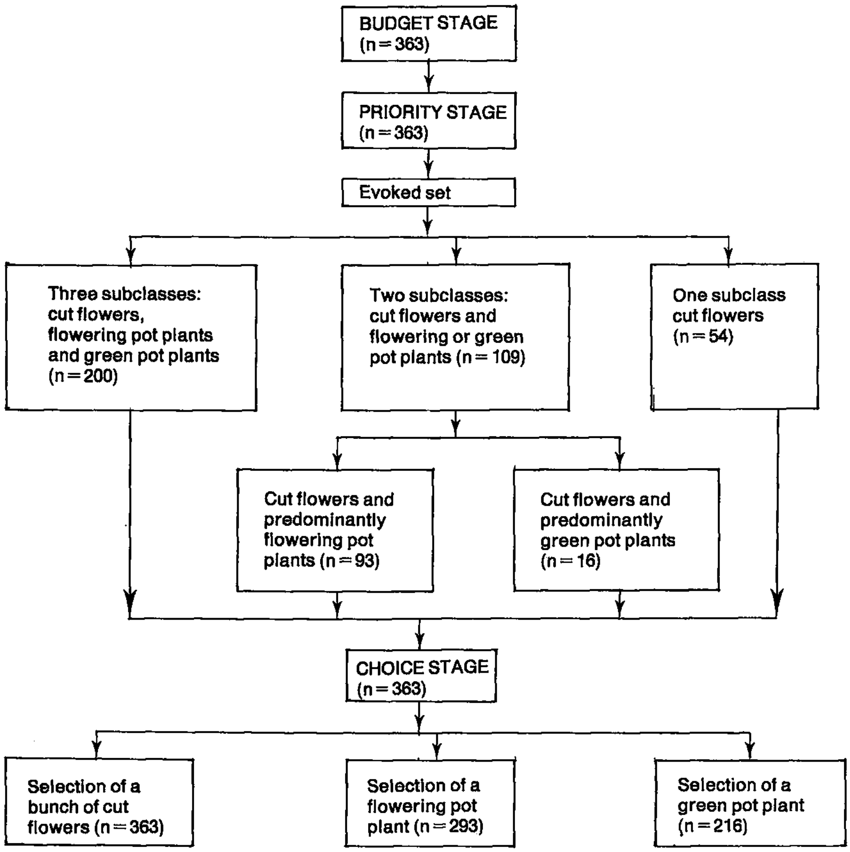



FIG. 7.1 Passage of habitual buyers through the multistage choice process for the purchase of cut flowers, flowering pot plants, or green pot plants.

## 7.2 MODEL SPECIFICATION

### *7.2.1 Choice of a stochastic model of consumer behaviour in literature*

Several investigators (eg., Colard 1975; Kalwani and Morrison 1977), have stressed that the choice of a particular stochastic model to describe consumer behaviour should not be a matter of trial and error, but should be based on theoretical considerations and empirical testing. Colard (1975), for example, related the choice of a stochastic model to the distinction between extensive problem solving, limited problem solving, and routinized response behaviour, made by Howard and Sheth (1969), as summarized in Table 7.2.

TABLE 7.1 Market share of flower types in four-week periods (1972-1974) for all 1000 households in the sample

| | | January to mid-May | | | | | mid-May to September | | | | September to December | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| week no. | | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-32 | 33-36 | 37-40 | 41-44 | 45-48 | 49-52 |
| Carnation | 1972 | | | | | | | | | | | | | 8.5 |
| | 1973 | 7.1 | 8.2 | 9.9 | 7.2 | 5.8 | 14.8 | 30.1 | 19.6 | 11.9 | 8.8 | 8.3 | 8.9 | 8.4 |
| | 1974 | 5.7 | 6.1 | 5.7 | 6.1 | 9.4 | 17.0 | 26.1 | 23.3 | 15.9 | 8.9 | 8.3 | 9.2 | |
| Chrysanthemum | 1972 | | | | | | | | | | | | | 50.3 |
| | 1973 | 20.1 | 6.1 | 6.0 | 8.4 | 12.2 | 13.3 | 11.8 | 17.9 | 34.0 | 56.0 | 64.0 | 70.7 | 57.8 |
| | 1974 | 22.4 | 6.2 | 7.2 | 6.1 | 10.2 | 11.6 | 12.0 | 14.2 | 25.5 | 48.4 | 61.0 | 62.5 | |
| Freesia | 1972 | | | | | | | | | | | | | 16.5 |
| | 1973 | 17.3 | 15.6 | 15.6 | 17.0 | 17.5 | 19.8 | 9.2 | 5.1 | 3.0 | 3.2 | 5.4 | 4.6 | 6.7 |
| | 1974 | 14.6 | 18.5 | 18.8 | 22.1 | 15.7 | 16.9 | 14.2 | 9.1 | 9.5 | 12.1 | 9.5 | 9.1 | |
| Daffodil | 1972 | | | | | | | | | | | | | 5.1 |
| | 1973 | 19.8 | 26.9 | 27.4 | 19.9 | 5.2 | | | | | | | | 8.0 |
| | 1974 | 22.2 | 28.6 | 28.3 | 14.6 | 1.0 | | | | | | | | |
| Tulip | 1972 | | | | | | | | | | | | | 4.5 |
| | 1973 | 20.3 | 27.1 | 25.3 | 27.4 | 33.2 | 3.8 | | | | | | | 5.1 |
| | 1974 | 21.2 | 24.7 | 23.5 | 31.9 | 29.0 | 1.9 | | | | | | | |
| Rose | 1972 | | | | | | | | | | | | | 3.0 |
| | 1973 | 2.8 | 1.4 | 3.9 | 8.8 | 11.8 | 19.9 | 27.1 | 26.8 | 20.7 | 16.7 | 12.5 | 7.1 | 5.7 |
| | 1974 | 2.8 | 1.7 | 4.6 | 8.1 | 11.5 | 18.1 | 26.0 | 23.2 | 17.7 | 15.1 | 11.5 | 7.3 | |
| Other | 1972 | | | | | | | | | | | | | 12.1 |
| | 1973 | 12.6 | 14.7 | 11.9 | 11.3 | 14.3 | 28.4 | 21.8 | 30.6 | 30.4 | 15.3 | 9.8 | 8.7 | 8.3 |
| | 1974 | 11.1 | 14.2 | 11.9 | 11.1 | 23.2 | 34.5 | 21.7 | 30.2 | 31.4 | 15.5 | 9.7 | 11.9 | |

TABLE 7.2 Relation between stages of problem solving (Howard and Sheth 1969) and the most suitable stochastic model according to Colard (1975)

| Stages of problem solving | Stochastic Model |
|---|---|
| Extensive problem solving | None |
| Limited problem solving | Linear learning model or Markov model |
| Routinized response behaviour | Bernoulli model |

Extensive problem solving refers to a situation in which a buyer has not yet developed well-defined and structured choice criteria. Limited problem solving is the situation in which the choice criteria are known, but the buyer is undecided as to which of the set of alternatives is best for him. Routinized response behaviour is the situation in which the buyer has strong predispositions towards the alternatives considered. Colard (1975) reserved the first situation for completely new products; the second for a new alternative brand in a known product class; and the third for when no new alternatives are considered. According to Colard, in the last situation a Bernoulli model is the most suitable for frequently purchased and well-known products. Well-known stochastic models of consumer behaviour to be found in literature (eg., Massy et al. 1970; Wierenga 1974), in addition to the Bernoulli model, are the first-order Markov model, and the linear learning model. The linear learning model, which includes the other two models, is specified as

$$p_t = a + b\,x_{t-1} + c\,p_{t-1} \tag{7.1}$$

with $0 \leqq a \leqq 1$, $0 \leqq (a+b) \leqq 1$ and $0 \leqq c \leqq (1-a-b)$

where $p_t$ = the probability that a consumer chooses a specific product coded as 1 in period t

$x_{t-1}$ = 1 if the product with code 1 was chosen in period $t-1$

= 0 if another product (coded as zero) was chosen in period $t-1$.

The upper limit of $p_t$, when a large number of consecutive products with code 1 is chosen, is $p_u = (a+b)/(1\text{-}c)$; and the lower limit, when a large number of consecutive products coded as 0 is chosen, is $p_L = a/(1\text{-}c)$. In the linear learning model, the whole purchase history of a consumer, represented in $p_{t-1}$, affects the present probability ($p_t$) that the product with code 1 will be chosen. More recent purchases affect $p_t$ more than earlier purchases. In a first-order Markov model, only the preceding purchase affects the present purchase. This is true in Equation 7.1, if $c=0$. The corresponding Markov model has the following probabilities

| | | period t-1 | |
|---|---|---|---|
| | | 1 | 0 |
| period t | 1 | a+b | 1-a-b |
| | 0 | a | 1-a |

In a Bernoulli model, the purchase probabilities are constant for all periods. This is true in Equation 7.1, if a = b = 0 and c = 1, which implies $p_t = p_{t-1} = p$.
An extension of Equation 7.1, which is to be found in Wierenga, Srinivasan and Van Tilburg (1981), can be specified as follows

$$p_{it} = z_{1it} + z_{2it} \tag{7.2a}$$

where

$p_{it}$ = the probability that a consumer chooses product i in period t
$z_{1it}$ = the product loyalty for product i in period t
$z_{2it}$ = the marketing attraction for product i in period t.

$$z_{1it} = (1-d)\{(1-\lambda)x_{it-1} + \lambda p_{it-1}\} \tag{7.2b}$$

$$z_{2it} = dm_{it-1} \tag{7.2c}$$

where

$x_{it-1}$ = 1 if product i was chosen in period $t-1$
= 0 if another product was chosen in that period

d, $\lambda$ and $m_{it}$ ($i = 1,2,\ldots, I$) are parameters to be estimated:

$m_{it-1}$ = a marketing attraction parameter of product i between purchase occasion $t-1$ and t
d = a parameter measuring the relative effect of marketing attraction in relation to product loyalty

If $\lambda$ = 1, then there is no purchase feedback because
$p_{it} = (1-d)\, p_{it-1} + dm_{it-1}$
and if $\lambda = 0$, there is considerable purchase feedback because
$p_{it} = (1-d)\, x_{it-1} + dm_{it-1}$

Two methods can be used to test the suitability of a particular stochastic model of consumer behaviour. The essential difference between the two methods is the length of purchase history required for each household. One method tests which stochastic model best fits the purchase history of each individual household (e.g., Wierenga 1974; Colard 1975), thus taking into account heterogeneity in buying behaviour. For example, Colard (1975) concluded that for two of three soft drinks, the Bernoulli model gave the best description of consumer behaviour. A purchase history of at least 15 purchases for each household is required for this method.

The other method examines the extent Equation 7.1 or Equation 7.2, in which the probability $p_t$ is allowed to vary with consumers, fits the purchase history of all consumers represented in the frequency distribution of all possible purchase sequences of a particular length (e.g., Massy et al. 1970; Wierenga 1974). The estimated values of the parameters a, b, and c in Equation 7.1 or $\lambda$ in Equation 7.2 indicate the degree of purchase feedback. Wierenga, for example, estimated the parameters in Equation 7.1 for an unnamed food product, for beer, and for margarine. The linear learning model was found to be the most appropriate for the unnamed food product and for beer. The parameter values for margarine approximated those of a Bernoulli model. Wierenga compared various stochastic models in a simulation experiment for these products. The heterogeneous Bernoulli model generated the brand choice process almost as well as the heterogeneous linear learning model (Wierenga 1974, p 109). In this method, a purchase history consisting of at least two purchases is required for each household.

### *7.2.2 Choice of a stochastic model based on the purchase histories of each habitual buyer*

**Test procedure.** The choice of a stochastic model of consumer behaviour for cut flowers was made on the basis of results obtained from tests applied to purchase histories of individual households. The procedure was a follows. Firstly, the run test (e.g., Siegel 1956; Bradley 1968) was applied to purchase histories of habitual buyers for flowers. A purchase history is represented as a sequence of zeros and ones for purchases of a specified flower type (1) and all other types (0). From the run test it can be decided whether or not the null hypothesis of random alternation can be rejected. If random alternation prevails, then a Bernoulli model can be assumed. If purchase feedback can be assumed (left-sided region of rejection), then the procedure is as follows. Firstly, a chi-square test is applied to test whether the probability of success in the i-th purchase depends on the (i-1)-th purchase (test of a simple Markov Chain, Maxwell 1961, p 137). Secondly, Cox's cumulative score test is applied to test whether the probability of a success in the i-th purchase is a function of the number of successes achieved in the previous (i-1) purchases (Maxwell 1961, p 134).

The stochastic models described above, and the tests, assume stationarity. As the assortment of flowers varied during the year (Table 7.1), stationarity can be approximated by dividing the year into periods in which the assortment offered was reasonably stable; January to mid-May (week 1 to 20) is one such period. Stationarity can be assumed to a lesser extent in the period mid-May to December 1973, and in mid-May to November 1974, because of the large increase in market share of chrysanthemums in those periods. The number of purchases by individual households was too small to subdivide the second part of the year further. As a result, conclusions have been drawn on the basis of test results for the period January to mid-May. Test results for the period mid-

May to November or December are given for comparative purposes and not as support for the choice of a particular stochastic model.

Purchase histories for individual habitual buyers were obtained as follows. Cut flower purchases were selected from each household's history of flower and plant purchases. If a household purchased more than one flower type on the same day, then the flower types purchased were recorded in random order. Then, the type most frequently purchased during the period was coded 1 and all other flowers were coded 0. This was done to avoid series with very few ones which would have occurred had cut flowers with low market shares been coded as 1. In each period, only habitual buyers making at least 15 such purchases were selected. From Table 7.3 it can be shown that in the first part of the year, tulips, daffodils, and freesias were the types most frequently purchased whereas, in the second part of the year, chrysanthemums were by far the most frequently purchased type.

The run test requires a number of runs in a sequence of zeros and ones; a run being an unbroken sequence of the same type of purchases. If a household has a purchase history of 00 1111 0 11, then there are four runs. Define $n_1$ as the number of ones in the sequence and $n_0$ as the number of zeros and define $n = n_1 + n_0$. In the example, $n_1 = 6$, $n_0 = 3$, $n = 9$ and the number of runs is four, $r = 4$. If both $n_1$ and $n_0$ are smaller or equal to 20, then r can be compared with critical values $R_\alpha$, given in for example, Siegel (1956). If $r \leqq R_\alpha^l$, then the null hypothesis of random alternation is rejected and purchase feedback is assumed. If $r \geqq R_\alpha^r$, then the null hypothesis of random alternation is also rejected because there are too many runs indicating that systematic variation in flower buying behaviour occurred. If $R_\alpha^l < r < R_\alpha^r$, then the null hypothesis of random alternation will not be rejected and a Bernoulli model can be assumed. If $n_1$ or $n_0 > 20$, then a standard normal approximation can be used for

$$z = \frac{(|r - E(r)| - 0.5)}{\sqrt{V(r)}} \tag{7.3}$$

$$\text{with } E(r) = \frac{2n_1n_0}{n} + 1 \text{ and } V(r) = \frac{2n_1n_0(2n_1n_0 - n)}{n^2(n-1)}$$

The test is two-sided. The power of the run test is rather low for purchase histories of 20 to 40 purchases as is the case here. This may result in accepting households with a non-Bernoulli purchase pattern (Massy et al. 1970, p 59). This can be partly counteracted by taking a significance level α which is not too low, say 5%. Violation of the stationarity assumption of the run test may result in rejecting households with Bernoulli purchase patterns.

**Results of the run test.** For all 363 habitual buyers, purchase histories were compiled for each of the four periods distinguished. The number of habitual buyers with at least 15 purchases in a particular period, and characteristics of

TABLE 7.3 Types of flowers most frequently purchased by habitual buyers making at least 15 flower purchases in the period specified

| | January to mid-May 1973 | January to mid-May 1974 | mid-May to December 1973 | mid-May to November 1974 |
|---|---|---|---|---|
| Carnation | 11 | 8 | 16 | 24 |
| Chrysanthemum | 8 | 9 | 140 | 116 |
| Freesia | 30 | 43 | 2 | 12 |
| Daffodil | 39 | 30 | | |
| Tulip | 64 | 79 | | |
| Hyacinth | 1 | | | |
| Rose (long stem) | | | 2 | 2 |
| Rose (short stem) | 1 | | 18 | 18 |
| Anemone | 1 | 1 | | |
| Gladiolus | | | 1 | 3 |
| Iris | 1 | | | |
| Lily | 1 | 1 | | 1 |
| Mixed bunch | | | | 3 |
| Other | 2 | 1 | 9 | 7 |
| Total number of households | 159 | 172 | 188 | 186 |

the purchase histories, are given in Table 7.4. The proportion of habitual buyers with n $\geqq$ 15 in each period distinguished varied from 44% to 52%. The mean for each household characteristic of habitual buyers with n $\geqq$ 15 did not differ significantly at a 5% level from those with n < 15 (Hotelling $T^2$ test). The mean number of purchases for these habitual buyers in January to mid-May 1973 and 1974 was 24.1 and 24.0 respectively, and in mid-May to December 1973, 26.8; and in mid-May to November 1974, 25.7. The mode of the number of observations was about equal to the minimum number of purchases required for the run test. Purchases made on the same day were entered in three orders. In this way, three sequences of purchases: A, B, and C, were obtained for each household.

Results of the run test in each period distinguished are given in Table 7.5. For some habitual buyers making at least 15 purchases, the run test could not be performed because either $n_1$ or $n_0$ was too small. The results for a particular period did not deviate greatly for the sequences A, B, or C, in which the purchases made on the same day were placed in a different order. In the period January to mid-May both in 1973 and in 1974, the null hypothesis of random alternation was not rejected at a 5% significance level (2.5% at each side) for about 90% of the habitual buyers for which the run test could be carried out. Purchase feedback could be assumed for about 7% (left-sided region of rejection) and systematic variation could be assumed for about 2% (right-sided region of rejection) of these habitual buyers. As already discussed, the stationarity assumption did not hold for the period mid-May to the end of the year. Yet, the null hypothesis of random alternation was not rejected at a 5% significance level for about 75% of the habitual buyers for which the run test could be carried out. It can be concluded from the results obtained for the period January to mid-May in 1973 and in 1974 that there was no purchase feedback for most habitual buyers. These results suggest that the choice behaviour can be described by a Bernoulli model for this period.

TABLE 7.4 Number of habitual buyers making at least 15 purchases of flowers in the period specified and characteristics of their purchase histories for these periods

| | Habitual buyers with at least 15 purchases | | Characteristics of purchase histories | | |
|---|---|---|---|---|---|
| | Number | Proportion (%) | Mean | Mode | Maximum number |
| Jan. to mid-May 1973 | 159 | 44 | 24.1 | 15 | 73 |
| Jan. to mid-May 1974 | 172 | 47 | 24.0 | 16 | 71 |
| mid-May to Dec. 1973 | 188 | 52 | 26.8 | 17 | 91 |
| mid-May to Nov. 1974 | 186 | 51 | 25.7 | 17 | 93 |

TABLE 7.5 Results of the run test for each of the four periods distinguished

| | Sequences of purchases | No. of habitual buyers tested | No. of habitual buyers | | |
|---|---|---|---|---|---|
| | | | for which $H_0$ was not rejected | in the region of rejection | |
| | | | | left-sided (2.5%) | right-sided (2.5%) |
| Jan. to mid-May 1973 | A | 153 | 141 | 10 | 2 |
| | B | 152 | 137 | 9 | 6 |
| | C | 152 | 138 | 9 | 5 |
| Jan. to mid-May 1974 | A | 166 | 151 | 11 | 4 |
| | B | 166 | 147 | 11 | 8 |
| | C | 165 | 149 | 10 | 6 |
| mid-May to Dec. 1973 | A | 182 | 132 | 47 | 3 |
| | B | 181 | 132 | 46 | 3 |
| | C | 182 | 137 | 44 | 1 |
| mid-May to Nov. 1974 | A | 186 | 137 | 39 | 10 |
| | B | 186 | 138 | 40 | 8 |
| | C | 186 | 141 | 38 | 7 |

TABLE 7.6 Proportion (%) of habitual buyers for whom in two periods both the run test could be carried out and the null hypothesis of random alternation was not rejected at a 5% significance level

| | Period and purchase sequence | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | mid-May to Dec. 1973 | | | Jan. to mid-May 1974 | | | mid-May to Nov. 1974 | | |
| | A | B | C | A | B | C | A | B | C |
| Jan. to mid-May 1973 | .64 | .61 | .66 | .86 | .79 | .81 | .71 | .70 | .72 |
| mid-May to Dec. 1973 | | | | .63 | .60 | .65 | .60 | .61 | .62 |
| Jan. to mid-May 1974 | | | | | | | .70 | .68 | .72 |

The extent to which the results of the run test differed between two periods for the same habitual buyers was also examined (Table 7.6). For about 80% of the habitual buyers, $H_0$ was not rejected in the period January to mid-May in both 1973, and 1974. This indicates that the type of choice behaviour in which a purchase in period t was not affected by a purchase in a previous period did not change very much in the course of time.

### *7.2.3 Choice of a stochastic model based on the combined purchase histories of all habitual buyers*

Equation 7.2 was applied to consumer behaviour as to cut flowers by Wierenga, Srinivasan and Van Tilburg (1981). They divided the two-year study period into periods of two months each to approximate stationarity. For their analysis, the flower market was divided into freesias, daffodils, tulips and other cut flowers for the periods each of two months between January to April, and into carnations, chrysanthemums, roses, and other cut flowers for the rest of the year. Sequences of nonoverlapping purchase histories of length three were collected from the panel data for each two-month period. In this way, relative frequencies for the 64 purchase sequences of length three could be obtained and used in the minimum chi-square procedure to estimate parameters in Equation 7.2 (Table 7.7).

The parameter $\lambda$ was about 1 or equal to 1, indicating that in the product loyalty part of the model zero-order behaviour (no purchase feedback) dominated or that individual choice probabilities did not change very much as a result of purchase feedback. Therefore, this part of the model may well be approximated by a heterogeneous multinomial model.

TABLE 7.7 Estimates of the parameters $\lambda$ and d in Equation 7.2 with number of cut flowers $I=4$ and purchase sequences of length three

| Period | Type | 1973 | | 1974 | |
|---|---|---|---|---|---|
| | | $\lambda$ | d | $\lambda$ | d |
| Jan. to Feb. | freesia, daffodil, tulip, other cut flowers | 0.90 | 0.08 | 1.00 | 0.06 |
| Mar. to Apr. | | 1.00 | 0.13 | 1.00 | 0.31 |
| May to June | carnation, chrysanthemum, rose, other cut flowers | 0.90 | 0.26 | 1.00 | 0.09 |
| July to Aug. | | 1.00 | 0.09 | 0.93 | 0.12 |
| Sep. to Oct. | | 1.00 | 0.10 | 0.80 | 0.25 |
| Nov.to Dec. | | 0.94 | 0.04 | | |
| Nov. | | | | 1.00 | 0.07 |
| Mean | | 0.96 | 0.12 | 0.96 | 0.15 |

Source: Wierenga et al. (1981)

Further, it can be concluded from Table 7.7 that the coefficient d, representing the relative importance of the marketing attraction part of the model ranged from 0.04 to 0.31, the mean in 1973 being 0.12, and in 1974, 0.15. This means that the proportion of the choice behaviour affected by marketing factors ranged from 4% to 31%. The rank correlation between a market dynamics factor of flower type i in period t, $m^*_{it}$ with $m^*_{it} = g(dm_{it})$, and the ratio of the relative price of this type of flower in period t+1 to that in period t was -0.70, indicating that an increase in relative prices caused a decrease in the marketing attraction of a flower. Thus it may be concluded that relative prices had a significant, but in most periods t a small (d) effect on choice behaviour for flowers. This corresponds with the idea that price is one of many variables that affects this type of choice behaviour.

### *7.2.4 Choice of the model and the procedure to estimate purchase probabilities*

The results in Section 7.2.2 suggest that the choice behaviour of individual habitual buyers for a particular flower type can be described best by a Bernoulli model; and the results in Section 7.2.3 suggest that the combined choice behaviour of all habitual buyers for a number of specified flower types can be approximated by a heterogeneous multinomial model. However, as these results are similar, it can be concluded that the choice of flower types made by individual habitual buyers can be described by a multinomial model.

The probability a particular flower type i being chosen by household h, $p_{hi}$, in each trial must be estimated from the data by applying the Bernoulli law of large numbers (e.g., Parzen 1960, p 229). Let $p_{hi}$ be the probability that habitual buyer h chooses flower type i, and let $1\text{-}p_{hi}$ be the probability that any other type will be chosen. If the experiment is repeated $n_h$ independent times, then the number of successes $S^i_{nh}$ of choosing a flower type i is binomially distributed with mean $n_h p_{hi}$ and variance $n_h p_{hi}(1\text{-}p_{hi})$. Let $f^i_{nh} = S^i_{nh}/n_h$ denote the relative frequency of successes (i) in the $n_h$ trials, then $f^i_{nh}$ has mean $p_{hi}$ and variance $p_{hi}(1\text{-}p_{hi})/n_h$. According to Bernoulli's law of large numbers, for any $\varepsilon$, no matter how small, it follows that

$$\lim_{n \to \infty} \Pr(|f^i_{nh} - p_{hi}| \leqq \varepsilon) = 1 \tag{7.4a}$$

$$\lim_{n \to \infty} \Pr(|f^i_{nh} - p_{hi}| > \varepsilon) = 0 \tag{7.4b}$$

where Pr denotes probability. Thus, $f^i_{nh}$ (or briefly $f_{hi}$) has been used as a consistent estimate of $p_{hi}$.

For each habitual buyer making at least 15 purchases in a period, the purchase probability for each flower type i was estimated with $f^i_{nh}$. The purchase probability estimate for the second period of the year can be considered to be the mean of that for the summer and autumn assortment of flowers.

*7.2.5 Model relating purchase probability estimates to household characteristics*

In this section, a model is specified for relating differences in habitual buyers in their purchase probabilities and the household characteristics defined earlier.

Define

$f_{hi}$ = purchase probability estimate of habitual buyer h for flower type i

$x_{hl}$ = the l-th characteristic of household h

$\eta_{hi}$ = the disturbance term for household h related to parameter i.

It is assumed that $\eta_{hi}$ is normally distributed with $E\eta_{hi} = 0$, and $E\eta_{hi}^2 = \sigma_{ii}$, $E(\eta_{hi}, \eta_{hi'}) = \sigma_{ii'}$ for $i \neq i'$ and $E(\eta_{hi}, \eta_{h'i'}) = 0$ for $h \neq h'$ and all combinations of i and i'.

The general form of the model can be specified as

$$Ef_{hi} = g_i(x_{hl}, \ldots, x_{hL}) \quad \text{for } h = 1, 2, \ldots, H \tag{7.5}$$

Each observation of $f_{hi}$ is subject to a disturbance term $\eta_{hi}$.

Since for the flower types $i = 1,2,\ldots,I$, the conditions $f_{hi} > 0$ and $\sum_{i=1}^{I} f_{hi} = 1$ hold, consideration should be given to whether provision must be made in Equation 7.5 to take these conditions into account. Equation 7.5 is specified as

$$f_{hi} = \sum_{l=0}^{L} \gamma_{il} x_{hl} + \eta_{hi} \tag{7.6}$$

with $x_{h0} = 1$ for all h. The same arguments used in Section 6.2.3 hold for estimating the parameters in Equation 7.6 by ordinary least squares. It can be proved that

$$\sum_i \hat{\gamma}_{il} = 0 \text{ for } l \neq 0 \text{ and } \sum_i \hat{\gamma}_{i0} = 1, \text{ which implies } \sum_i \hat{f}_{hi} = 1$$

The chance of obtaining negative $\hat{f}_{hi}$ was taken.

**Heteroscedasticity.** The question whether or not heteroscedasticity must be taken into account in estimating the parameters in Equation 7.6 is examined for a situation in which the proportion of purchases of flower type i is explained. In Section 7.2.4, it has been shown that the relative frequency of choosing flower type i in $n_h$ trials, $f^i_{nh}$, has a distribution with mean $p_{hi}$ and variance

$$a_{hi}^2 = p_{hi}(1 - p_{hi})/n_h \text{ with } n_h \geqq 15 \tag{7.7}$$

As both $p_{hi}$ and $n_h$ vary with each household, the disturbances $u_{hi}$ are heteroscedastic in the equation

$$p_{hi} = g_i(x_{hl}, \ldots, x_{hL}) + u_{hi}, \text{ for } h = 1, 2, \ldots, H \tag{7.8}$$

To adjust the parameter estimates for the effect of heteroscedasticity, $1/a_{hi}$ can be used as a weighting factor in Equation 7.8. In Table 7.8 values of $a_{hi}$ and $1/a_{hi}$ are shown for different values of $p_{hi}$ and realistic values of $n_h$.

TABLE 7.8 Values of $a_{hi}$ and $1/a_{hi}$ for different values of $p_{hi}$ and two realistic values of $n_h$

| $p_{hi}$ | $n_h = 15$ | | $n_h = 30$ | |
|---|---|---|---|---|
| | $a_h$ | $1/a_h$ | $a_h$ | $1/a_h$ |
| 0.99 or 0.01 | 0.026 | 38.92 | 0.018 | 55.05 |
| 0.9 or 0.1 | 0.077 | 12.91 | 0.055 | 18.26 |
| 0.8 or 0.2 | 0.103 | 9.68 | 0.073 | 13.69 |
| 0.7 or 0.3 | 0.118 | 8.45 | 0.084 | 11.95 |
| 0.6 or 0.4 | 0.126 | 7.91 | 0.089 | 11.18 |
| 0.5 | 0.129 | 7.75 | 0.091 | 10.95 |

It can be deduced from Table 7.8 that the closer $p_{hi}$ is to zero or one, the greater the weighting factor $1/a_h$ must be. If this weighting factor is used, then the weights will vary too much between households because the estimates of $p_{hi}$ for buying households varied, roughly, between 0.01 and 0.90 (Table 7.9). In addition, the effect of a possible specification error in Equation 7.8 on the heteroscedasticity of the disturbances is not known. It was therefore decided not to correct for heteroscedasticity.

## 7.3 ESTIMATED PURCHASE PROBABILITIES FOR INDIVIDUAL FLOWER TYPES

Characteristics of the frequency distribution of the estimated purchase probabilities for each flower type distinguished are given in Table 7.9. The mean estimated purchase probability of buyers of each flower type tended to be low. The types of flowers most frequently purchased were tulips, with a mean purchase probability of about 0.30 in the period January to mid-May, and chrysanthemum with a mean purchase probability of about 0.40 in the period mid-May to December. For each type of flower distinguished, there were households that did not buy that particular type at all in the study period, and there were also habitual buyers with a purchase probability of about 0.8 or 0.9 for the particular flower type. Consequently, the variation in choice was considerable. In order to investigate the reasons for this variation, the relationship between the purchase probability estimates and household characteristics of habitual buyers was studied.

The stability of purchase probabilities was also examined by correlating the purchase probability estimates for the periods in 1973 and in 1974 (Table 7.10). It can be derived from Table 7.10 that the purchase probability estimate of habitual buyers choice of a particular flower type was very similar in corresponding periods in 1973 and 1974, because of the similarity of the flower assortment offered. Further, it can be concluded that those who had a low or a high purchase probability estimate for a particular type in one period of the year, often also

TABLE 7.9 Distribution of the estimated purchase probability of each flower type specified for habitual buyers making at least 15 purchases in one period and buying the flower type specified

| | | Proportion of habitual buyers (n ≧ 15) buying a particular type (%) | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|
| Jan. to mid-May 1973 (n = 159) | | | | | | |
| | Carnation | 59 | 0.141 | 0.126 | 12.74 | 2.85 |
| | Chrysanthemum | 65 | 0.126 | 0.115 | 8.08 | 2.56 |
| | Freesia | 83 | 0.192 | 0.138 | 2.62 | 1.47 |
| | Daffodil | 89 | 0.231 | 0.165 | 1.21 | 1.16 |
| | Tulip | 92 | 0.307 | 0.173 | -0.59 | 0.50 |
| | Rose | 57 | 0.108 | 0.077 | 1.24 | 1.38 |
| | Other | 83 | 0.150 | 0.093 | 0.00 | 0.81 |
| Jan. to mid-May 1974 (n = 172) | | | | | | |
| | Carnation | 50 | 0.124 | 0.117 | 10.44 | 2.86 |
| | Chrysanthemum | 69 | 0.113 | 0.107 | 7.41 | 2.52 |
| | Freesia | 91 | 0.198 | 0.130 | 0.01 | 0.83 |
| | Daffodil | 92 | 0.206 | 0.141 | 3.66 | 1.47 |
| | Tulip | 96 | 0.291 | 0.167 | 0.33 | 0.76 |
| | Rose | 58 | 0.100 | 0.061 | 0.44 | 1.00 |
| | Other | 85 | 0.177 | 0.107 | 1.40 | 1.08 |
| Mid-May to Dec. 1973 (n = 188) | | | | | | |
| | Carnation | 89 | 0.158 | 0.177 | 9.04 | 2.32 |
| | Chrysanthemum | 98 | 0.392 | 0.178 | 0.47 | 0.55 |
| | Freesia | 65 | 0.107 | 0.068 | 0.88 | 1.08 |
| | Rose | 88 | 0.215 | 0.140 | 1.20 | 1.12 |
| | Other | 95 | 0.228 | 0.143 | 1.10 | 0.98 |
| Mid-May to Nov. 1974 (n = 186) | | | | | | |
| | Carnation | 86 | 0.180 | 0.127 | 3.91 | 1.67 |
| | Chrysanthemum | 97 | 0.329 | 0.155 | 2.82 | 1.07 |
| | Freesia | 83 | 0.136 | 0.083 | 2.70 | 1.36 |
| | Rose | 88 | 0.198 | 0.144 | 3.40 | 1.56 |
| | Other | 95 | 0.250 | 0.142 | 0.15 | 0.69 |

TABLE 7.10 Correlation coefficients showing the relationship between purchase probability estimates for certain types of flowers for habitual buyers in certain periods in 1973 and 1974

| | Periods | | | |
| --- | --- | --- | --- | --- |
| | Jan. to mid-May 1973 and Jan. to mid-May 1974 | mid-May to Dec. 1973 and mid-May to Nov. 1974 | Jan. to mid-May 1973 and mid-May to Dec. 1973 | Jan. to mid-May 1974 and mid-May to Nov. 1974 |
| Carnation | .65 [a] | .68 | .56 | .53 |
| Chrysanthemum | .69 | .62 | .46 | .48 |
| Freesia | .68 | .46 | .42 | .48 |
| Daffodil | .77 | | | |
| Tulip | .74 | | | |
| Rose | .59 | .72 | .50 | .44 |
| Other | .58 | .59 | .50 | .39 |
| n | 123 | 147 | 129 | 133 |

[a] All coefficients are significant at a 0.1% level.

had a correspondingly low or high purchase probability for the same type in another period. As may be expected, there was no positive relationship between purchase probability estimates for two types in a particular period. However, this was not the case for carnations and chrysanthemums in the period January to May (r about 0.20; $P < 0.05$), thus indicating that habitual buyers tended to have a similar purchase probability estimate for both types in this period.

## 7.4 RELATIONSHIP BETWEEN PURCHASE PROBABILITY ESTIMATES AND HOUSEHOLD CHARACTERISTICS

### *7.4.1 January to mid-May*

In the first period of the year, January to mid-May, tulips, daffodils, and freesias dominated the market (Table 7.1). Purchase probability estimates for these and some other types were related to household characteristics using Equation 7.6 for the corresponding periods in 1973 and 1974. These results are presented below and hold under the condition: 'all other household characteristics being equal'.

**Spring flowers: tulips and daffodils.** The purchase probability estimates for spring flowers were found to be related to the following household characteristics: geographical area, size of residential municipality, access to a garden, age of the wife, and proportion of the flower and plant budget spent at market or street stall (Tables 7.11 and 7.12). The purchase probability estimate of habitual buyers living in the western, eastern or southern part of the country did not differ very much. Possibly, the purchase probability estimate for tulips was higher and that for daffodils was lower than that for habitual buyers living in the north. This is put forward tentatively because only a small number of habitual buyers lived in the north (3 out of 159 in 1973; and 6 out of 172 in 1974). The purchase probability estimates for habitual buyers living in municipalities of at least 100000 inhabitants was relatively high for tulips and low for daffodils, but was significant for tulips in 1974 only and for daffodils in 1973 only. Access to a garden was found to be related to a relatively low purchase probability estimate for tulips in 1973, perhaps because tulips were available in their own gardens. Habitual buyers under 30 years of age had a relatively higher purchase probability estimate for daffodils than did other habitual buyers, possibly, because daffodils were cheaper than tulips. The average price per stem in both years was 15.5 cents for daffodils and 23.2 cents for tulips. For 1973, habitual buyers who spent a relatively high proportion of their flower and plant budget at markets or street stalls had a higher purchase probability estimate for daffodils than did other habitual buyers. This may be related to the positive effect of the ambulatory trade on the purchase of flowers.

TABLE 7.11 Relationship between household characteristics of habitual buyers and the proportion of purchases of tulips in the period January to mid-May in 1973 and in 1974

| Household characteristics | 1973 (n = 159) | | 1974 (n = 172) | |
|---|---|---|---|---|
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | |
| AB (high) | .116 | 1.73 | .061 | 0.98 |
| C | .047 | 0.79 | .059 | 1.04 |
| $D_1$ | .061 | 1.05 | .084 | 1.54 |
| Geographical area | | | | |
| west | .225 | 2.06 | .126 | 1.71 |
| east | .185 | 1.58 | .050 | 0.62 |
| south | .232 | 1.96 | .137 | 1.63 |
| Size of residential municipality (inhabitants) | | | | |
| ≧ 100000 | .051 | 1.36 | .084 | 2.50 |
| 30000–100000 | -.006 | 0.15 | -.010 | 0.27 |
| Access to a garden | -.090 | 2.88 | -.028 | 0.93 |
| Household size | .008 | 0.72 | .012 | 1.20 |
| Age of wife (years) | | | | |
| 30–64 | -.072 | 1.40 | -.031 | 0.66 |
| ≧ 65 | -.047 | 0.74 | .009 | 0.15 |
| Attitude to housekeeping | -.015 | 0.50 | -.029 | 1.04 |
| Price consciousness | .008 | 0.24 | -.028 | 0.99 |
| Proportion of expenditure | | | | |
| for own home | -.029 | 0.27 | -.066 | 0.69 |
| from florist | -.056 | 0.82 | -.056 | 0.94 |
| at market or street stall | -.023 | 0.39 | -.018 | 0.37 |
| Constant | .126 | | .174 | |
| $R^2$ | .179 | | .159 | |

**Freesias.** Although freesias can be purchased throughout the year in the Netherlands, the mean purchase probability estimate for households purchasing freesias was higher in the period January to mid-May (about 0.20) than in the other period of the year (about 0.12). In January to mid-May, variation in the purchase probability estimates was found to be related to social class. Those in social class AB had a relatively lower purchase probability than those in other social classes (1973, $P < 10\%$; 1974, $P < 5\%$): no particular reason for this could be found.

**Chrysanthemums.** The mean purchase probability estimate for households purchasing chrysanthemums was considerably higher in the period mid-May to December (about 0.36) than in January to mid-May (about 0.12). Purchase probability estimates for January to mid-May were shown to be related to age. Those over 65 years of age had a relatively higher purchase probability for chry-

TABLE 7.12 Relationship between household characteristics of habitual buyers and the proportion of purchases on daffodils in the period January to mid-May in 1973 and in 1974

| Household characteristics | 1973 (n = 159) | | 1974 (n = 172) | |
|---|---|---|---|---|
| | Regression coefficient | Absolute t value | Regression coefficient | Asolute t value |
| Social class | | | | |
| AB (high) | -.009 | 0.13 | -.011 | 0.21 |
| C | -.009 | 0.16 | -.039 | 0.81 |
| $D_1$ | -.016 | 0.30 | -.022 | 0.48 |
| Geographical area | | | | |
| west | -.199 | 1.92 | -.186 | 3.00 |
| east | -.198 | 1.78 | -.141 | 2.05 |
| south | -.293 | 2.60 | -.225 | 3.16 |
| Size of residential municipality (inhabitants) | | | | |
| ≧ 100000 | -.083 | 2.35 | -.017 | 0.59 |
| 30000–100000 | -.031 | 0.77 | .046 | 1.42 |
| Access to a garden | .019 | 0.64 | .006 | 0.26 |
| Household size | -.000 | 0.00 | -.009 | 1.04 |
| Age of the wife (years) | | | | |
| 30-64 | -.095 | 1.95 | -.050 | 1.24 |
| ≧ 65 | -.117 | 1.94 | -.104 | 2.00 |
| Attitude to housekeeping | .011 | 0.39 | .018 | 0.78 |
| Price consciousness | -.006 | 0.22 | .008 | 0.34 |
| Proportion of expenditure | | | | |
| for own home | .040 | 0.39 | .027 | 0.34 |
| from florist | .091 | 1.39 | -.030 | 0.60 |
| at market or street stall | .115 | 2.06 | -.029 | 0.68 |
| Constant | .433 | | .455 | |
| $R^2$ | .126 | | .153 | |

santhemums than those in the other age groups (1973, P < 5%). Possibly, older people prefer to buy these 'autumn flowers' in spring because of the variation in colour and shape, or because of their lasting qualities.

**Roses.** The mean purchase probability estimate for households purchasing roses was considerably lower in the period January to mid-May (about 0.11) than in the other period of the year (about 0.20). Purchase probabilities for January to mid-May were not found to be significantly related to the household characteristics considered.

**Carnations and infrequently purchased flowers.** The mean purchase probability estimate for households purchasing carnations was lower in the period January to mid-May (about 0.13) than in the other part of the year (about 0.17), purchase probability estimates for carnations were found to be related to attitude to housekeeping. Those with a positive attitude had a relatively higher purchase probability than those with a negative attitude (1973, $P < 10\%$; 1974, $P < 5\%$). In addition, those with a positive attitude to housekeeping had a relatively lower purchase probability for infrequently purchased flowers than those with a negative attitude (1973, $P < 10\%$; 1974, $P < 5\%$). Apparently, the variable, attitude to housekeeping, distinguished buyers of more traditional flower types (e.g., carnations) from buyers of less traditional types, such as, infrequently purchased flowers.

*7.4.2 Mid-May to December*

In the second period of the year, chrysanthemums dominated the market, but carnations, roses, and freesias were also frequently purchased (Table 7.1). Variation in purchase probability estimates for flower types was also found to be related to household characteristics (Equation 7.6) for the period mid-May to December both in 1973 and in 1974. These results are presented below and hold under the condition: 'all other household characteristics being equal'.

**Chrysanthemums.** Variation in purchase probability estimates for chrysanthemums was found to be related to the following household characteristics: geographical area and age (Table 7.13). The small number of habitual buyers living in the north has to be taken into account: in 1973, 4 out of 188; and in 1974, 2 out of 186. The purchase probability estimate for chrysanthemums of habitual buyers living in the western, eastern or southern part of the country did not differ greatly. Possibly, their purchase probability was lower than that of habitual buyers living in the north. A factor affecting this is that chrysanthemums were frequently sold in supermarkets especially in the north. In 1973, those over 65 years of age had a relatively higher purchase probability estimate for chrysanthemums than those in other age groups. This is in accordance with findings for the first period of the year, January to mid-May.

**Roses.** Variation in purchase probability estimate for roses was found to be related to the proportion of the flower and plant budget spent at markets or street stalls, and to age. Those who spent a relatively high proportion of their flower and plant budget at markets or street stalls had a higher purchase probability estimate for roses than did others (1973, $P < 1\%$; 1974 $P < 5\%$). Households in which the wife was over 30 years of age had a relatively lower purchase probability estimate for roses than households in which the wife was under 30 years of age (1973; 30-64 year: $P < 1\%$, 65+: $P < 5\%$). It would seem that younger persons purchased roses more frequently than did others.

**Infrequently purchased flowers.** Those spending a relatively high proportion of their flower and plant budget at markets or street stalls had a lower purchase probability estimate for infrequently purchased flowers than did others (1973, $P < 2\%$; 1974, $P < 2\%$). This may be explained by the fact that the assortment of cut flowers that could be purchased at the markets and the street stalls may have been less varied than the assortment on sale at florists.

TABLE 7.13 Relationship between household characteristics of habitual buyers and the proportion of purchases on chrysanthemums in the periods, mid-May to December 1973 and mid-May to November 1974

| Household characteristics | Mid-May to December 1973 (n = 188) | | Mid-May to November 1974 (n = 186) | |
|---|---|---|---|---|
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value |
| Social class | | | | |
| AB (high) | -.065 | 1.05 | .010 | 0.16 |
| C | -.022 | 0.40 | .071 | 1.26 |
| $D_1$ | -.000 | 0.00 | .061 | 1.12 |
| Geographical area | | | | |
| west | -.425 | 4.80 | -.280 | 2.41 |
| east | -.348 | 3.75 | -.198 | 1.64 |
| south | -.393 | 4.11 | -.328 | 2.73 |
| Size of residential municipality (inhabitants) | | | | |
| ≧ 100000 | .014 | 0.42 | -.028 | 0.91 |
| 30000–100000 | -.035 | 0.97 | -.030 | 0.94 |
| Access to a garden | .040 | 1.44 | .027 | 1.04 |
| Household size | .016 | 1.59 | -.000 | 0.03 |
| Age of wife (years) | | | | |
| 30–64 | -.013 | 0.30 | -.010 | 0.28 |
| ≧ 65 | .110 | 2.02 | .014 | 0.29 |
| Attitude to housekeeping | -.001 | 0.03 | .029 | 1.15 |
| Price consciousness | .026 | 0.98 | .022 | 0.87 |
| Proportion of expenditure | | | | |
| for own home | -.019 | 0.21 | -.083 | 0.96 |
| from florist | .051 | 0.88 | .025 | 0.47 |
| at market or street stall | -.062 | 1.22 | -.017 | 0.37 |
| Constant | .735 | | .585 | |
| $R^2$ | .239 | | .153 | |

**Carnations and freesias.** Variation in the purchase probability estimate for carnations and for freesias was found not to be related at a 5% significance level to any of the household characteristics considered.

## 7.5 CONCLUSIONS

It can be concluded that the choice behaviour of individual habitual buyers for cut flowers can be described by a multinomial model. This means that the choice of a particular flower type in a particular period was not affected by the choice in the previous period for most habitual buyers. Habitual buyers were heterogeneous in their choice. For example, in the period January to mid-May 1973, 59% of those making at least 15 purchases bought carnations; the mean purchase probability estimate being 0.14 with a standard deviation of 0.13. In the same period, 92% of these habitual buyers bought tulips; the mean purchase probability estimate being 0.31 with a standard deviation of 0.17. Similar examples can be given for carnations and chrysanthemums in period mid-May to December in 1973 and in 1974. The heterogeneity of habitual buyers in their flower choice could be explained only partly by differences in household characteristics. Those household characteristics that discriminated between the purchase probability estimates for a number of types of flowers were: geographical area, size of the residential municipality, age, attitude to housekeeping, and proportion of the flower and plant budget spent at the market or street stall.

# 8 SEGMENTATION IN THE FLOWER AND PLANT MARKET

## 8.1 Introduction

One aim of this study is to determine whether measurable, accessible, and substantial segments can be found in the cut flower and pot plant market in the Netherlands (Section 4.1). A market segment is easily accessible when, for example, most households in the segment live in a particular geographical area, or in municipalities of at least 100000 inhabitants. A segment is also accessible when household characteristics, such as social class or stage in the life cycle typical of that segment, are also typical of subscribers to a particular journal or magazine.

In this chapter, market segments are defined on the basis of household characteristics, buying characteristics, and both. The way in which policy makers may use these segments will depend on the particular problem at hand and whether it is local (retailers), regional (auctions, wholesalers), or national (flower industry).

Two methodological approaches have been used to define market segments. In one, market segments were defined in advance, for example, segments differing in buying intensity (Figure 4.1), in socio-economic and demographic characteristics (Table 4.2), or in the number of subclasses of flowers and plants considered in the household's evoked set (Figure 6.1). In the other approach, segments were defined from analysis of the relationship between response parameter estimates and household characteristics. Whether these segments are interesting from a marketing point of view will be examined in this chapter.

A summary of the various types of segmentation to be discussed is given in Figure 8.1. Firstly, the whole sample of 1000 households has been divided into market segments on the basis of buying intensity: occasional buyers and regular buyers. The latter segment was divided further into habitual and nonhabitual buyers. In Section 8.2, differences between these segments are discussed, and also whether habitual buyers having differing numbers of subclasses of flowers and plants in their evoked set, were accessible and substantial market segments. In Section 8.3, segments of regular, and also of habitual buyers are defined from the analyses in preceding chapters.

## 8.2 Market segments differing in buying intensity or evoked set

### *8.2.1 Occasional versus regular buyers*

Characteristics of these segments are given in Table 8.1. By definition, buying

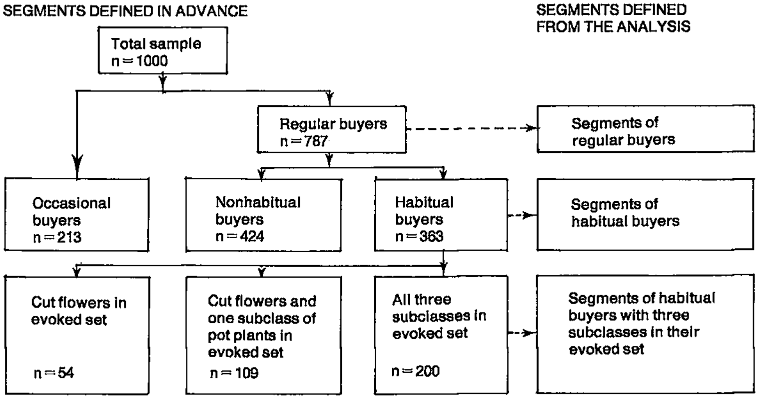



FIG. 8.1 Segments in the consumer 'Market' of cut flowers and pot plants.

intensity differed between these segments; occasional buyers represented about 21% of households in the sample, and regular buyers, 79%. The means of the household characteristics differed significantly between occasional and regular buyers (Hotelling's $T^2$ statistic, 5% significance level). The two market segments differed for the most part on the following household characteristics: geographical area; size of residential municipality; access to a garden; age; and attitude to housekeeping. Occasional buyers were more evenly distributed throughout the country, whereas about 50% of the regular buyers were found mainly in the western part. About 75% of occasional buyers and 50% of regular buyers resided in municipalities of less than 30000 inhabitants. About 30% of occasional buyers, but only 15% of regular buyers were over 65 years of age. About 75% of the occasional buyers and 50% of regular buyers had a positive attitude to housekeeping. Thus in summary, regular buyers of flowers and plants tended to live in the west of the country; or in heavily populated municipalities; or to be younger; or to have a negative attitude to housekeeping.

*8.2.2 Nonhabitual versus habitual buyers*

Characteristics of the two market segments distinguished within the segment of regular buyers are given in Table 8.2. By definition, buying intensity differed between these segments; nonhabitual buyers represented about 42%, and habitual buyers about 36% of the sample. The null hypothesis of no difference between household characteristics in the two segments was rejected at a 5% significance level. Nonhabitual buyers were found to be more evenly distributed throughout the country than habitual buyers. About 65% of habitual buyers as against 40% of nonhabitual buyers were found in the west of the country; and about 60% of nonhabitual buyers and 40% of habitual buyers resided in municipalities of less than 30000 inhabitants. About 75% of nonhabitual buyers and 60% of habit-

TABLE 8.1 Household characteristics of the total sample, and the market segments, occasional and regular buyers

| | Total sample (n = 1000) | | | Occasional buyers (n = 213) | | | Regular buyers (n = 787) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number | Proportion | Mean | Number | Proportion | Mean | Number | Proportion | Mean |
| Weekly expenditure (guilders) | | | 1.40 | | | .15 | | | 1.74 |
| Social class | | | | | | | | | |
| AB (high) | 107 | .107 | | 16 | .075 | | 91 | .116 | |
| C | 324 | .324 | | 58 | .272 | | 266 | .338 | |
| $D_1$ | 448 | .448 | | 104 | .488 | | 344 | .437 | |
| $D_2$ | 121 | .121 | | 35 | .164 | | 86 | .109 | |
| Geographical area | | | | | | | | | |
| west | 475 | .475 | | 62 | .291 | | 413 | .525 | |
| east | 179 | .179 | | 36 | .169 | | 143 | .182 | |
| south | 229 | .229 | | 74 | .347 | | 155 | .197 | |
| north | 117 | .117 | | 41 | .192 | | 76 | .097 | |
| Size of residential municipality (inhabitants) | | | | | | | | | |
| $\geqq$ 100000 | 294 | .294 | | 35 | .164 | | 259 | .329 | |
| 30000–100000 | 156 | .156 | | 23 | .108 | | 133 | .169 | |
| < 30000 | 550 | .550 | | 155 | .728 | | 395 | .502 | |
| Access to a garden | | | | | | | | | |
| yes | 718 | .718 | | 172 | .808 | | 546 | .694 | |
| no | 282 | .282 | | 41 | .192 | | 241 | .306 | |
| Household size | | | 3.29 | | | 3.36 | | | 3.27 |
| Age of wife (years) | | | | | | | | | |
| $\leqq$ 29 | 141 | .141 | | 22 | .103 | | 119 | .151 | |
| 30 -64 | 675 | .675 | | 126 | .592 | | 549 | .698 | |
| $\geqq$ 65 | 184 | .184 | | 65 | .305 | | 119 | .151 | |
| Attitude to housekeeping | | | | | | | | | |
| positive | 555 | .555 | | 160 | .751 | | 395 | .502 | |
| negative | 445 | .445 | | 53 | .249 | | 392 | .498 | |
| Price consciousness | | | | | | | | | |
| more | 687 | .687 | | 144 | .676 | | 543 | .690 | |
| less | 313 | .313 | | 69 | .324 | | 244 | .310 | |

TABLE 8.2 Household characteristics of nonhabitual and habitual buyers

| | Nonhabitual buyers (n = 424) | | Habitual buyers (n = 363) | |
|---|---|---|---|---|
| | Proportion | Mean | Proportion | Mean |
| Weekly expenditure (guilders) | | 1.02 | | 2.60 |
| Social class | | | | |
| AB (high) | .106 | | .127 | |
| C | .309 | | .372 | |
| $D_1$ | .455 | | .416 | |
| $D_2$ | .130 | | .085 | |
| Geographical area | | | | |
| west | .410 | | .658 | |
| north | .130 | | .058 | |
| east | .196 | | .165 | |
| south | .264 | | .119 | |
| Size of residential municipality (inhabitants) | | | | |
| $\geqq$ 100000 | .264 | | .405 | |
| 30000–100000 | .149 | | .193 | |
| < 30000 | .587 | | .402 | |
| Access to a garden | | | | |
| yes | .757 | | .620 | |
| no | .243 | | .380 | |
| Household size | | 3.27 | | 3.27 |
| Age of wife (years) | | | | |
| $\leqq$ 29 | .165 | | .135 | |
| 30–64 | .684 | | .714 | |
| $\geqq$ 65 | .151 | | .152 | |
| Attitude to housekeeping | | | | |
| positive | .500 | | .504 | |
| negative | .500 | | .496 | |
| Price consciousness | | | | |
| more | .698 | | .680 | |
| less | .302 | | .320 | |
| Proportion of expenditure | | | | |
| for the home | .668 | | .781 | |
| from florist | .427 | | .308 | |
| at the market or street stall | .304 | | .405 | |

ual buyers had access to a garden. Thus, habitual buyers tended to live in the west of the country, or in more highly populated areas.

The difference in level of expenditure on flowers and plants between habitual and nonhabitual buyers was found to be related, in particular, to age, proportion of the flower budget spent for home use, and proportion spent at the market or street stall (Table III.9). Habitual buyers in the age group 30 – 64 years spent more on flowers and plants than habitual buyers in other age groups, but such a distinction could not be made for nonhabitual buyers. A higher proportion of the flower and plant budget, spent by habitual buyers for the home, was found to be related to higher total expenditure on flowers and plants. The reverse was found to be the case for nonhabitual buyers. Also, a higher proportion of the flower and plant budget spent by habitual buyers at the florist or market and street stall was found to be related to higher total expenditure on flowers and plants but this was not the case for nonhabitual buyers.

Several response parameter estimates were found to differ between the two segments (Table 8.3). The mean of the distribution of the price parameter and also the mean price elasticity differed significantly between habitual and nonhabitual buyers; habitual buyers were more price elastic (Tables 5.9 and 5.10). The mean of the distribution of parameter estimates for present and past advertising did not differ significantly between these two segments, but the mean estimates of the trend parameter differed significantly. Growth of expenditure on the product class was found to be greater for habitual than for nonhabitual buyers.

A summary of the measurability, accessibility, and substantiality of the three market segments distinguished: namely, occasional, nonhabitual and habitual buyers; is given in Table 8.4. Occasional and nonhabitual buyers had several characteristics in common. Apart from the relatively low level of expenditure on flowers and plants, both segments tended to be concentrated in the south and north of the country with relatively few households in either segment in the west of the country, or in municipalities of more than 30000 inhabitants. The number of purchases by occasional buyers was too low for estimation of their price elasticity or trend parameter. However, it seems reasonable to assume that the demand for flowers and plants by occasional buyers, as in the case of nonhabitual buyers, was price inelastic and with little increase.

The question may well be raised as to whether marketing policy can be used to stimulate demand for flowers and plants by occasional and nonhabitual buyers. Reductions in price, or more intensive national advertising cannot be advocated on the basis of the results from this analysis. It would seem that the most effective way to increase demand would be to stimulate interest at the

TABLE 8.3 Mean and median response parameter estimates for nonhabitual and habitual buyers

| Response parameter | Nonhabitual buyers | | Habitual buyers | | Difference in mean[a] |
|---|---|---|---|---|---|
| | mean | median | mean | median | |
| Price parameter | -0.04 | -0.04 | -0.26 | -0.21 | s |
| Price elasticity | -0.28 | -0.32 | -0.81 | -0.73 | s |
| Parameter for | | | | | |
| present advertising | 0.01 | 0.03 | 0.02 | 0.05 | n.s |
| past advertising | -0.08 | -0.07 | -0.02 | -0.05 | n.s |
| Trend parameter | 0.04 | 0.05 | 0.25 | 0.20 | s |

[a] s = significant at 5% level; n.s = not significant at 5% level

TABLE 8.4 Measurability, accessibility, and substantiality of the market segments, occasional, non-habitual, and habitual buyers

| Segment | Occasional buyers (n=213) | Nonhabitual buyers (n=424) | Habitual buyers (n=363) |
|---|---|---|---|
| *Measurability* | | | |
| Average weekly expenditure (guilders) | 0.15 | 1.01 | 2.60 |
| Price elasticity | | -0.28 | -0.81 |
| Trend parameter | | 0.04 | 0.25 |
| *Accessibility* | | | |
| Area | | | |
| west (%) | 29 | 41 | 66 |
| east (%) | 17 | 20 | 17 |
| south (%) | 35 | 26 | 12 |
| north (%) | 19 | 13 | 6 |
| Size of residential municipality | | | |
| ≧ 30000 inhabitants (%) | 27 | 41 | 60 |
| *Substantiality* | | | |
| Proportion of the market | | | |
| households (%) | 21 | 43 | 36 |
| expenditure (%) | 3 | 30 | 67 |

time when these segments tend to purchase, for example for Mother's Day (Table 5.7) or at Christmas.

### *8.2.3 Segments of habitual buyers differing in the number of subclasses in their evoked set*

In Chapter 6, habitual buyers with one, two, and three subclasses of flowers and plants in their evoked set were specified (Figure 6.1). The average amount spent differed very little between these groups. The purchase characteristics of the market segment having two subclasses in their evoked set (cut flowers and pot plants, that is predominantly flowering plants) are given in Table 8.5 and those with three subclasses in Table 8.6. Household characteristics of the two segments did not differ significantly and are the same as those for all habitual

TABLE 8.5 Purchase characteristics[a] of habitual buyers with two subclasses in their evoked set

| | Cut flowers | Flowering plants |
|---|---|---|
| Mean budget share | 0.77 | 0.23 |
| Marginal budget share | 0.72 | 0.28 |
| Budget elasticity | 1.00 | 1.39 |
| Uncompensated price elasticity | -0.95 | -0.98 |

[a] All values are means over the four seasons in 1974 for 58 out of 93 habitual buyers for whom parameter estimates could be obtained.

TABLE 8.6 Purchase characteristics[a] of habitual buyers with three subclasses in their evoked set

| | Cut flowers | Flowering plants | Green plants |
|---|---|---|---|
| Mean budget share | 0.61 | 0.24 | 0.15 |
| Marginal budget share | 0.53 | 0.25 | 0.21 |
| Budget elasticity | 0.98 | 1.25 | 1.47 |
| Uncompensated price elasticity | -0.86 | -0.87 | -0.96 |

[a] All values are means over the four seasons in 1974 for 127 habitual buyers for whom parameter estimates could be obtained.

buyers given in Table 8.4. As may be expected, those with two subclasses in their evoked set tended to spend a greater proportion of their flower and plant budget on cut flowers than those with an evoked set of three subclasses. The budget elasticity for plants, being predominantly flowering plants in the first segment (Table 8.5), and both flowering and green plants in the second segment (Table 8.6), was higher than that for cut flowers.

Budget and price elasticities did not differ greatly between habitual buyers with two and those with three subclasses in their evoked set. Also since it was not possible to draw conclusions about the responses to the industry's advertising policy, it is suggested that these two groups should not be treated as separate market segments.

Consideration can be given to whether it is worthwhile dividing the segment of habitual buyers with three subclasses in their evoked set into subsegments. In this segment, the marginal budget shares of households were found to be related to several household characteristics (Table 6.13). The marginal budget share for cut flowers was relatively high for habitual buyers who spent a high proportion of their flower and plant budget for home use rather than on gifts, and relatively low for those having access to a garden or with a positive attitude to housekeeping. On the other hand, the marginal budget share for flowering plants was relatively low for habitual buyers in social class AB; for those living in municipalities of more than 100000 inhabitants; or for those who spent a relatively high proportion of the flower and plant budget for home use. However, it was relatively high for those in the age group 30 to 64 years, and also for those whith a positive attitude to housekeeping. The marginal budget share for green plants was relatively high for habitual buyers living in municipalities of more than 100000 inhabitants, or for those having access to a garden; but was relatively low for those in the age group 30 to 64 years.

It seems that subsegments can be defined on the basis of household characteristics: number of inhabitants in residential municipality; access to a garden; age; or proportion of the flower and plant budget spent for home use. However, these subsegments may not necessarily be substantial.

## 8.3 Segments defined from analysis of the relationship between parameter estimates and household characteristics

### *8.3.1 Segments of regular buyers*

Response parameter estimates of regular buyers were found to be related to a set of household characteristics (Tables 5.8 to 5.12). Possibly, 'special segments for special purposes' can be defined.

Growth in expenditure on flowers and plants (Table 5.8) was greater in municipalities of more than 30000 inhabitants than in others, which may reflect the strong position of the ambulatory trade in relatively large municipalities (Table 5.4). Also, both the price parameter estimate (Table 5.9) and the price elasticity (Table 5.10) of regular buyers were found to be related to size of residential municipality. Regular buyers in municipalities of over 30000 inhabitants were more price elastic than those living in smaller municipalities.

Regular buyers found to be relatively sensitive to present advertising (Table 5.11) tended to belong to social class AB; to live in the west, east or south of the country; or to spend a relatively high proportion of their flower and plant budget for home use. In the week prior to Mother's Day, regular buyers under 30 years of age, or living in municipalities of between 30000 and 100000 inhabitants spent relatively large amounts on flowers and plants (Table 5.12).

These results suggest that size of municipality is the most important variable on which to subdivide the segment of regular buyers. Regular buyers living in urbanized municipalities tended to be more price elastic, and inclined to spend more on flowers for Mother's Day, also to increase expenditure on flowers and plants in the course of time to a greater extent than those living in rural municipalities. Segments of regular buyers based on size of residential municipality were both accessible and substantial (Table 8.1).

### *8.3.2 Segments of habitual buyers*

The extent to which differences in the responses of habitual buyers to various marketing or market variables were found to be related to household characteristics is summarized. The following response parameters were used for this purpose: price elasticity in both the budget and priority stage of the multistage choice process; present and past advertising in the budget stage; and purchase probabilities for particular flower types in the choice stage.

**Segments differing in price sensitivity.** It was expected that the price elasticity of the number of purchases of flowers and plants in the budget stage would be positively related to uncompensated own price elasticities for the main subclass, cut flowers, in the priority stage. This relationship was examined in respect of the 127 habitual buyers having three subclasses in their evoked set. For a reliable comparison, the difference in the period of observation chosen in the budget stage (week) and priority stage (three-month period) had to be eliminated. Thus, price elasticities for habitual buyers in the budget stage were also estimated for three-month periods, resulting in eight observations for each habitual buyer. The price elasticities were estimated in the regression equation

$$q_{ht} = a_h + b_h p_t + c_h D_w + d_h D_s + e_h D_A + u_{ht}, \tag{8.1}$$

where $q_{ht}$ = the number of purchases of flowers or plants in the three-month period t by household h (see Chapter 6 for the specification of the three-month periods);

$p_t$ = the mean price of flowers or a pot plant in the three-month period t (deflated);

$D_w$ = 1 in the period December to February (winter)
= 0 other periods of the year;

$D_s$ = 1 in the period March to May (spring)
= 0 other periods of the year;

$D_A$ = 1 in the period September to November (autumn)
= 0 other periods of the year;

$u_{ht}$ = disturbance term for household h in period t.

The resulting residual number of degrees of freedom is three. The extent to which the null hypothesis

$$b_h = c_h = d_h = e_h = o \tag{8.2}$$

held for all 363 habitual buyers and for the 127 habitual buyers having three subclasses in their evoked set, was examined with the test described in Appendix V.1. The null hypothesis (Equation 8.2) was rejected at a 1% significance level, implying that the regressions (Equation 8.1) are appropriate for habitual buyers. The price elasticity for three month period t is

$$E_{ht} = b_h \cdot p_t / q_{ht} \tag{8.3}$$

The relationship between the price elasticities derived from Equation 8.1 and the uncompensated own price elasticities for flowers, flowering plants, and green plants for the 127 habitual buyers with three subclasses, seemed to be low (Table 8.7). As expected, it tended to be highest for the main subclass flowers. This result suggests that the elasticities in the priority stage provide additional information on the price elasticity of habitual buyers with an evoked set of three subclasses.

For the budget stage, habitual buyers living in municipalities of more than 30000 inhabitants, or those spending a relatively large proportion of their flower and plant budget at the market or street stall, or those with a negative attitude to housekeeping, were more price sensitive than other habitual buyers. For the priority stage, several results specific for particular seasons were obtained (Section 6.5.2). Since size of residential municipality tended to be related to the number of outlets of ambulatory traders, it can be concluded that price reduc-

TABLE 8.7 Correlation coefficients (r) showing the relationships between the price elasticity for the whole product class in the budget stage and the uncompensated own price elasticities of the demand for cut flowers, flowering pot plants, and green pot plants, respectively, in the priority stage for habitual buyers with three subclasses in their evoked set (n = 127)

| | Relationship between price elasticity (budget stage) and uncompensated own price elasticities (priority stage) for | | | | | |
|---|---|---|---|---|---|---|
| | Cut flowers | | Flowering pot plants | | Green pot plants | |
| | r | P | r | P | r | P |
| Winter 1973/74 | 0.04 | >0.10 | 0.16 | 0.04 | 0.14 | >0.10 |
| Spring 1974 | 0.13 | 0.08 | 0.22 | 0.01 | -0.08 | >0.10 |
| Summer 1974 | 0.12 | 0.09 | -0.04 | >0.10 | -0.12 | >0.10 |
| Autumn 1974 | 0.15 | 0.05 | -0.09 | >0.10 | 0.00 | >0.10 |

tions would have more appeal to habitual buyers living in urbanized municipalities than to those in rural municipalities.

**Market segments differing in sensitivity to advertising.** The relationship between parameter estimates for present advertising and household characteristics for regular buyers is discussed in Section 8.3.1. This relationship was not found to differ significantly between habitual and nonhabitual buyers (Table 5.11). Thus, it can be concluded that expenditure on national advertising had more effect when directed to habitual buyers in the highest social class, or to those who frequently purchased flowers and plants for home use, than when directed to other habitual buyers. It seems appropriate to choose the proportion of expenditure for own home as a basis for market segmentation with regard to response to advertising, because the highest social class is rather small (Table III.2). As there was a positive correlation between expenditure for home use and expenditure at market or street stall ($r = .120$; $n = 787$; $P < 0.001$); and a negative correlation between expenditure for home use and expenditure at the florist ($r = -.260$; $n = 787$; $P < 0.001$), advertising at the market or street stall would seem to be more effective than advertising at the florist.

**Segments differing in purchase probability estimates for flowers.** Habitual buyers over 65 years of age tended to have a relatively high purchase probability for chrysanthemums, whereas those less than 30 years had a relatively high purchase probability for daffodils and roses. The purchase probability of habitual buyers with a positive attitude to housekeeping was relatively high for carnations and relatively low for infrequently purchased flowers. The purchase probability of habitual buyers patronizing markets or street stalls was relatively high for roses and relatively low for infrequently purchased flowers.

### *8.3.3 Segments of habitual buyers using the concept of standard buyers*

Segmentation in Section 8.3.1 and 8.3.2 was based on a procedure to ascertain whether households having particular buying characteristics in common could be described by particular socio-economic and demographic characteristics. The approach in this section is to use the socio-economic and demographic characteristics of standard habitual buyers to estimate their buying characteristics and then to classify them according to such buying characteristics. The question becomes then whether each group of standard habitual buyers, having similar buying characteristics, also has similar socio-economic or demographic characteristics.

Standard habitual buyers have been determined as to those who differed in at least one of the following household characteristics: geographical area, social class, or age (Section 4.2.2). Additional household characteristics (Appendix V.2) were determined using frequency distributions of household characteristics of all habitual buyers. For each standard habitual buyer, a set of parameter estimates reflecting his buying behaviour was calculated by inserting his household characteristics (Appendix V.2) in the regression models, relating response parameter estimates to household characteristics estimated in the Chapters 5 to 7. Cluster analysis was applied to these sets of parameter estimates. Then the extent to which standard habitual buyers in the same cluster had household characteristics in common was examined. In this way, groups of habitual buyers with similar household and buying characteristics were obtained.

The analysis was based on the data of all 363 habitual buyers for the budget stage, 127 habitual buyers with three subclasses in their evoked set for the priority stage, and approximately 170 habitual buyers making at least 15 purchases of flowers in a specified period in the choice stage (Table 7.4). In view of the size of the clusters arrived at, the analysis was perhaps more interesting from a methodological point of view than reliable from the sample size.

**Clusters of standard habitual buyers.** Buying characteristics of standard habitual buyers to be used in the cluster analysis were selected on the criteria: extent to which response parameter estimates were significantly related to household characteristics; and the relevance of a particular buying characteristic to market policy.

The following response parameters were chosen in the budget stage: the trend parameter to represent growth or decline in expenditure on flowers and plants; the price parameter to represent household sensitivity to price policy; and the parameter for present advertising which, contrary to that for past advertising, tended to be related to household characteristics. Estimates of these parameters for each of the standard habitual buyers were obtained by inserting their household characteristics (Appendix V.2) in Equation 5.15.

For the priority stage, the marginal budget shares, which are more stable over the course of time than budget and price elasticities, were selected. Estimates of the marginal budget shares of habitual buyers with an evoked set of three subclasses were obtained for each standard habitual buyer by inserting their household characteristics in Equation 6.26. The estimate of the marginal budget share for flowers was not used in the cluster analysis, because the marginal budget shares add to one.

For the choice stage, only choice in the largest subclass, cut flowers, was considered. For the first half of the year, the spring flowers, tulips and daffodils, were selected because they are the flowers in season (Table 7.1). For the second part of the year, chrysanthemums, roses and infrequently purchased flowers were selected. Estimates of purchase probabilities for each standard habitual buyer were obtained by inserting their household characteristics in Equation 7.6.

Thus, ten buying characteristics were obtained for each of the 48 standard habitual buyers. Groups of standard habitual buyers having similar buying characteristics were then determined by cluster analysis.

The procedure chosen to find segments of standard habitual buyers was as follows. The Euclidean distance between buying characteristics of standard buyers h and h′ was calculated by

$$d^2_{hh'} = \sum_{l=1}^{L} (z_{hl} - z_{h'l})^2 \tag{8.4a}$$

where

$$z_{hl} = \frac{y_{hl}}{\sigma_l} \tag{8.4b}$$

is the standardized response parameter estimate l with

$$\sigma_l^2 = \sum_{h=1}^{H} (y_{hl} - \bar{y}_l)^2 / H \tag{8.4c}$$

These Euclidean distances were used in two agglomerative hierarchical clustering techniques, the nearest neighbour and the furthest neighbour method, with seven clusters as stopping criterion. As the resulting provisional clusters were different, an optimization technique[a], in which entities can also be re-allocated, was applied to both configurations of seven clusters. With this technique the number of clusters was reduced from seven to five; the result was the same in both cases. Surprisingly, every cluster seemed to have homogeneous elements with respect of socio-economic and demographic characteristics. The way in which these characteristics are represented in each cluster is depicted in Figure 8.2.

From Figure 8.2, five groups of habitual buyers can be characterized as follows:

[a] In the CLUSTAN program RELOCATE (Wishart 1978; 1982), the ratio of the determinants $|W|/|T|$ is minimized where W is the matrix of sums of squares and cross products within clusters and T is the total dispersion matrix (e.g., Everitt 1974, pp 26-27).

Group 1: consisting of those not belonging to the highest social class and living in either the south or east of the country and being under 30 years of age; or living in the west in a municipality of more than 30000 inhabitants;

Group 2: consisting of those not belonging to the highest social class, living in either the south or east of the country and being over 30 years of age; or living in the west in a municipality of less than 30000 inhabitants;

Group 3: consisting of those living in the south, east, or west and belonging to social class AB;

Group 4: consisting of those living in the north and belonging to either social class C or D;

Group 5: consisting of those living in the north and belonging to social class AB.

In defining five groups of habitual buyers in this way, a minor error was made by not taking into account the three standard habitual buyers marked with an asterisk in Figure 8.2.

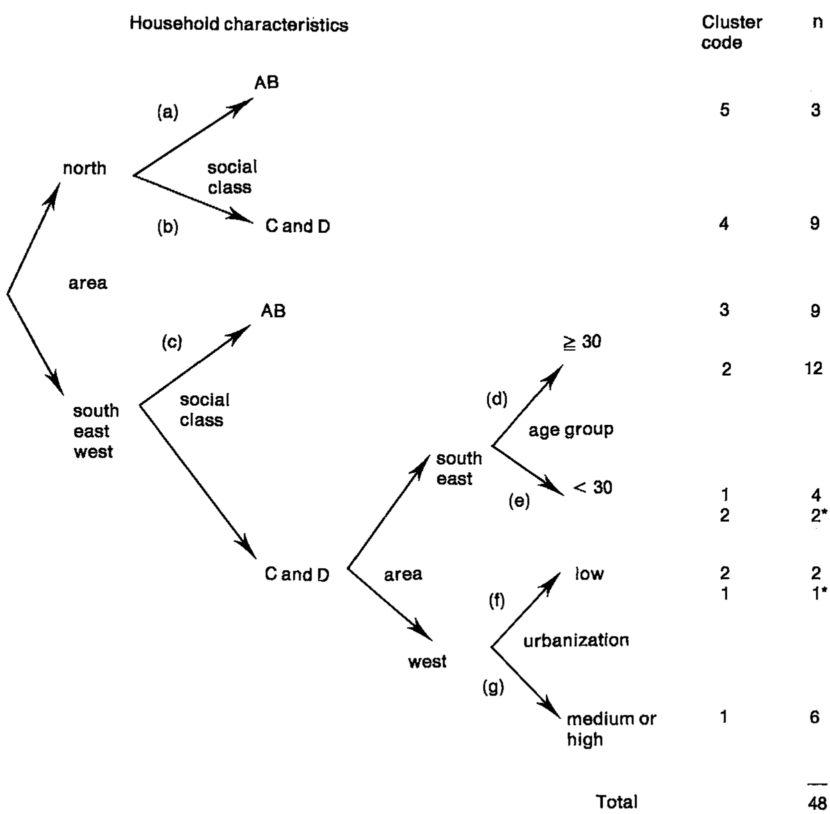



FIG. 8.2 Household characteristics of standard habitual buyers (n = 48) in five clusters.

TABLE 8.8 Number of habitual buyers in groups suggested by the analysis of standard habitual buyers

| Groups of habitual buyers | Stage in the multistage choice process | | | | | |
|---|---|---|---|---|---|---|
| | Budget | Priority | Choice | | | |
| | | | Spring | | Remainder of the year | |
| | | | 1973 | 1974 | 1973 | 1974 |
| 1 | 151 | 51 | 71 | 79 | 86 | 87 |
| 2 | 149 | 49 | 62 | 63 | 73 | 71 |
| 3 | 42 | 17 | 23 | 24 | 25 | 26 |
| 4+5 | 21 | 10 | 3 | 6 | 4 | 2 |
| Total | 363 | 127 | 159 | 172 | 188 | 186 |
| 2+4 | | | 65 | 68 | 77 | 72 |
| 3+5 | | | 23 | 25 | 25 | 27 |

**Segments of habitual buyers.** The number of habitual buyers in each group suggested from Figure 8.2 is given in Table 8.8.

Groups 4 and 5 were combined because of the small number in each. This combined group consisted of habitual buyers living in the north, but the number in this part of the country was still too low for inclusion in the analysis of the choice stage. The mean estimates of buying characteristics of habitual buyers in the budget and in the priority stage in the four remaining groups are given in Table 8.9.

As the number of observations for the choice stage in group 4 + 5 was very low, it was decided to combine (a) and (c), and (b) and (d) in Figure 8.2. Thus, three groups were obtained for the choice stage: 1, 2+4, and 3+5. The mean estimates of buying characteristics of habitual buyers in the choice stage are given for the three groups in Table 8.10.

TABLE 8.9 Mean estimates of buying characteristics of habitual buyers in the budget stage and in the priority stage in groups suggested by the analysis of standard habitual buyers

| Groups of habitual buyers | Budget stage | | | Priority stage | | |
|---|---|---|---|---|---|---|
| | Trend parameter | Advertising parameter | Price parameter | Marginal budget share | | |
| | | | | Cut flowers | Flowering pot plants | Green pot plants |
| 1 | .32 | -.02 | -.31 | .54 | .22 | .24 |
| 2 | .19 | .03 | -.17 | .53 | .30 | .17 |
| 3 | .12 | .18 | -.34 | .54 | .22 | .25 |
| 4+5 | .34 | -.14 | -.34 | .53 | .28 | .20 |
| Mean | .25 | .02 | -.26 | .53 | .25 | .21 |
| Number of habitual buyers | 363 | 363 | 363 | 127 | 127 | 127 |

TABLE 8.10 Mean estimates of buying characteristics of habitual buyers in the choice stage for three groups suggested by the analysis of standard habitual buyers

| Groups of habitual buyers | Purchase probabilities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Spring | | | | Remainder of the year | | | | | |
| | Tulip | | Daffodil | | Rose | | Chrysanthemum | | Infrequently purchased flowers | |
| | 1973 | 1974 | 1973 | 1974 | 1973 | 1974 | 1973 | 1974 | 1973 | 1974 |
| 1 | .33 | .33 | .19 | .17 | .22 | .21 | .36 | .31 | .20 | .20 |
| 2+4 | .21 | .22 | .22 | .22 | .15 | .13 | .43 | .35 | .21 | .26 |
| 3+5 | .34 | .29 | .20 | .19 | .21 | .18 | .33 | .28 | .28 | .29 |
| Mean | .28 | .28 | .21 | .19 | .19 | .17 | .39 | .32 | .22 | .24 |
| Number of habitual buyers | 159 | 172 | 159 | 172 | 188 | 186 | 188 | 186 | 188 | 186 |

Differences in cluster means were tested with multivariate analysis of variance (Appendix V.3). Since not all parameter estimates were obtained for all habitual buyers, four different multivariate analyses of variance were applied. Firstly, one was applied to all 363 habitual buyers with estimates for the trend, advertising, and price parameter. Secondly, one was applied to 127 habitual buyers with estimates for the marginal budget share for flowering and for green plants and the previous three parameter estimates. Thirdly, one was applied to 159 (1973) and one to 172 (1974) habitual buyers with estimates for the purchase probability for tulips, and for daffodils, and the previous three parameter estimates. Finally, multivariate analysis of variance was applied to 188 (1973) and to 186 (1974) habitual buyers with estimates for the purchase probability for roses, for chrysanthemums, and for infrequently purchased cut flowers and the first three parameter estimates. The mean parameter estimates for the budget and choice stages were found to differ significantly between clusters, but this was not the case for parameter estimates for the priority stage. Thus, on the basis of the preceding analysis, the following segments of habitual buyers are suggested.

The first segment consists of habitual buyers, not belonging to the highest social class and either living in the south or east of the country and being under 30 years of age, or of all ages living in the west of the country in urbanized municipalities. Buying behaviour in this segment can be characterized by the following aspects: growth in expenditure was relatively high, and the segment was relatively sensitive to price changes but reasonably insensitive to national advertising. They made more than the mean number of purchases of tulips and roses and less than the mean number of purchases of daffodils, chrysanthemums and infrequently purchased flowers. The mean level of expenditure was moderate, being 2.50 guilders per week.

The second segment consists of habitual buyers, not belonging to the highest social class, either living in the south or east of the country and being over 30 years of age, or of all ages living in the west of the country in a rural municipality. In this segment, growth in expenditure was relatively low and the segment was relatively insensitive to both changes in prices and national advertising. Fewer tulips and roses but more chrysanthemums were purchased than the mean for habitual buyers. The mean level of expenditure was moderate, being 2.65 guilders per week.

The third segment consists of habitual buyers belonging to social class AB and living in the west, east, or south of the country. In this segment, growth in expenditure was low and the segment was sensitive to both changes in prices and advertising. More purchases were made of tulips and infrequently purchased flowers, and relatively fewer purchases of chrysanthemums than the mean for habitual buyers. The mean level of expenditure was high, being 3.12 guilders per week.

The fourth segment consists of habitual buyers living in the north of the country. In this segment, growth in expenditure was high and expenditure was sensitive to price changes, but relatively insensitive to changes in national advertising. The mean level of expenditure was low, being 1.98 guilders per week.

The first two segments were found to be substantial (consisting each of approximately 40% of the habitual buyers) as compared with the third and fourth segments which could perhaps be of interest at a regional or local level.

It may be concluded that segments of habitual buyers can be defined from combined results of the analysis of each stage of the assumed multistage choice process. However, results obtained for the priority stage did not contribute to the definition of the suggested segments.

When comparing the segments of habitual buyers proposed in the previous section with those obtained in this section, it would seem that the results as to habitual buyers' sensitivity to changes in price, and national advertising correspond, whereas the results for particular flower types are more specific in this than in the preceding section.

# 9 CONCLUSION AND EVALUATION OF THE STUDY

The aims of this study were to improve insight into consumer behaviour in respect of cut flowers and pot plants in the Netherlands; to ascertain whether market segments can be distinguished; and whether the methods and models used in this study are applicable to market research in the flower industry. In the first sections of this chapter, conclusions are drawn on consumer behaviour and the market segments distinguished. Finally, the methods used are evaluated in terms of their applicability to the flower industry.

## 9.1 Buying Behaviour

### *9.1.1 General purchase characteristics*

This study has been based on purchase data from a representative sample of 1000 households in the Netherlands for the period December 1972 to November 1974. General characteristics of consumer behaviour were observed, which may be of relevance to the flower and pot plant industry. Approximately 36% of all households were classified as habitual buyers: these households purchased flowers and pot plants about once per week and spent more for home use than for gifts. Approximately 42% of all households were classified as nonhabitual buyers, making purchases about once per month; and approximately 21% as occasional buyers, making purchases about once every six months. Of the total expenditure on flowers and plants of all households during the period of the study, habitual buyers spent 67%; nonhabitual buyers, 30%; and occasional buyers, 3%.

Approximately 75% of the total number of purchases were made for home use, about two-thirds of which were made by the wife. The remaining 25% of the total number of purchases were made for gifts, about nine-tenths of which were made by the wife.

The proportion of purchases made at various retail outlets in 1973 and in 1974 were as follows: 30% from florists; 25% from markets; 20% from street stalls; 9% from house-to-house vendors; 8% from supermarkets; and 8% from growers, garden centres, and gardeners.

Almost half of the total number of purchases of flowers and pot plants were made on Saturdays and about 90% of the total were made in the latter half of the week, between Wednesday and Saturday: 8% on Wednesdays; 11% on Thursdays; 27% on Fridays; and 45% on Saturdays.

More than 80% of the total number of purchases of cut flowers in 1973 and in 1974 were of six types only: chrysanthemums being the most frequently purchased. The proportion of the total number of purchases of the most popular types was 25%, chrysanthemums; 13%, freesias; 13%, tulips; 12%, roses; 11%, carnations; and 9%, daffodils. A wider range of pot plants was purchased, in the same period, cyclamen being most frequently purchased. The proportion of the total number of purchases of the most popular types was: 13%, cyclamen; 12%, azaleas; and 9%, chrysanthemums.

Of the households purchasing either one type of flower or another, or both, the proportion purchasing both types was higher than 70% for the following combinations: chrysanthemums and freesias, or tulips, or carnations; freesias and tulips or carnations; and, tulips and carnations.

Of the households purchasing either one plant or another, or both, the proportion purchasing both was higher than 40%, for the following combinations: azaleas and cyclamen, or saintpaulias, or chrysanthemums, or begonia rex; begonia rex and cyclamen or saintpaulia; and, chrysanthemum and cyclamen.

The purchase of a particular type of flower could be described by a multinomial model for a large majority of habitual buyers. This means that, within a particular season, the probability of purchasing a particular type of flower did not change for these buyers.

Certain household characteristics were found to be positively related to expenditure on flowers and plants, in particular, the demographic variables, living in the west or east of the country, and living in municipalities of more than 30000 inhabitants. The variable, having a positive attitude to housekeeping, however, was found to be negatively related to expenditure on flowers and plants.

### *9.1.2 Response parameter estimates*

**Price elasticities.** The mean household price elasticity of the demand for cut flowers and pot plants was -0.28 for nonhabitual and -0.81 for habitual buyers. For the 55% of all habitual buyers who made purchases in all three subclasses distinguished (cut flowers, flowering pot plants, and green pot plants): the mean household price elasticity was -0.86 for cut flowers, -0.87 for flowering pot plants, and -0.96 for green pot plants. In the choice stage of the multistage choice process model, price was one of many variables influencing choice.

**Substitution.** From the cross-price elasticities between flowers and flowering plants; flowers and green plants, and flowering and green plants, it can be inferred that purchases of flowers were the least affected by price fluctuations in other subclasses. This indicates that the demand for cut flowers was more stable than the demand for flowering, and for green pot plants.

**Income and budget elasticities.** Since data on income were not available, the relationship between the flower and plant purchases and household income was measured in terms of expenditure, and social class. All other household characteristics being equal, expenditure on flowers and plants increased in line with increasing social class; and also, tended to be greater in households in which the wife was of the age group, 30 to 64 years. Presumably, the incomes of households are higher in that age group than in others. These results suggest that the income elasticity was positive for households in the Netherlands in the period 1973 and 1974. For all habitual buyers who purchased both cut flowers and pot plants, the budget elasticity for pot plants was higher than that for cut flowers, except in winter when the budget elasticities for cut flowers and flowering pot plants were almost the same. For habitual buyers who made purchases in three subclasses: cut flowers, flowering pot plants, and green pot plants, the budget elasticity for green pot plants was higher than that for flowering pot plants during winter and spring, but not during summer and autumn.

**Response to national advertising.** The effect of national advertising on demand was higher in seasons when demand was high or increasing than in seasons when demand was low or decreasing. This is in agreement with the general thesis that advertising is particularly effective in stimulating an already increasing demand.

## 9.2 Market segmentation

Market segments could be distinguished because differences between households in response parameter estimates tended to be related to differences in socio-economic and demographic characteristics. These segments were determined in three ways. In the first approach, segments were defined in advance on the basis of buying frequency, and then examined from a marketing point of view. Secondly, market segments were determined which are of special interest in formulating marketing policies, with particular regard to: product, price, and advertising policies. In the third approach, subsegments of habitual buyers were distinguished from an analysis of the buying behaviour of a group of buyers defined as standard buyers. Similarity in response parameter estimates for these standard buyers was found to be related to having certain household characteristics in common.

### *9.2.1 Segments defined in advance on the basis of buying frequency*

On the basis of buying frequency, three market segments were defined: habitual buyers; nonhabitual buyers; and occasional buyers. Occasional buyers tended to live in less densely populated areas than nonhabitual and habitual buyers. Two-thirds of the habitual buyers lived in the west of the country, whereas two-thirds of the occasional buyers resided elsewhere. Expenditure on cut flowers and pot plants by habitual buyers tended to increase more and purchases were more price elastic than that of nonhabitual buyers.

### *9.2.2 Segments on the basis of consumer behaviour in respect of aspects of marketing policy*

For product policy, segmentation was based on the criterion of preference. This was determined from the estimated marginal budget share of cut flowers, flowering pot plants, and green pot plants for habitual buyers purchasing in all three subclasses. Habitual buyers with a relatively high marginal budget share for cut flowers frequently did not have access to a garden, had a negative attitude to housekeeping, or spent a relatively high proportion of their budget for flowers and plants for use at home. Those with a relatively high marginal budget share for flowering pot plants, frequently belonged to the lower social classes, lived in municipalities of less than 100000 inhabitants, belonged to the age group 30 to 64 years, had a positive attitude to housekeeping, or spent a relatively small proportion of this budget for use at home. Those with a relatively high marginal budget share for green pot plants, frequently lived in municipalities of more than 100000 inhabitants, had access to a garden, or were under 30 years of age. In addition, the estimated purchase probability for various types of flowers can be used as an indicator of preference. The estimated purchase probability for infrequently purchased flowers for the period January to May was relatively low for habitual buyers with a positive attitude to housekeeping. For the period May to December, it was relatively low for those spending a high proportion of this budget at markets and street stalls.

For price policy, segmentation was based on the criterion, price sensitivity measured by the price parameter estimate in the budget stage of the choice process model. Habitual buyers were more price elastic in their purchases than nonhabitual buyers; or lived more often in the west of the country; or in urbanized municipalities than nonhabitual buyers. Habitual buyers who were price sensitive tended to live in urbanized municipalities, or to spend a large proportion of their flower and plant budget at the market or street stall, or to have a negative attitude to housekeeping.

For advertising policy, the criterion for segmentation was, sensitivity to national advertising. Even though household sensitivity to national advertising tended to be low, some differences between households were found. Regular buyers, both habitual and nonhabitual buyers, were relatively sensitive to national advertising when they belonged to the highest social class, or lived in the west, east, or south of the country; or spent a relatively high proportion for home use.

### *9.2.3 Segments of habitual buyers determined from analysis of the results for the multistage choice process*

From an analysis of the results for all three stages of the multistage choice process, four segments of habitual buyers were distinguished. Characteristics of the three largest subsegments are summarized. The largest segment incorporating approximately 44% of the habitual buyers was relatively sensitive to price changes, but somewhat insensitive to national advertising. It consisted of those who were not of the highest social class, either living in the west of the country in urbanized municipalities, or living in the east or south of the country and under 30 years of age. Growth in expenditure on flowers and pot plants was high and the purchase of tulips and roses was favoured by this segment. The second largest segment incorporating approximately 40% of the habitual buyers tended to be relatively insensitive to both price changes and national advertising. It consisted also of those who were not of the highest social class, either living in the west of the country in a rural municipality, or living in the east or south of the country and over 30 years of age. Growth in expenditure in this segment was minimal and it tended to favour chrysanthemums. The smallest segment incorporating approximately 13% of the habitual buyers was sensitive to changes in price and advertising. It consisted of habitual buyers of the highest social class and living in the west, east, or south of the country. Growth in expenditure by this segment was low also and tulips and infrequently purchased flowers were favoured.

Several ways of segmenting the market have been suggested, however, the question is whether, for a particular segmentation of the market, buying behaviour continued to differ between segments after 1974. As panel data are also available for the period 1975 to 1980 it would be possible to investigate this. This could be done by collecting purchase data of households for each segment for the period and estimating the response parameters and testing whether such estimates differ significantly. A further study could be carried out to verify whether these segments continued to differ.

## 9.3 Evaluation of the approach of the study

A clearer insight into consumer behaviour in respect of cut flowers and pot plants can be obtained by using a model which distinguishes a number of stages in the purchase process. The low correlation coefficients between habitual buyers' price elasticity of demand in the budget stage, and the price elasticities of the demand for cut flowers, flowering plants, or green plants in the priority stage, suggest that the multistage choice process provides additional information. Another advantage of a multistage analysis is that the results obtained for different stages can be linked to aspects of marketing policy. For example, if the objective is to shift expenditure from one subclass to another, then the results obtained in this study for the priority stage may well be of use.

The question could be raised as to what extent the results of this study support the hypothesis that a multistage choice process adequately describes consumer behaviour in respect of cut flowers and pot plants. The data available allow only an indication to be given, particularly because data on household income were not available. The appropriateness of a multistage choice process can be supported by the statistical significance of the results obtained, the extent to which the results can be interpreted, and the consistency of the results for various stages in the multistage choice process.

The results of the study regarding the total expenditure on flowers and plants, the choice made between subclasses, and the stochastic choice of type of flower, suggest that the hypothesis of a multistage choice process by habitual buyers cannot be rejected. This can be elucidated as follows. The mean coefficient of determination, $R^2$, was approximately 0.20 for the analysis in which the response parameters for the first stage were estimated, and approximately 0.85 for the estimation of the response parameters in the second stage. In the analysis of the relationship of response parameter estimates, and of purchase probability estimates to household characteristics, $R^2$ was between 0.05 and 0.25. This indicates that, as is usual in an analysis of individual households, a relatively small proportion of the variation in the variable of interest could be explained. It must be admitted that substantial values of $R^2$ only give an indication of the usefulness of a model. In all three stages; the budget, priority, and choice stage, significant relationships, with the expected sign, were found between response parameter estimates and household characteristics. The consistency of the results between stages of the multistage choice process can be checked by use of the price variable. In the budget stage, the price parameter estimate in the demand equation was negative for approximately 70% of habitual buyers. In the priority stage, the parameter estimates obtained in the Linear Expenditure System indicated that these were consistent with economic reasoning for approximately 60% of habitual buyers purchasing both flowers and plants and, consequently, the elasticities were also negative. In the choice stage, an increase in relative prices seemed to cause a small decrease in the marketing attraction of a particular type of flower.

Many of the methods and models used in this study can be applied in practice when panel data on consumer behaviour of individual households are available. In particular, the analysis of buying behaviour in respect of cut flowers and pot plants as a three stage choice proces seems te be appropriate from the point of view of market segmentation. It is suggested that more applied research will need to be done in order to test the costs and benefits of this approach for marketing policy for such products.

# APPENDIX I

## Data from the consumer panel of the Netherlands Institute for Agricultural Marketing Research (NIAM) and the advertising agency of the Commodity Board (Produktschap voor Siergewassen)

TABLE I.1 Total household expenditure ($10^6$ Dutch guilders) on cut flowers, pot plants, and floral arrangements (1973-1980)[a]

| Year | Cut flowers | Pot plants | Subtotal | Floral arrangements | Total |
|---|---|---|---|---|---|
| 1973 | 213 | 101 | 314 | | |
| 1974 | 241 | 118 | 359 | | |
| 1975 | 245 | 127 | 372 | | |
| 1976 | 259 | 134 | 393 | | |
| 1977 | 308 | 147 | 455 | 61 | 516 |
| 1978 | 352 | 138 | 490 | 69 | 559 |
| 1979 | 398 | 137 | 535 | 71 | 606 |
| 1980 | 430 | 141 | 571 | 73 | 644 |

[a] For number of households, see Table 1.1.

TABLE I.2 Average price (Dutch guilders) and price index of cut flowers, pot plants, and floral arrangements (1973-1980)

| Year | Cut flowers (10 stems) | | Pot plant | | Floral rangements | Cos of living[a] |
|---|---|---|---|---|---|---|
| | Average price | Price index | Average price | Price index | Price | Index |
| 1973 | 2.81 | 100 | 3.08 | 100 | | 100 |
| 1974 | 3.01 | 107 | 3.36 | 109 | | 109 |
| 1975 | 3.18 | 113 | 3.88 | 126 | | 120 |
| 1976 | 3.53 | 126 | 4.18 | 136 | | 131 |
| 1977 | 3.93 | 140 | 4.36 | 142 | 13.70 | 138 |
| 1978 | 4.32 | 154 | 4.51 | 146 | 15.40 | 144 |
| 1979 | 4.60 | 164 | 4.46 | 145 | 15.90 | 151 |
| 1980 | 4.96 | 177 | 4.52 | 147 | 16.90 | |

[a] Pocket yearbook of the Netherlands Central Bureau of Statistics, The Hague.

TABLE I.3 Available data on households in the consumer panel

| | | | Number of households |
|---|---|---|---|
| A | Geographical area | | |
| | I | Conurbation of Amsterdam, Rotterdam, and The Hague | 209 |
| | II | Remainder of North Holland, South Holland, and Utrecht | 266 |
| | III | Groningen, Friesland, and Drente | 117 |
| | IV | Overijssel and Gelderland | 179 |
| | V | Zeeland, North Brabant, and Limburg | 229 |

TABLE I.3 Continued

| | | |
|---|---|---|
| B | Size of residential municipality (inhabitants) | |
| | Urban municipalities (towns) | |
| | $\geqq$ 100000 | 294 |
| | 50000–100000 | 109 |
| | 30000–50000 | 47 |
| | < 30000 | 100 |
| | Urbanized rural municipalities | 243 |
| | Rural municipalities | 207 |
| C | Social class | |
| | AB (high) | 107 |
| | $C_1$ | 79 |
| | $C_2$ | 245 |
| | $D_1$ | 448 |
| | $D_2$ (low) | 121 |
| D | Occupation of male head of household | |
| | Blue collar | 308 |
| | White collar | 276 |
| | Own business | 118 |
| | Not working | 298 |
| E | Size of household (persons) | |
| | 1 | 112 |
| | 2 | 284 |
| | 3 | 179 |
| | 4 | 215 |
| | 5 | 114 |
| | 6 | 54 |
| | $\geqq$ 7 | 42 |
| F | Age of youngest member of the household (years) | |
| | 0-4 | 160 |
| | 5-14 | 265 |
| | 15-24 | 155 |
| | $\geqq$ 25 | 420 |
| G | Age of wife (years) | |
| | < 20 | 3 |
| | 20-24 | 42 |
| | 25-29 | 96 |
| | 30-34 | 106 |
| | 35-39 | 95 |
| | 40-49 | 204 |
| | 50-64 | 270 |
| | $\geqq$ 65 | 184 |
| H | Garden | |
| | at home | 710 |
| | elsewhere | 8 |
| | no garden | 282 |

TABLE I.3 Continued

| | | |
|---|---|---|
| I | Regularity in doing housework | |
| | 1. very | 244 |
| | 2. | 310 |
| | 3. | 338 |
| | 4. not at all | 108 |
| J | Attitude to housekeeping | |
| | 1. positive | 172 |
| | 2. | 383 |
| | 3. | 285 |
| | 4. negative | 160 |
| K | Price consciousness | |
| | 1. very | 201 |
| | 2. | 486 |
| | 3. | 176 |
| | 4. not at all | 137 |
| L | Time spent by wife working outside the house | |
| | full time (40 hours or more) | 18 |
| | half time (20 hours) | 49 |
| | less than half time (less than 20 hours) | 12 |
| | irregular hours | 91 |
| | no job | 830 |
| M | Loyalty to particular retail outlet(s) | |
| | 1. very | 112 |
| | 2. | 255 |
| | 3. | 314 |
| | 4. not at all | 319 |
| N | Purchase data | |
| | 1. Year, week, and day of each purchase | |
| | 2. Number of flower stems or number of plants purchased | |
| | 3. Type of cut flowers or pot plant purchased | |
| | 4. Price for each stem or plant | |
| | 5. Type of retail outlet: florist, weekly market, street stall, house-to-house, supermarket, and gardener/garden centre | |
| | 6. Buyer (wife or other household member) and purpose of purchase (use in own home or gift) | |

TABLE I.4 Monthly expenditure on national advertising of cut flowers and pot plants ($10^3$ Dutch guilders)

| Year | Month | Media | | | Total |
|---|---|---|---|---|---|
| | | Periodicals, newspapers | Radio, TV | Other | |
| 1972 | Sep. | 53.6 | 15.5 | | 69.1 |
| | Oct. | 32.3 | 26.6 | | 58.9 |
| | Nov. | 49.1 | 21.6 | | 70.7 |
| | Dec. | 25.2 | 31.0 | | 56.2 |
| 1973 | Jan. | 34.3 | 6.2 | 21.3 | 61.8 |
| | Feb. | 36.4 | 11.8 | | 48.2 |
| | Mar. | 44.2 | 14.7 | | 58.9 |
| | Apr. | 36.3 | 6.0 | | 42.3 |
| | May | 191.5 | 7.4 | 23.6 | 222.5 |
| | Jun. | 101.9 | 24.0 | 18.0 | 119.9 |
| | Jul. | 68.4 | 25.1 | 23.6 | 117.1 |
| | Aug. | 70.6 | 25.8 | | 96.4 |
| | Sep. | 126.4 | 19.4 | 23.4 | 169.2 |
| | Oct. | 105.4 | 9.5 | | 114.9 |
| | Nov. | 158.6 | | | 158.6 |
| | Dec. | 71.8 | | | 71.8 |
| 1974 | Jan. | 44.2 | 10.2 | 25.5 | 79.9 |
| | Feb. | 46.6 | 9.0 | | 55.6 |
| | Mar. | 63.8 | 9.6 | | 73.4 |
| | Apr. | 59.2 | 7.2 | | 66.4 |
| | May | 77.5 | 5.4 | 29.9 | 112.8 |
| | Jun. | 64.5 | 10.2 | 51.0 | 125.7 |
| | Jul. | 63.1 | 17.4 | 30.2 | 110.7 |
| | Aug. | 47.4 | 21.0 | 30.6 | 99.0 |
| | Sep. | 63.5 | 24.6 | 25.1 | 113.2 |
| | Oct. | 74.2 | 19.2 | 4.8 | 98.2 |
| | Nov. | 92.6 | 0.6 | | 93.2 |

Source: Advertising agency of the Commodity Board (Produktschap voor Siergewassen).

# APPENDIX II

## Data on purchases of cut flowers and pot plants in West European countries collected by means of consumer panels

TABLE II.1 Consumer panels from which data on cut flowers and pot plant purchases in West European countries were collected

| Country | Organization | Consumer panel agency | Number of households | Period |
|---|---|---|---|---|
| Belgium | Landbouw-Economisch Instituut (LEI) | own panel | 3000 of which 500 report two weeks in every twelve weeks | 1973[a] |
| France | Comité National Interprofessional de l'Horticulture Florale etc. (CNIH) | SOFRES | 10000 individuals over 15 years old | 1976[a] |
| West Germany | Produktschap voor Siergewassen[b] | GFK/G und I | 5000 | 1974-1980 |
| The Netherlands | Produktschap voor Siergewassen | Netherlands Institute for Agricultural Marketing Research (NIAM) connected with AGB | 2000<br>5000 | 1973-1975<br>1976-1980 |
| Great Britain[c] | Produktschap voor Siergewassen | Attwood/AGB | 5000<br>4000<br>4000 | 1974<br>1975<br>1981-1982 |
| Switzerland | Produktschap voor Siergewassen | NIAM/AGB | 2000 | 1981-1982 |
| Austria | Produktschap voor Siergewassen | GFK/G und I | 2650 | 1981-1982 |
| Denmark | Produktschap voor Siergewassen | GFK/G und I | 1000 | 1981-1982 |
| Norway | Produktschap voor Siergewassen | GFK/G und I | 1500 | 1981-1982 |
| Sweden | Produktschap voor Siergewassen | GFK/G und I | 2000 | 1980-1982 |

[a] Data still being collected
[b] Netherlands Commodity Board for Ornamentals
[c] Excluding Northern Ireland

TABLE II.2 Average household expenditure on cut flowers, pot plants and floral arrangements (Swiss Francs)

| | Rate of exchange from national currency to SWF[a] | Expenditure | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cut flowers | | Pot plants[b] | | Floral arrangements | | Flowers and plants | All floral products |
| | | Amount (SWF) | Proportion | Amount (SWF) | Proportion | Amount (SWF) | Proportion | Amount (SWF) | Amount (SWF) |
| Belgium | | | | | | | | | |
| 1977 | 0.06691 | 54.3 | 0.46 | 35.4 | 0.30 | 27.8 | 0.24 | 89.7 | 117.6 |
| 1978 | 0.05652 | 48.4 | 0.47 | 30.2 | 0.29 | 25.4 | 0.24 | 79.1 | 104.5 |
| 1979 | 0.05670 | 52.3 | 0.45 | 32.3 | 0.28 | 31.9 | 0.27 | 84.5 | 116.4 |
| 1980 | 0.05730 | 53.2 | 0.44 | 35.9 | 0.30 | 30.9 | 0.26 | 89.1 | 120.0 |
| France[cd] | | | | | | | | | |
| 1977 | 0.4880 | 41.6 | | 43.3 | | 15.0 | | 84.9 | 99.9 |
| 1978 | 0.3948 | 35.2 | | 40.5 | | 15.4 | | 75.7 | 91.1 |
| 1979 | 0.3908 | 37.5 | 0.36 | 54.0 | 0.51 | 14.2 | 0.14 | 91.4 | 105.7 |
| 1980 | 0.3965 | 47.9 | 0.35 | 69.9 | 0.51 | 20.0 | 0.15 | 117.8 | 137.8 |
| 1981 | 0.3613 | 59.8 | 0.36 | 78.9 | 0.47 | 29.1 | 0.17 | 138.7 | 167.8 |
| West Germany | | | | | | | | | |
| 1977 | 1.0326 | 54.6 | 0.62 | 30.0 | 0.34 | 3.8 | 0.04 | 84.7 | 88.5 |
| 1978 | 0.8856 | 46.9 | 0.61 | 26.6 | 0.35 | 3.3 | 0.04 | 73.5 | 76.8 |
| 1979 | 0.9072 | 50.2 | 0.61 | 29.1 | 0.35 | 3.4 | 0.04 | 79.4 | 82.2 |
| 1980 | 0.9218 | 52.4 | 0.58 | 34.7 | 0.38 | 4.0 | 0.04 | 87.2 | 91.2 |
| Netherlands | | | | | | | | | |
| 1977 | 0.9769 | 69.9 | 0.61 | 33.4 | 0.29 | 11.3 | 0.10 | 103.3 | 114.7 |
| 1978 | 0.8221 | 64.3 | 0.63 | 25.2 | 0.25 | 12.6 | 0.12 | 89.5 | 102.1 |
| 1979 | 0.8289 | 73.3 | 0.66 | 25.2 | 0.23 | 13.1 | 0.12 | 98.5 | 111.6 |
| 1980 | 0.8431 | 80.6 | 0.66 | 26.4 | 0.22 | 13.7 | 0.11 | 107.0 | 120.7 |
| Great Britain | | | | | | | | | |
| 1974 | 6.9590 | 10.5 | 0.68 | 4.9 | 0.32 | | | 15.4 | |
| 1975 | 5.7206 | 9.0 | 0.70 | 3.8 | 0.30 | | | 12.8 | |
| 1981 | 3.9531 | 13.0 | 0.60 | 8.7 | 0.40 | | | 21.7 | |
| 1982 | 3.5433 | 12.0 | 0.63 | 7.1 | 0.37 | | | 19.1 | |
| Switzerland | | | | | | | | | |
| 1981 | 1.0000 | 38.0 | 0.49 | 40.0 | 0.51 | | | 78.0 | |
| 1982 | 1.0000 | 36.0 | 0.48 | 39.0 | 0.52 | | | 75.0 | |
| Austria | | | | | | | | | |
| 1981 | 0.1231 | 33.1 | 0.53 | 29.1 | 0.47 | | | 62.2 | |
| 1982 | 0.1188 | 34.0 | 0.51 | 32.2 | 0.49 | | | 66.2 | |
| Denmark | | | | | | | | | |
| 1981 | 0.2753 | 10.5 | 0.28 | 26.4 | 0.72 | | | 36.9 | |
| 1982 | 0.2434 | 8.8 | 0.28 | 22.9 | 0.72 | | | 31.6 | |
| Norway | | | | | | | | | |
| 1981 | 0.3417 | 18.8 | 0.34 | 37.2 | 0.66 | | | 56.0 | |
| 1982 | 0.3150 | 18.3 | 0.31 | 41.6 | 0.69 | | | 59.9 | |

TABLE II.2 Continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sweden | | | | | | | |
| 1980 | 0.3958 | 26.7 | 0.39 | 42.5 | 0.61 | | 69.2 |
| 1981 | 0.3883 | 28.3 | 0.36 | 50.9 | 0.64 | | 79.6 |
| 1982 | 0.3249 | 26.6 | 0.37 | 46.1 | 0.63 | | 72.5 |

[a] Based on exchange rates used by the International Association of Horticultural Producers (AIPH).
[b] Including balcony plants except in Belgium and France.
[c] Average consumer expenditure was converted to average household expenditure.
[d] As from 1979 onwards, the panel was also asked to report purchases for the cemetry, the reported purch of flowering pot plants increased considerably in the month of November.
Source: see Table II.1

TABLE II.3 Prices for cut flowers, pot plants, and floral arrangements (in national currency and in Swiss francs)

| Country/year | Bunch of 10 cut flowers | | Pot plants | | Floral arrangements | |
|---|---|---|---|---|---|---|
| | National currency | Swiss francs | National currency | Swiss francs | National currency | Swiss francs |
| Belgium[a b] (francs) | | | | | | |
| 1977 | 117 | 7.83 | 121 | 8.10 | 490 | 32.79 |
| 1978 | 137 | 7.73 | 129 | 7.30 | 519 | 29.32 |
| 1979 | 134 | 7.59 | 119 | 6.77 | 602 | 34.13 |
| 1980 | 137 | 7.84 | 122 | 7.02 | 543 | 31.11 |
| France[b] (francs) | | | | | | |
| 1977 | 17.45 | 8.52 | 31.02 | 15.14 | 87.36 | 42.63 |
| 1978 | 17.52 | 6.92 | 27.60 | 10.90 | 85.25 | 33.66 |
| 1979 | 18.27 | 7.14 | 28.94 | 11.31 | 91.35 | 35.70 |
| 1980 | 17.94 | 7.11 | 29.66 | 11.76 | 74.25 | 29.44 |
| 1981 | 19.36 | 6.99 | 32.14 | 11.61 | 118.67 | 42.88 |
| West Germany (deutsch marks) | | | | | | |
| 1977 | 7.34 | 7.58 | 2.32 | 2.40 | 13.46 | 13.90 |
| 1978 | 7.57 | 6.70 | 2.44 | 2.16 | 12.58 | 11.14 |
| 1979 | 7.83 | 7.10 | 2.73 | 2.48 | 13.53 | 12.27 |
| 1980 | 8.55 | 7.88 | 2.73 | 2.52 | 16.60 | 15.30 |
| Netherlands (guilders) | | | | | | |
| 1977 | 3.93 | 3.84 | 4.36 | 4.26 | 13.70 | 13.38 |
| 1978 | 4.32 | 3.55 | 4.51 | 3.70 | 15.40 | 12.66 |
| 1979 | 4.60 | 3.81 | 4.46 | 3.70 | 15.90 | 13.18 |
| 1980 | 4.96 | 4.18 | 4.52 | 3.81 | 16.90 | 14.25 |
| Great Britain (pounds) | | | | | | |
| 1974 | 0.27 | 1.89 | 0.49 | 3.42 | | |
| 1975 | 0.29 | 1.67 | 0.54 | 3.11 | | |
| 1981 | 0.80 | 3.16 | 1.18 | 4.66 | | |
| 1982 | 0.90 | 3.19 | 1.21 | 4.29 | | |

Table II.3 Continued

| | | | | |
|---|---|---|---|---|
| Switzerland (francs) | | | | |
| 1981 | 10.10 | 10.10 | 4.60 | 4.60 |
| 1982 | 9.40 | 9.40 | 4.59 | 4.59 |
| Austria (schilling) | | | | |
| 1981 | 79.00 | 9.72 | 14.15 | 1.74 |
| 1982 | 80.90 | 9.61 | 19.35 | 2.30 |
| Denmark (kroner) | | | | |
| 1981 | 21.00 | 5.78 | 8.12 | 2.24 |
| 1982 | 23.20 | 5.65 | 8.25 | 2.01 |
| Norway (kroner) | | | | |
| 1981 | 54.00 | 18.45 | 13.63 | 4.66 |
| 1982 | 55.80 | 17.58 | 16.52 | 5.20 |
| Sweden (kronor) | | | | |
| 1980 | 22.30 | 8.83 | 8.79 | 3.48 |
| 1981 | 25.50 | 9.90 | 9.34 | 3.63 |
| 1982 | 28.00 | 9.10 | 10.02 | 3.26 |

[a] Data supplied by Mr. L. Nicolaus of the Belgian Landbouw-Economisch Instituut.
[b] Average price per purchase.

Table II.4 Proportion (%) of households purchasing cut flowers and pot plants in four-weekly periods during one year

| Period | | Belgium[a] | France[b] | West Germany | Netherlands | Great Britain | Switzerland | Austria | Denmark | Norway | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1980 | 1977 | 1980 | 1980 | 1981 | 1981 | 1981 | 1981 | 1981 | 1980 |
| I | Jan | 22 | 22 | 37 | 54 | 26 | 31 | 18 | 37 | 20 | 35 |
| | Feb | | 23 | 39 | 59 | 25 | 40 | 35 | 43 | 32[c] | 39 |
| | Mar | | 23 | 48 | 63 | 31 | 39 | 26 | 43 | 28 | 45 |
| II | Apr[d] | 26 | 20 | 49 | 62 | 42[c] | 42 | 33 | 44 | 26 | 45 |
| | May | | 22[c] | 50[c] | 65[c] | 23 | 47[c] | 49[c] | 35[c] | 32 | 34[c] |
| | Jun | | 18 | 44 | 54 | 18 | 36 | 41 | 35 | 36 | 40 |
| | | | | 35 | 51 | 19 | 23 | 30 | 22 | 18 | 23 |
| III | Jul | 19 | 12 | 32 | 42 | 15 | 17 | 18 | 19 | 9 | 16 |
| | Aug | | 11 | 36 | 54 | 15 | 23 | 15 | 20 | 16 | 26 |
| | Sep | | 15 | 38 | 54 | 18 | 26 | 20 | 23 | 17 | 31 |
| IV | Oct | 24 | 27 | 45 | 56 | 15 | 35 | 32 | 23 | 17 | 35 |
| | Nov | | 17 | 40 | 57 | 14 | 32 | 23 | 27 | 21 | 38 |
| | Dec | | 26 | 40 | 58 | 15 | 29 | 29 | 33 | 32 | 43 |

[a] Belgium, based on periods of two weeks
[b] France, data for individuals for periods on one month and also including floral arrangements.
[c] Mother's Day.
[d] Easter.

TABLE II.5 Main types of cut flowers purchased ranked according to household expenditure

| | Belgium 1980 | France[a] 1977 | West Germany 1980 | Netherlands 1980 | Great Britain 1982 | Switzerland 1982 | Austria 1982 | Denmark 1982 | Norway 1982 | Sweden 1982 |
|---|---|---|---|---|---|---|---|---|---|---|
| Chrysanthemum | 3 | 6 | 5 | 1 | 2 | | 5 | 4 | 5 | |
| Rose | 1 | 1 | 2 | 2 | 6 | 2 | 3 | 3 | 3 | 3 |
| Carnation | 2 | 2 | 3 | 3 | 4 | 3 | 2 | | 1 | 4 |
| Freesia | | | | 4 | | | | 6 | | |
| Mixed bunch | | | 1 | 5 | 1 | 1 | 1 | 2 | 2 | 2 |
| Tulip | | 3 | 4 | 6 | 5 | 5 | 4 | 1 | 4 | 1 |
| Daffodil | | | | 7 | 3 | | | 5 | | 5 |
| Gerbera | | | 6 | | | 6 | | | | |
| Aster | | | 7 | | | | | | | |
| Orchid | | | | | | 4 | 6 | | 6 | 6 |
| Gladiolus | | 4 | | | | | | | | |
| Anemone | | 5 | | | | | | | | |

[a] Ranked in order according to number of flowers purchased.

TABLE II.6 Main types of pot plants purchased ranked according to household expenditure

| | West Germany 1980 | Netherlands 1980 | Great Britain 1982 | Switzerland 1982 | Austria 1982 | Denmark 1982 | Norway 1982 | Sweden 1982 |
|---|---|---|---|---|---|---|---|---|
| Azalea | 4 | 2 | 2 | 3 | 3 | 4 | 3 | 5 |
| Geranium | 1 | 6 | 5 | 1 | 1 | | 5 | 2 |
| Cyclamen | 3 | 3 | 4 | | | | | |
| Begonia | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 1 |
| Poinsettia | 6 | 4 | | 5 | 5 | 2 | 2 | 3 |
| Heath, erica | 5 | | | 4 | 4 | | | |
| Cacti/succulents | | 7 | | | | | | |
| Saintpaulia | | 5 | | | | | | |
| Petunia | | | | | | 5 | 4 | 4 |
| Chrysanthemum | | | 1 | | | 3 | | |

TABLE II.7 Proportion of expenditure on cut flowers and pot plants spent at various market outlets

| Market outlet | Belgium[a] 1980 | France[b] 1980 | West Germany 1980 | Netherlands 1980 | Great Britain 1981 | Switzerland 1981 | Austria 1981 | Denmark 1981 | Norway 1981 | Sweden 1981 |
|---|---|---|---|---|---|---|---|---|---|---|
| Florist | 62 | 58 | 44 | 41 | 37 | 46[c] | 39 | 41 | 40 | 50 |
| Weekly market | 14 | 20 | 12 | 14 | 13 | 6 | 5 | 6 | 11 | 6 |
| Street stall | | | | 17 | 3 | | 4 | | | |
| House-to-house | 3 | | | 4 | | | | | | |
| Grower, garden centre, gardener | 9 | 12 | 28 | 9 | 14 | | 36 | 13 | 34 | 12 |
| Supermarket and department store | 6 | 9 | 13 | 13 | 12 | 45[d] | 14 | 36 | 13 | 30 |
| Greengrocer | | | | | 13 | | | | | |
| Other | 6 | 1 | 3 | 3 | 8 | 3 | 2 | 4 | 2 | 2 |

[a] Cut flowers only.
[b] Floral arrangements also included.
[c] Also includes the purchases at garden centres.
[d] 32% purchased at the Migros supermarket.

# APPENDIX III

## Additional information to Chapter 5 on the budget decision as to expenditure on cut flowers and pot plants by regular buyers

### III.1 Data on national expenditure on advertising for flowers and plants and the distribution of household characteristics

TABLE III.1 Weekly indices of present ($r_t$) and past ($\bar{r}_t$) national advertising on cut flowers and pot plants

| Year | Month | Expenditure ($R_m$) on national advertising (thousands of guilders) | $\bar{R}_m$ [a] | Weekly index | |
|---|---|---|---|---|---|
| | | | | $r_t$ [b] | $\bar{r}_t$ [c] |
| 1972 | Sep. | 69.1 | | | |
| | Oct. | 58.9 | | | |
| | Nov. | 70.7 | | | |
| | Dec. | 56.2 | 66.2 | 12.7 | 14.9 |
| 1973 | Jan. | 61.8 | 61.9 | 14.0 | 14.0 |
| | Feb. | 48.2 | 62.9 | 12.1 | 15.7 |
| | Mar. | 58.9 | 55.4 | 13.3 | 12.5 |
| | Apr. | 42.3 | 56.3 | 9.9 | 13.1 |
| | May | 222.5 | 49.8 | 50.2 | 11.2 |
| | Jun. | 119.9 | 107.9 | 28.0 | 25.2 |
| | Jul. | 117.1 | 128.2 | 26.4 | 28.9 |
| | Aug. | 96.4 | 153.2 | 21.8 | 34.6 |
| | Sep. | 169.2 | 111.1 | 39.5 | 25.9 |
| | Oct. | 114.9 | 127.6 | 25.9 | 28.8 |
| | Nov. | 158.6 | 126.8 | 37.0 | 29.6 |
| | Dec. | 71.8 | 147.6 | 16.2 | 33.3 |
| 1974 | Jan. | 79.9 | 115.1 | 18.0 | 26.0 |
| | Feb. | 55.6 | 103.4 | 13.9 | 25.9 |
| | Mar. | 73.4 | 69.1 | 16.6 | 15.6 |
| | Apr. | 66.4 | 69.6 | 15.5 | 16.2 |
| | May | 112.8 | 65.1 | 25.5 | 14.7 |
| | Jun. | 125.7 | 84.2 | 29.3 | 19.6 |
| | Jul. | 110.7 | 101.6 | 25.0 | 22.9 |
| | Aug. | 99.0 | 116.4 | 22.4 | 26.3 |
| | Sep. | 113.2 | 111.8 | 26.4 | 26.1 |
| | Oct. | 98.2 | 107.6 | 22.2 | 24.3 |
| | Nov. | 93.2 | 103.5 | 21.7 | 24.2 |

a $\bar{R}_m = 1/3 \sum_{s=1}^{3} R_{m-s}$

b $r_t = \frac{7}{d_m} * R_m$, where $d_m$ = number of days in month m

c $\bar{r}_t = \frac{7}{d_m} * \bar{R}_m$

TABLE III.2 Frequency distribution of household characteristics in the total sample and market segments: occasional, regular, habitual, and nonhabitual buyers

| | Total sample (n = 1000) | | | Occasional buyers (n = 213) | | | Regular buyers (n = 787) | | | Habitual buyers (n = 363) | | | Nonhabitual buyers (n = 424) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Proportion (%) | Mean | n | Proportion (%) | Mean | n | Proportion (%) | Mean | n | Proportion (%) | Mean | n | Proportion (%) | Mean |
| Mean weekly expenditure (guilders) | | | 1.40 | | | .15 | | | 1.74 | | | 2.60 | | | 1.01 |
| Mean number of weekly purchases | | | .45 | | | .04 | | | .56 | | | .86 | | | .29 |
| Social class | | | | | | | | | | | | | | | |
| AB (high) | 107 | .107 | | 16 | .075 | | 91 | .116 | | 46 | .127 | | 45 | .106 | |
| C | 324 | .324 | | 58 | .272 | | 266 | .338 | | 135 | .372 | | 131 | .309 | |
| $D_1$ | 448 | .448 | | 104 | .488 | | 344 | .437 | | 151 | .416 | | 193 | .455 | |
| $D_2$ | 121 | .121 | | 35 | .164 | | 86 | .109 | | 31 | .085 | | 55 | .130 | |
| Geographical area | | | | | | | | | | | | | | | |
| west | 475 | .475 | | 62 | .291 | | 413 | .525 | | 239 | .658 | | 174 | .410 | |
| north | 117 | .117 | | 41 | .192 | | 76 | .097 | | 21 | .058 | | 55 | .130 | |
| east | 179 | .179 | | 36 | .169 | | 143 | .182 | | 60 | .165 | | 83 | .196 | |
| south | 229 | .229 | | 74 | .347 | | 155 | .197 | | 43 | .119 | | 112 | .264 | |
| Size of residential municipality (inhabitants) | | | | | | | | | | | | | | | |
| ≧ 100000 | 294 | .294 | | 35 | .164 | | 259 | .329 | | 147 | .405 | | 112 | .264 | |
| 30000–100000 | 156 | .156 | | 23 | .108 | | 133 | .169 | | 70 | .193 | | 63 | .149 | |
| < 30000 | 550 | .550 | | 155 | .728 | | 395 | .502 | | 146 | .402 | | 249 | .587 | |
| Access to a garden | | | | | | | | | | | | | | | |
| yes | 718 | .718 | | 172 | .808 | | 546 | .694 | | 225 | .620 | | 321 | .757 | |
| no | 282 | .282 | | 41 | .192 | | 241 | .306 | | 138 | .380 | | 103 | .243 | |
| Household size | | | 3.287 | | | 3.362 | | | 3.267 | | | 3.265 | | | 3.269 |

TABLE III.2 Continued

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age of wife (years) | | | | | | | | | | | | | |
| ≦ 29 | 141 | .141 | 22 | .103 | 119 | .151 | | 49 | .135 | | 70 | .165 | |
| 30–64 | 675 | .675 | 126 | .592 | 549 | .698 | | 259 | .714 | | 290 | .684 | |
| ≧ 65 | 184 | .184 | 65 | .305 | 119 | .151 | | 55 | .152 | | 64 | .151 | |
| Attitude to house-keeping | | | | | | | | | | | | | |
| positive | 555 | .555 | 160 | .751 | 395 | .502 | | 183 | .504 | | 212 | .500 | |
| negative | 445 | .445 | 53 | .249 | 392 | .498 | | 180 | .496 | | 212 | .500 | |
| Price consciousness | | | | | | | | | | | | | |
| more | 687 | .687 | 144 | .676 | 543 | .690 | | 247 | .680 | | 296 | .698 | |
| less | 313 | .313 | 69 | .324 | 244 | .310 | | 116 | .320 | | 128 | .302 | |
| Proportion of expenditure | | | | | | | | | | | | | |
| for own home | | | | | | | .720 | | | .781 | | | .668 |
| from florist | | | | | | | .372 | | | .308 | | | .427 |
| from market or street stall | | | | | | | .351 | | | .405 | | | .304 |

## III.2 Tests on autocorrelation and heteroscedasticity

### III.2.1 Test on positive first-order autocorrelation

The test on positive first-order autocorrelation of the disturbances in Equations 5.12 and 5.13 is based on a procedure described by Durbin and Watson (1951). The Durbin-Watson statistic is as follows

$$d = \frac{\sum_{t=2}^{T} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{T} \hat{u}_t^2} \approx 2(1-\hat{\rho}) \text{ for large T} \tag{III.1}$$

where $\hat{u}_t$ = the least-squares estimate of the disturbance term in period t.
$\hat{\rho}$ = the estimate of the autocorrelation coefficient $\rho$ with $|\rho| < 1$.

Define $d_h$ as the Durbin-Watson statistic calculated with the $\hat{u}_{ht}$ ($t = 1,2,\ldots,T$) in Equations 5.12 or 5.13.
Under the null hypothesis of zero-order correlation, the distribution of $\frac{1}{4}\, d_h$ can be approximated by a Beta distribution with density

$$\frac{1}{\beta(p,q)} \left(\frac{d_h}{4}\right)^{p-1} \left(1-\frac{d_h}{4}\right)^{q-1} \quad \text{for } 0 \leqq \frac{d_h}{4} \leqq 1 \tag{III.2}$$

and zero for $d_h < 0$ and $d_h > 1$. For this distribution

$$E(d_h) = \frac{4p}{p+q} \text{ and var } (d_h) = \frac{16\,pq}{(p+q)^2(p+q+1)} \tag{III.3}$$

The mean and variance of $d_h$ vary according to the values of the independent variables in Equations 5.12 and 5.13. As the explanatory variables are the same for all h ($h = 1,2,\ldots,H$), $E(d_h)$, and var $(d_h)$ are independent of h, the parameters p and q in Equation III.3 can be determined from the calculated mean and variance of $d_h$ as described by Durbin and Watson, in this case $p = 56.718$ and $q = 48.803$. The statement that $\frac{1}{4}\, d_h$ is Beta distributed is equivalent to $F_{oh}(d^*) = P_o(\frac{1}{4}d_h \leq d^*)$ is uniformly distributed. This null distribution was investigated by applying the Kolmogorov-Smirnov test to the H observations of $F_{oh}(d^*)$.
For this purpose, the $F_{oh}(d^*)$ were ranked with $F_{oi}(d^*) < F_{oi+1}(d^*)$ and the maximum deviation between observed and theoretical distribution was calculated as follows

$$D = \underset{i=1,2,..H}{\text{maximum}} \left| F_{oi}(d^*) - \frac{i}{H} \right| \tag{III.4}$$

For $H > 40$, critical values of D for significance levels of 5% and 1% are approximately $\frac{1.36}{\sqrt{H}}$ and $\frac{1.63}{\sqrt{H}}$ respectively (e.g., Van der Laan 1975). For the market segments of interest, these critical values $D^*_\alpha$ are given in Table III.3. The resulting value for D is given in Table III.4 for different segments and for either expenditure on cut flowers and pot plants or number of purchases of these products as variable to be explained. The null hypothesis of no autocorrelation will not be rejected when $D < D^*_\alpha$ for a specified $\alpha$.

TABLE III.3 Critical values ($D^*_\alpha$) in the Kolmogorov-Smirnov one-sample test for different significance levels and market segments: habitual, nonhabitual, and regular buyers

| Market segment | Number of households | Critical values $D^*_\alpha$ | |
|---|---|---|---|
| | | $\alpha = 0.05$ | $\alpha = 0.01$ |
| Habitual buyers | 363 | 0.071 | 0.085 |
| Nonhabitual buyers | 424 | 0.067 | 0.080 |
| Regular buyers | 787 | 0.048 | 0.058 |

TABLE III.4 Maximum value D in a Kolmogorov-Smirnov test for the market segments: habitual, nonhabitual, and regular buyers

| Market segment | Number of households | Expenditure (Equation 5.12) | Number of purchases (Equation 5.13) |
|---|---|---|---|
| Habitual buyers | 363 | .031 | .129 |
| Nonhabitual buyers | 424 | .048 | .073 |
| Regular buyers | 787 | .029 | .095 |

It can be concluded that the null hypothesis of no autocorrelation will not be rejected for Equation 5.12 applied to both habitual and nonhabitual buyers, and for Equation 5.13 applied to nonhabitual buyers.

III.2.2 Tests on heteroscedasticity of the disturbances in Equation 5.15

The variable to be explained in Equation 5.15, that is the response parameter estimate, was estimated with Equation 5.12. Equation 5.12 was written in matrix notation in Equation 5.6. The least-squares estimator of vector $\alpha_h$ with elements $\alpha_{hj}$ is

$$\hat{\alpha}_h = (Z_h'Z_h)^{-1}Z_h'e_h \tag{III.5}$$

and, the covariance matrix is

$$V(\hat{\alpha}_h) = s_h^2(Z_h'Z_h)^{-1} \tag{III.6}$$

As $Z_h = Z$ for $h = 1,2,....,H$ in Equation 5.12, differences in standard errors of the $\hat{\alpha}_{hj}$ ($j = 1,2,....,q$) depend only on $s_h$ which is the estimator for $\sigma_h$. It is assumed that $\gamma_{hj}$, the standard error of the disturbances in Equation 5.15 is correlated with $\sigma_h$ in Equation 5.12, because $\hat{\alpha}_{hj}$ is the variable to be explained in Equation 5.15. The parameter $\gamma_{hj}$ cannot be estimated. Thus, $s_h$, which is the estimator of $\sigma_h$, was taken as proxy variable to examine the extent of heteroscedasticity in the disturbances in Equation 5.15.

The procedure used is as follows. The Barlett test is used to determine whether $H_0 : \sigma_1^2 = \sigma_2^2 = ... = \sigma_H^2$ is to be rejected. If $H_0$ is rejected, then the extent to which $\sigma_h$ can be explained by household characteristics is to be examined (e.g., Johnston 1972, p 220; Maddala 1977, p 262). If more than, say, 50% of the variation in $s_h$ can be explained by variation in household characteristics, then linear regression in which the variables are weighted with a function of household characteristics may be applied to improve the parameter estimates in Equation 5.15. If less than, say, 50% of the variation can be explained, weighting of the variables in Equation 5.15 with $1/s_h$ should be considered. This procedure was carried out. The null hypothesis of equal variances between households was rejected by Barlett's test even at very small significance levels.

TABLE III.5 $R^2$ in regressions with ln $s_h$ as variable to be explained for market segments: habitual, nonhabitual, and regular buyers

| Market segment | n | $s_h$ as estimated in | |
|---|---|---|---|
| | | Equation 5.12 | Equation 5.13 |
| Habitual buyers | 363 | .159 | .176 |
| Nonhabitual buyers | 424 | .231 | .141 |
| Regular buyers | 787 | .132 | .158 |

*Regression of household characteristics on $s_h$*

If $\underline{s}_h^2 \sim \sigma_h^2 X_r^2/r$, then $E(\underline{s}_h^2) = \sigma_h^2$ and var $(\underline{s}_h^2) = 2\sigma_h^4/r$. If $\ln \underline{s}_h^2$ is considered instead of $\underline{s}_h^2$, then the variance of $(\ln \underline{s}_h^2) = 2/r$ which is a constant. Thus ln $(\underline{s}_h)$ was taken as the variable to be explained. The relationship of ln $s_h$ to household characteristics, with $s_h$ as estimated in Equation 5.12 is shown in Table III.6. The coefficient of determination $R^2$ of the regressions with regular buyers, habitual buyers and nonhabitual buyers (with ln $s_h$ as variable to be explained, where $s_h$ was obtained from Equations 5.12 or 5.13) are given in Table III.5.

From these low values of $R^2$, it may be concluded that the parameter estimates in Equation 5.15 cannot be improved by linear regression with a function of household characteristics as weights.

*Weighting with $1/s_h$.*

It is also possible to weight the variables in Equation 5.15 with $1/s_h$. From the results of the time-series analyses (Equation 5.12) it could be deduced, that households with low values for $s_h$ often spent large amounts on cut flowers and pot plants on occasions, such as, Mother's Day, All Souls' Day, and Christmas. If all variables in Equation 5.15 are weighted with $1/s_h$, then the weights of these households are greater than those of other households. Thus specification errors in Equations 5.12 or 5.13, because of variables not included in the model or because of misspecification of the statistical relationship, may affect the size of the weight to a large extent. Therefore, it was decided not to weight the variables with $1/s_h$.

Thus, it can be concluded that any correction of parameter estimates in Equation 5.15 for heteroscedasticity would only reduce the quality of the parameter estimates.

## III.3 Characteristics of a frequency distribution

Kurtosis is defined as

$$k_1 = \frac{\sum_{h=1}^{H} \left[(x_h - \bar{x})/s\right]^4}{H} - 3 \qquad \text{(III.7)}$$

where $x_h$ = the observation for household h, h = 1,2,....,H; and

$\bar{x} = \frac{1}{H}\sum_h x_h$ is the mean of the $x_h$ and

$\sigma^2 = \sum_{h=1}^{H} (x_h - \bar{x})^2/H$ is the standard deviation of the $x_h$

Kurtosis is a measure of the relative peakedness or flatness of the curve defined by the distribution of cases. A normal distribution has a kurtosis of zero. A positive Kurtosis value means that the distribution is more peaked (narrow) than; and a negative value means that the distribution is flatter than a normal distribution (Figure III.1).

TABLE III.6 Relationship between household characteristics and the natural logarithm of the estimated standard errors in Equation 5.12 in regular, habitual, and nonhabitual buyers

| Household characteristics | Equation 5.15 | | Equation 5.18 | | | |
|---|---|---|---|---|---|---|
| | Regular buyers (n=787) | | Habitual buyers (n=363) | | Nonhabitual buyers (n=424) | Absolute t value of difference |
| | Regression coefficient | Absolute t value | Regression coefficient | Absolute t value | Regression coefficient | |
| Social class | | | | | | |
| AB (high) | .316 | 4.83 | .273 | 3.07 | .182 | 0.76 |
| C | .192 | 3.57 | .124 | 1.62 | .133 | 0.09 |
| $D_1$ | .108 | 2.10 | .095 | 1.27 | .062 | 0.35 |
| Geographical area | | | | | | |
| west | .177 | 3.17 | .088 | 1.00 | .113 | 0.24 |
| east | .152 | 2.49 | .194 | 1.97 | .050 | 1.21 |
| south | .042 | 0.70 | .054 | 0.53 | .056 | 0.00 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | .085 | 2.22 | .025 | 0.49 | .013 | 1.64 |
| 30000–100000 | .115 | 2.60 | .096 | 1.70 | .041 | 0.70 |
| Access to a garden | .004 | 0.12 | .027 | 0.59 | .033 | 0.10 |
| Household size | .001 | 0.09 | -.010 | 0.66 | .005 | 0.73 |
| Age of wife (years) | | | | | | |
| 30–64 | .070 | 1.59 | .076 | 1.27 | .042 | 0.43 |
| ≧ 65 | -.112 | 1.83 | -.141 | 1.74 | -.079 | 0.57 |
| Attitude to housekeeping | -.004 | 1.39 | -.022 | 0.52 | -.077 | 0.96 |
| Price consciousness | -.004 | 1.30 | .024 | 0.55 | -.098 | 2.03 |
| Proportion of expenditure | | | | | | |
| for own home | -.074 | 0.98 | -.385 | 2.88 | -.257 | 0.81 |
| from florist | .239 | 3.77 | .278 | 3.14 | .352 | 0.64 |
| from market or street stall | -.080 | 1.21 | .011 | 0.13 | -.216 | 1.91 |
| Constant | .532 | | .999 | | .645 | 1.62 |
| $R^2$ | .132 | | | | .338 | |

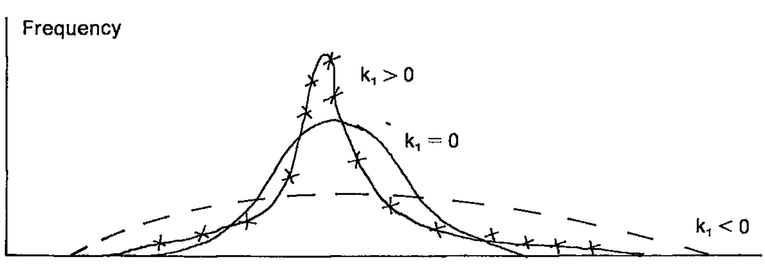



Figure III.1 Kurtosis for different functions

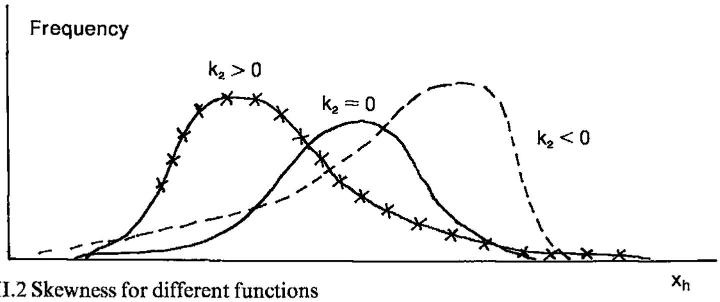


Figure III.2 Skewness for different functions

Skewness is defined as

$$k_2 = \frac{\sum_{h=1}^{H} \left[(x_h - \bar{x})/s\right]}{H} \tag{III.8}$$

It is a measure of deviations from symmetry, and disappears when the distribution is symmetrical. A positive value indicates that the observations are concentrated to the left of the mean, with most of the extreme values to the right. A negative value indicates concentration to the right of the mean (Figure III.2).

## III.4 Distributions of parameter estimates

## III.5 Regression Equations 5.15 and 5.18 applied to households in the market segment of regular buyers

The relationship between expenditure on cut flowers and pot plants by regular buyers and household characteristics are given in Table III.9. The difference in regression coefficients between habitual and nonhabitual buyers was estimated with Equation 5.18. The absolute t value of the difference in regression coefficients indicates whether the relationship between expenditure and a particular household characteristic differs significantly between households in the market segments habitual and nonhabitual buyers.

TABLE III.7 Frequency distribution of parameter estimates obtained in regression analyses for individual households to explain the weekly expenditure on cut flowers and pot plants (Equation 5.12) in habitual, nonhabitual, and regular buyers

| Parameter | Market segment | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|
| Average weekly expenditure (guilders) ($\bar{e}_h = \frac{1}{T} \sum_t e_{ht}$) | Habitual [a] | 0.75 | 12.84 | 2.60 | 1.53 | 10.38 | 2.61 |
| | Nonhabitual [b] | 0.19 | 8.61 | 1.01 | 0.84 | 23.96 | 4.02 |
| | Regular [c] | 0.19 | 12.84 | 1.74 | 1.44 | 10.29 | 2.51 |
| Trend ($\hat{\alpha}_{h2}$) | Habitual | -2.13 | 3.37 | 0.25 | 0.67 | 2.16 | 0.46 |
| | Nonhabitual | -4.01 | 5.82 | 0.04 | 0.55 | 35.63 | 1.69 |
| | Regular | -4.01 | 5.82 | 0.13 | 0.62 | 13.28 | 1.01 |
| Price ($\hat{\alpha}_{h3}$) | Habitual | -6.54 | 5.07 | 0.00 | 1.58 | 2.02 | -0.24 |
| | Nonhabitual | -3.21 | 11.65 | 0.13 | 1.12 | 26.31 | 2.61 |
| | Regular | -6.54 | 11.65 | 0.07 | 1.35 | 8.84 | 0.57 |
| Present advertising ($\hat{\alpha}_{h4}$) | Habitual | -5.99 | 3.89 | -0.53 | 1.31 | 1.55 | -0.15 |
| | Nonhabitual | -6.17 | 3.85 | -0.19 | 1.00 | 4.18 | -0.50 |
| | Regular | -6.17 | 3.89 | -0.35 | 1.16 | 2.51 | -0.38 |
| Past advertising ($\hat{\alpha}_{h5}$) | Habitual | -11.03 | 4.98 | -0.48 | 2.12 | 4.00 | -0.85 |
| | Nonhabitual | -11.30 | 9.38 | -0.20 | 1.66 | 8.77 | -0.31 |
| | Regular | -11.30 | 9.38 | -0.33 | 1.89 | 6.00 | -0.72 |
| Mother's Day ($\hat{\alpha}_{h6}$) | Habitual | -7.87 | 29.55 | 2.80 | 5.19 | 4.45 | 1.74 |
| | Nonhabitual | -14.06 | 28.97 | 2.08 | 4.47 | 9.12 | 2.25 |
| | Regular | -14.06 | 29.55 | 2.41 | 4.83 | 6.42 | 1.99 |
| All Souls' Day ($\hat{\alpha}_{h7}$) | Habitual | -7.15 | 31.82 | 0.34 | 2.60 | 58.70 | 4.95 |
| | Nonhabitual | -6.86 | 15.01 | 0.28 | 1.76 | 17.95 | 2.93 |
| | Regular | -7.15 | 31.82 | 0.31 | 2.19 | 58.35 | 4.66 |
| Christmas ($\hat{\alpha}_{h8}$) | Habitual | -8.30 | 22.13 | 0.78 | 3.68 | 6.72 | 1.88 |
| | Nonhabitual | -5.93 | 12.84 | 0.58 | 2.42 | 5.01 | 1.73 |
| | Regular | -8.30 | 22.13 | 0.68 | 3.06 | 8.03 | 1.98 |
| Winter ($\hat{\alpha}_{h9}$) | Habitual | -5.35 | 6.02 | 0.28 | 1.68 | 1.75 | -0.02 |
| | Nonhabitual | -10.74 | 2.76 | -0.03 | 1.12 | 19.93 | -2.19 |
| | Regular | -10.74 | 6.02 | 0.11 | 1.41 | 6.45 | -0.46 |
| Spring ($\hat{\alpha}_{h10}$) | Habitual | -7.69 | 6.32 | 0.38 | 1.83 | 2.46 | -0.56 |
| | Nonhabitual | -7.95 | 8.50 | 0.21 | 1.33 | 9.30 | 0.37 |
| | Regular | -7.95 | 8.50 | 0.29 | 1.58 | 4.66 | -0.23 |

TABLE III.7 Continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Summer holidays ($\hat{\alpha}_{h11}$) | Habitual | -7.33 | 5.17 | -0.37 | 1.48 | 2.89 | -0.17 |
| | Nonhabitual | -3.77 | 7.09 | -0.14 | 0.98 | 9.28 | 1.37 |
| | Regular | -7.33 | 7.09 | -0.25 | 1.24 | 5.25 | 0.12 |
| Autumn ($\hat{\alpha}_{h12}$) | Habitual | -4.22 | 6.62 | 0.34 | 1.46 | 3.38 | 0.69 |
| | Nonhabitual | -3.61 | 5.27 | -0.02 | 0.95 | 5.49 | 0.69 |
| | Regular | -4.22 | 6.62 | 0.15 | 1.22 | 4.91 | 0.88 |
| Coefficient of determination ($R_h^2$) | Habitual | 0.02 | 0.65 | 0.19 | 0.11 | 3.32 | 1.64 |
| | Nonhabitual | 0.03 | 0.81 | 0.18 | 0.11 | 4.88 | 1.79 |
| | Regular | 0.02 | 0.81 | 0.19 | 0.11 | 4.17 | 1.72 |
| Standard deviation of estimated disturbances ($\hat{\sigma}_h$) | Habitual | 0.88 | 10.40 | 3.11 | 1.34 | 3.67 | 1.57 |
| | Nonhabitual | 0.67 | 12.92 | 2.18 | 1.15 | 20.36 | 3.23 |
| | Regular | 0.67 | 12.92 | 2.61 | 1.32 | 7.61 | 2.03 |
| Natural logarithm of $\hat{\sigma}_h$ | Habitual | -0.13 | 2.34 | 1.05 | 0.40 | 0.35 | 0.19 |
| | Nonhabitual | -0.40 | 2.56 | 0.68 | 0.43 | 0.84 | 0.54 |
| | Regular | -0.40 | 2.56 | 0.85 | 0.45 | 0.12 | 0.24 |
| Durbin-Watson statistic ($d_h$) | Habitual | 1.52 | 2.80 | 2.15 | 0.20 | 0.05 | -0.00 |
| | Nonhabitual | 1.27 | 2.79 | 2.13 | 0.22 | 1.18 | -0.73 |
| | Regular | 1.27 | 2.80 | 2.14 | 0.21 | 0.82 | -0.44 |
| Present advertising (alternative Equation 5.22 with x = 0.95) | Habitual | -1.52 | 1.15 | 0.02 | 0.44 | 1.29 | -0.63 |
| | Nonhabitual | -2.05 | 1.50 | 0.01 | 0.34 | 5.24 | -0.31 |
| | Regular | -2.05 | 1.50 | 0.01 | 0.39 | 2.77 | -0.52 |
| Past advertising (alternative Equation 5.22 with x = 0.95) | Habitual buyers | -5.37 | 5.43 | -0.02 | 1.31 | 2.19 | -0.35 |
| | Nonhabitual | -7.57 | 4.57 | -0.08 | 0.95 | 11.49 | -0.94 |
| | Regular | -7.57 | 5.43 | -0.05 | 1.13 | 5.16 | -0.52 |

[a] Habitual buyers n = 363;
[b] Nonhabitual buyers n = 424;
[c] Regular buyers n = 787.

TABLE III.8 Frequency distribution of parameter estimates obtained in regression analyses for individual households to explain the weekly number of purchases of cut flowers and pot plants (Equation 5.13) in habitual, nonhabitual, and regular buyers

| Parameter | Market segment | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|
| Average number of weekly purchases ($\bar{q}_h = \frac{1}{T} \sum_t q_{ht}$) | Habitual [a] | 0.35 | 3.21 | 0.86 | 0.47 | 5.39 | 2.10 |
| | Nonhabitual [b] | 0.11 | 2.03 | 0.29 | 0.22 | 17.00 | 3.57 |
| | Regular [c] | 0.11 | 3.21 | 0.56 | 0.46 | 5.96 | 2.08 |
| Price ($\hat{\alpha}_{h3}$), deflated prices | Habitual | -2.52 | 1.21 | -0.26 | 0.53 | 1.00 | -0.47 |
| | Nonhabitual | -1.25 | 1.18 | -0.04 | 0.31 | 1.76 | -0.25 |
| | Regular | -2.52 | 1.21 | -0.14 | 0.44 | 2.28 | -0.80 |
| Price elasticity, deflated prices | Habitual | -5.66 | 4.81 | -0.81 | 1.72 | 0.21 | 0.02 |
| | Nonhabitual | -11.44 | 8.02 | -0.28 | 3.06 | 0.36 | -0.15 |
| | Regular | -11.44 | 8.02 | -0.53 | 2.54 | 1.08 | 0.02 |
| Coefficient of determination ($R_h^2$) | Habitual | 0.03 | 0.49 | 0.19 | 0.08 | 0.81 | 0.75 |
| | Nonhabitual | 0.03 | 0.64 | 0.17 | 0.08 | 3.48 | 1.38 |
| | Regular | 0.03 | 0.64 | 0.18 | 0.08 | 1.98 | 1.06 |
| Durbin-Watson statistic ($d_h$) | Habitual | 1.42 | 2.84 | 2.10 | 0.24 | -0.29 | -0.11 |
| | Nonhabitual | 1.35 | 2.63 | 2.11 | 0.23 | 0.35 | -0.60 |
| | Regular | 1.35 | 2.84 | 2.11 | 0.23 | 0.01 | -0.37 |

[a] Habitual buyers n = 363;
[b] Nonhabitual buyers n = 424;
[c] Regular buyers n = 787.

TABLE III.9 Relationship between household characteristics and expenditure on cut flowers and pot plants in regular, habitual, and nonhabitual buyers

| Household characteristics | Equation 5.15 | | Equation 5.18[a] | | | |
|---|---|---|---|---|---|---|
| | Regular buyers (n=787) | | Habitual buyers (n=363) | | Nonhabitual buyers (n = 424) | Absolute t value of difference in regression coefficients ($\hat{\delta}_1$ and $\hat{\delta}_0$) |
| | Regression coefficient | Absolute t value | Regression coefficient ($\hat{\beta}_{11}$ and $\hat{\beta}_{01}$) | Absolute t value | Regression coefficient ($\hat{\beta}_{12}$ and $\hat{\beta}_{02}$) | |
| Social class | | | | | | |
| AB (high) | .893 | 4.25 | .847 | 3.10 | .404 | 1.21 |
| C | .474 | 2.74 | .408 | 1.73 | .138 | 0.89 |
| $D_1$ | .251 | 1.51 | .142 | 0.62 | .137 | 0.00 |
| Geographical area | | | | | | |
| west | .646 | 3.60 | .531 | 1.97 | .299 | 0.70 |
| east | .507 | 2.58 | .827 | 2.74 | .117 | 1.95 |
| south | -.031 | 0.16 | .191 | 0.61 | .033 | 0.42 |
| Size of residential municipality (inhabitants) | | | | | | |
| ≧ 100000 | .292 | 2.37 | .119 | 0.78 | .010 | 0.51 |
| 30000–100000 | .265 | 1.86 | .241 | 1.39 | .015 | 0.92 |
| Access to a garden | -.055 | 0.45 | .070 | 0.51 | -.004 | 0.36 |
| Household size | -.032 | 0.87 | -.080 | 1.63 | -.026 | 0.84 |
| Age of wife (years) | | | | | | |
| 30–64 | .322 | 2.27 | .555 | 3.01 | .044 | 2.08 |
| ≧ 65 | -.046 | 0.23 | -.019 | 0.08 | -.108 | 0.26 |
| Attitude to housekeeping | -.057 | 0.56 | -.021 | 0.16 | -.123 | 0.58 |
| Price consciousness | -.143 | 1.33 | -.060 | 0.45 | -.184 | 0.68 |
| Proportion of expenditure | | | | | | |
| for own home | .368 | 1.52 | .652 | 1.56 | -.853 | 3.10 |
| from florist | .078 | 0.38 | .764 | 2.81 | .166 | 1.68 |
| from market or street stall | -.193 | 0.91 | .645 | 2.62 | -.370 | 2.79 |
| Constant | .493 | | .547 | | 1.578 | 1.53 |
| $R^2$ | .116 | | .386 | | | |
| Average weekly expenditure (guilders) | 1.44 | | 2.61 | | 1.01 | |

[a] with $(\bar{e}_h)$ as variable to be explained

# APPENDIX IV

## Additional information to Chapter 6 on the priority stage: the allocation of budget to subclasses of flowers and plants by habitual buyers

IV.1 Cut flowers and pot plants purchased by the same households

The adequacy of the subclasses distinguished; cut flowers, flowering, and green plants, (Section 3.2), has been investigated by determining which combinations of cut flowers and of pot plants were most frequently purchased by the same household during the period, December 1972 – November 1974. The ten cut flowers and 15 pot plants most frequently purchased by all households in the sample were selected, and then the extent to which these types were purchased by the same households within the study period was represented by a measure between zero and one

$$k_{ij} = \frac{a_{ij}}{a_i + a_j - a_{ij}} \quad i,j = 1,2,\ldots,n \tag{IV.1}$$

where

$a_{ij}$ = number of households purchasing both product i and product j between December 1972 and November 1974

$a_l$ = number of households purchasing product l in that period ($l = i,j$)

n = number of flowers and plants types distinguished.

A purchase-relationship matrix K was calculated for both an analysis sample (Table IV.1) and a control sample. The size of these samples, which were drawn from the total number of buying households (941), was 503 and 438, respectively. A low value in Table IV.1 indicates that few households purchased both product i and j, for example, the combination of mixed bunches (treated as a separate type of flowers) and primula, whereas the number of households purchasing the combination, freesia and chrysanthemum, was high. A row and column for the same product containing only low values, indicates that few households purchased this product and one of the other products specified, for example, fuchsia, gloxinia, climbing ivy, hibiscus, and fern.

The extent to which combinations of flowers, plants, or both were purchased by the same household can be visualized with multidimensional scaling, applied to the coefficients $k_{ij}$. Results in two dimensions were obtained for the analysis sample of 503 households and for the control sample of 438 households. A small distance between two points, each point representing a particular product, indicates that these products were purchased often by the same household. It could be concluded that the types of flowers distinguished were purchased frequently by the same household. The same held for a number of flowering plants such as, azalea, cyclamen, chrysanthemum, geranium, saintpaulia, poinsettia, and begonia; and for green plants such as, climbing ivy and fern.

Products frequently purchased by the same households can also be grouped with cluster analysis. Euclidean distances between the co-ordinates of the points in the two dimensional space were calculated. With a hierarchical clustering technique (Wards method), seven clusters (Table IV.2) were selected. The results for both the analysis and the control sample suggest that the subclasses distinguished, cut flowers, flowering pot plants, and green pot plants, correspond to preferences shown by households in their buying behaviour.

IV.2 Linear Expenditure System with a disturbance term derived from a utility function with random shocks

Theil (1975) and Barten (1966,1968) have also specified a utility function with random shocks. They began with an unspecified direct utility function and the assumption that the utility function in the constrained maximum can be approximated by a quadratic utility function

TABLE IV.1 Purchase-relationship matrix for cut flowers and pot plants based on an analysis sample of 503 households

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gladiolus | 1 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| Mixed bunch | 2 | .30 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | |
| Carnation | 3 | .47 | .39 | 1.00 | | | | | | | | | | | | | | | | | | | | | | |
| Chrysanthemum | 4 | .47 | .35 | .72 | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| Freesia | 5 | .47 | .36 | .71 | .76 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| Lily | 6 | .40 | .27 | .38 | .37 | .42 | 1.00 | | | | | | | | | | | | | | | | | | | |
| Daffodil | 7 | .49 | .38 | .62 | .63 | .67 | .41 | 1.00 | | | | | | | | | | | | | | | | | | |
| Tulip | 8 | .50 | .38 | .74 | .76 | .75 | .43 | .69 | 1.00 | | | | | | | | | | | | | | | | | |
| Rose (long stem) | 9 | .39 | .29 | .47 | .45 | .49 | .40 | .47 | .50 | 1.00 | | | | | | | | | | | | | | | | |
| Rose (short stem) | A | .47 | .35 | .64 | .63 | .69 | .43 | .62 | .68 | .54 | 1.00 | | | | | | | | | | | | | | | |
| Azalea | B | .39 | .31 | .47 | .51 | .50 | .35 | .48 | .52 | .41 | .50 | 1.00 | | | | | | | | | | | | | | |
| Begonia rex | C | .32 | .28 | .40 | .41 | .38 | .28 | .39 | .39 | .31 | .38 | .43 | 1.00 | | | | | | | | | | | | | |
| Begonia semperflorens | D | .26 | .21 | .30 | .31 | .31 | .23 | .28 | .29 | .26 | .29 | .35 | .38 | 1.00 | | | | | | | | | | | | |
| Succulents | E | .29 | .26 | .30 | .30 | .30 | .23 | .30 | .30 | .27 | .30 | .29 | .24 | .22 | 1.00 | | | | | | | | | | | |
| Chrysanthemum (potted) | F | .33 | .25 | .38 | .44 | .41 | .31 | .41 | .41 | .29 | .39 | .44 | .35 | .28 | .28 | 1.00 | | | | | | | | | | |
| Cyclamen | G | .36 | .28 | .46 | .52 | .47 | .31 | .46 | .46 | .33 | .43 | .46 | .41 | .35 | .26 | .43 | 1.00 | | | | | | | | | |
| Fuchsia | H | .13 | .10 | .13 | .13 | .13 | .10 | .14 | .13 | .10 | .13 | .15 | .18 | .18 | .17 | .14 | .13 | 1.00 | | | | | | | | |
| Geranium | I | .29 | .22 | .33 | .33 | .33 | .28 | .30 | .33 | .24 | .32 | .33 | .34 | .32 | .24 | .34 | .34 | .19 | 1.00 | | | | | | | |
| Gloxinia | J | .14 | .13 | .15 | .15 | .16 | .15 | .15 | .14 | .12 | .17 | .19 | .18 | .18 | .14 | .17 | .19 | .13 | .18 | 1.00 | | | | | | |
| Climbing ivy | K | .14 | .15 | .14 | .15 | .16 | .14 | .16 | .16 | .14 | .15 | .15 | .19 | .15 | .21 | .15 | .12 | .15 | .17 | .18 | 1.00 | | | | | |
| Hibiscus | L | .17 | .11 | .13 | .14 | .15 | .15 | .15 | .14 | .14 | .15 | .16 | .18 | .16 | .16 | .18 | .15 | .14 | .16 | .14 | .09 | 1.00 | | | | |
| Poinsettia | M | .24 | .21 | .30 | .31 | .30 | .24 | .29 | .30 | .23 | .31 | .28 | .31 | .24 | .21 | .30 | .31 | .15 | .29 | .22 | .09 | .17 | 1.00 | | | |
| Primula | N | .17 | .14 | .20 | .19 | .19 | .16 | .19 | .19 | .16 | .20 | .22 | .24 | .22 | .13 | .23 | .22 | .14 | .24 | .16 | .10 | .16 | .21 | 1.00 | | |
| Saintpaulia | O | .33 | .26 | .41 | .40 | .43 | .26 | .39 | .40 | .34 | .40 | .40 | .40 | .32 | .28 | .36 | .39 | .16 | .32 | .16 | .15 | .18 | .30 | .28 | 1.00 | |
| Fern | P | .18 | .16 | .14 | .14 | .13 | .14 | .14 | .13 | .16 | .15 | .16 | .13 | .15 | .24 | .14 | .14 | .11 | .24 | .09 | .23 | .09 | .09 | .09 | .19 | 1.00 |

Table IV.2 Clusters of cut flowers and pot plants with the number of clusters fixed at seven

| Cut flowers and pot plants | Clusters | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis sample | | | | | | | Validation sample | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 Gladiolus | x | | | | | | | x | | | | | | |
| 2 Mixed bunch | x | | | | | | | x | | | | | | |
| 3 Carnation | x | | | | | | | x | | | | | | |
| 4 Chrysanthemum | x | | | | | | | x | | | | | | |
| 5 Freesia | x | | | | | | | x | | | | | | |
| 6 Lily | x | | | | | | | x | | | | | | |
| 7 Daffodil | x | | | | | | | x | | | | | | |
| 8 Tulip | x | | | | | | | x | | | | | | |
| 9 Rose (long stem) | x | | | | | | | x | | | | | | |
| A Rose (short stem) | x | | | | | | | x | | | | | | |
| B Azalea | | x | | | | | | | x | | | | | |
| C Begonia rex | | x | | | | | | | x | | | | | |
| D Begonia semperflorens | | x | | | | | | | x | | | | | |
| E Cacti | x | | | | | | | | | | | x | | |
| F Chrysanthemum (potted) | | x | | | | | | | x | | | | | |
| G Cyclamen | | x | | | | | | | x | | | | | |
| H Fuchsia | | | | x | | | | | | x | | | | |
| I Geranium | | x | | | | | | | x | | | | | |
| J Gloxinia | | | | | x | | | | | | | | x | |
| K Climbing ivy | | | x | | | | | | | | x | | | |
| L Hibiscus | | | | | | x | | | | | | | | x |
| M Poinsettia | | x | | | | | | | x | | | | | |
| N Primula | | | | | | | x | | | x | | | | |
| O Saintpaulia | | x | | | | | | | x | | | | | |
| P Fern | | | x | | | | | | | | x | | | |

$$z_{ht} = a_{ht}' \, q_{ht} + \tfrac{1}{2} \, q_{ht}' \, A_{ht} \, q_{ht} \qquad \text{(IV.2a)}$$

where $a_{ht}$ is a vector of random shocks with elements $da_{hkt}$, $E(a_{ht}) = 0$ and $E(a_{ht} \, a_{ht}') = -fA_{ht}$ for $f > 0$

Applied to the Linear Expenditure System ($k = 1,2,\ldots,K$)

$$m_{hkt} = c_{hkt} \, p_{kt} + \beta_{hk} \, [m_{kt} - \sum_{j=1}^{K} p_{jt} \, c_{hjt}] + n_{hkt} \qquad \text{(IV.2b)}$$

gives (Phlips 1974, p 209; Theil 1975, p 69):

$$n_{hkt} = d_{ht}^2 \sum_{k=1}^{K} \left(\frac{\beta_{hl}}{p_{lt}} (\delta_{kl} - \beta_{hk}) \, da_{hlt}\right) \qquad \text{(IV.2c)}$$

with $d_{ht} = m_{ht} - \sum_j p_{jt} \, c_{hjt}$

and $\delta_{kl}$ is the Kronecker delta.

It can be derived that $E \, n_{hkt} = 0$

$$\begin{aligned}
\text{and}\quad E(n_{hkt}, n_{hlt}) &= -f\,\beta_{hk}\,\beta_{hl}\,d^2_{ht} \text{ if } k \neq 1\\
&= f\,\beta_{hk}\,(1-\beta_{hk})\,d^2_{ht} \text{ if } k = 1\\
\text{or}\quad E(n_{hkt}, n_{hlt}) &= -\sigma^2_{ht}\,\beta_{hk}\,\beta_{hl} \text{ if } k \neq 1\\
&= \sigma^2_{ht}\,\beta_{hk}\,(1-\beta_{hk}) \text{ if } k = 1\\
\text{or}\quad E\,n_{ht}\,n_{ht}' &= \sigma^2_{ht}\,S_h \qquad \text{(IV.2d)}
\end{aligned}$$

where $S_h$ is singular because $S_h' \iota = 0$.

The likelihood function for the demand system (Equation IV.2b) with covariance matrix (Equation IV.2d) is

$$-\tfrac{1}{2}\Big[\sum_{t=s+1}^{T} \ln|\sigma^2_h S_h^*| + \sum_{t=s+1}^{T} n_{ht}^{*\prime}(\sigma^2_h S_h^*)^{-1} n_{ht}^*\Big] \qquad \text{(IV.2e)}$$

where $S_h^*$ is $S_h$ with the Kth row and Kth column deleted and $n_{ht}^*$ is $n_{ht}$ with the Kth element deleted.

Demand system (Equation IV.2b) with covariance matrix (Equation IV.2d) holds for the neighbourhood of the optimum only. Thus, results obtained with likelihood function (Equation 6.14) were used as starting values in Equation IV.2e. However, maximization with likelihood function (Equation IV.2e) diverged frequently.

## IV.3 Tests on heteroscedasticity of the disturbances in Equation 6.26

The greater $\sigma_h$ in Equation 6.13 is, the greater the variance of the maximum likelihood estimates of the parameters in the Linear Expenditure System will be. As each estimated parameter $\beta_{hk}$ and $\gamma_{hk}$ ($k = 1,2,\ldots K$) is a variable to be explained in Equation 6.26, it can be expected that $\sigma_h$ and $\varepsilon_{hk}$ are correlated. As the parameter $\varepsilon_{hk}$ cannot be estimated, $s_h$, the estimator of $\sigma_h$, was taken as a proxy variable to examine the extent of heteroscedasticity of the disturbances in Equation 6.26. The procedure is as follows. Bartlett's test is used to examine whether or not $H_0: \sigma^2_1 = \sigma^2_2 = \ldots = \sigma^2_H$ will be rejected. If $H_0$ is rejected, then the extent to which $\sigma_h$ can be explained by household characteristics is examined (e.g., Johnston 1972, p 220; Maddala 1977, p 262). If more than, say, 50% of the variation in $s_h$ can be explained by variation in household characteristics, then linear regression with a function of household characteristics as weight factor may be applied to improve the parameter estimates in Equation 6.26. Otherwise, consideration can be given to weighting the variables in Equation 6.26 with $1/s_h$. These steps were followed as set out below.

Step 1: *Bartlett's test.* The null hypothesis of equal variances was rejected at even very small significance levels for the 127 habitual buyers with an evoked set of three subclasses, and for the 58 habitual buyers with an evoked set of two subclasses.

Step 2: *Regression of household characteristics on $s_h$.* Applying Equation 6.26 with either $s_h$ or $\ln s_h$ as the variable to be explained did not give significant results at a 5% level. Therefore, it was not appropriate to improve the estimates in Equation 6.26 by linear regression with a function of household characteristics as weights.

Step 3: *Weighting with $1/s_h$.* The third possibility was to weigh all variables in Equation 6.26 with $1/s_h$. The size of $s_h$ depends on both unexplained variation in household h buying behaviour in the course of time and on the extent to which Equation 6.11 has not been correctly specified. As the relative importance of each of these factors was unknown, it was decided not to weigh with $1/s_h$.

It may be concluded, that parameter estimates in Equation 6.26 are not corrected for heteroscedasticity, and that any correction would only reduce the quality of the parameter estimates.

## IV.4 Reliability of the parameter estimates in the Linear Expenditure System

The RR value of a parameter estimate in the Linear Expenditure System, which is comparable with the t value of regression coefficients, was obtained by dividing this estimate by its asymptotic standard error. As a rule of thumb, parameter estimates are considered to be significantly different from zero, if these estimates are more than twice their standard error. As asymptotical standard

TABLE IV.3 Frequency distribution of RR values (parameter estimates divided by their asymptotic standard error) in the Linear Expenditure System for habitual buyers with two subclasses in their evoked set

| Parameter | Condition on parameters in the LES | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $\hat{\beta}_{h1}$ | whole segment | 90 | 0.01 | 180.17 | 13.60 | 20.13 | 52.09 | 6.42 |
| | $d_{ht} > 0$ | 55 | 0.04 | 41.84 | 12.00 | 9.30 | 2.04 | 1.37 |
| $\hat{\beta}_{h2}$ | whole segment | 90 | 0.04 | 185.00 | 7.22 | 19.77 | 73.75 | 8.22 |
| | $d_{ht} > 0$ | 55 | 0.04 | 18.85 | 4.38 | 3.98 | 3.58 | 1.84 |
| $\hat{\gamma}_{h1}$ | whole segment | 90 | 0.00 | 112.88 | 6.36 | 16.81 | 31.39 | 5.38 |
| | $d_{ht} > 0$ | 55 | 0.00 | 29.52 | 2.01 | 4.73 | 21.37 | 4.18 |
| $\hat{\gamma}_{h2}$ | whole segment | 90 | 0.00 | 39.64 | 2.47 | 5.76 | 21.94 | 4.30 |
| | $d_{ht} > 0$ | 55 | 0.00 | 39.64 | 1.57 | 5.42 | 47.31 | 6.68 |
| $\hat{\sigma}_h$ | whole segment | 90 | 0.35 | 19.66 | 7.73 | 3.30 | 1.00 | 0.18 |
| | $d_{ht} > 0$ | 55 | 2.14 | 14.15 | 8.53 | 2.34 | 0.07 | -0.23 |

errors could not always be obtained, the number of RR values in Tables IV.3 and IV.4 is less than the number of habitual buyers for which parameter estimates were obtained.

RR values for habitual buyers with an evoked set of two subclasses are given in Table IV.3. Mean RR values are high enough to guarantee that most of the marginal budget shares differ significantly from zero. The mean RR value of the habit formation parameter for cut flowers is higher than the mean for flowering pot plants, which is less than 2. The RR values for $\hat{\sigma}_h$ vary between 2.1 and 14.2, indicating that they differ significantly from zero.

RR values for habitual buyers with an evoked set of three subclasses are given in Table IV.4. The mean RR value of the marginal budget share for cut flowers ($\hat{\beta}_{h1}$) is about 10, for flowering pot plants ($\hat{\beta}_{h2}$) about 5; and for green pot plants about 2.5. On average, marginal budget shares differ significantly from zero. The distributions of RR for $\hat{\beta}_{h1}$ to $\hat{\beta}_{h3}$ have the lognormal shape (see

TABLE IV.4 Frequency distribution of RR values (parameter estimates divided by their asymptotic standard error) in the Linear Expenditure System for habitual buyers with three subclasses in their evoked set

| Parameter | Condition on parameters in the LES | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $\hat{\beta}_{h1}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.01 | 63.52 | 9.86 | 10.10 | 9.01 | 2.62 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.01 | 63.52 | 10.18 | 10.11 | 11.25 | 2.86 |
| $\hat{\beta}_{h2}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.01 | 30.31 | 4.81 | 6.12 | 3.94 | 2.00 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.01 | 30.31 | 4.89 | 6.02 | 4.33 | 2.02 |
| $\hat{\beta}_{h3}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.01 | 16.11 | 2.34 | 2.43 | 10.70 | 2.74 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.02 | 16.11 | 2.47 | 2.71 | 9.47 | 2.74 |
| $\hat{\gamma}_{h1}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.00 | 429.61 | 6.95 | 33.42 | 154.63 | 12.20 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.00 | 429.61 | 7.00 | 40.44 | 108.24 | 10.29 |
| $\hat{\gamma}_{h2}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.01 | 29.10 | 2.73 | 4.61 | 13.10 | 3.32 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.01 | 29.10 | 2.55 | 4.94 | 13.83 | 3.53 |
| $\hat{\gamma}_{h3}$ | $\hat{\beta}_{hK} > 0$ | 169 | 0.00 | 13.09 | 0.77 | 1.53 | 25.00 | 4.00 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 0.00 | 5.59 | 0.61 | 1.18 | 4.57 | 2.26 |
| $\hat{\sigma}_h$ | $\hat{\beta}_{hK} > 0$ | 169 | 1.72 | 43.33 | 11.90 | 4.44 | 14.53 | 2.33 |
| | $\hat{\beta}_{hK} > 0, d_{ht} > 0$ | 114 | 4.31 | 43.33 | 12.45 | 4.72 | 15.84 | 2.77 |

peakedness and skewness in Table IV.4). Mean RR values of the habit formation parameters are about 7 for $\hat{\gamma}_{h1}$, about 2.5 for $\hat{\gamma}_{h2}$ and about 0.7 for $\hat{\gamma}_{h3}$. Therefore, the mean habit formation parameter for green pot plants does not differ significantly from zero. The RR values for $\hat{\sigma}_h$ vary between 4.3 and 43.3, indicating that they differ significantly from zero.

## IV.5 Frequency distribution of budget and price elasticities of 127 habitual buyers with an evoked set of three subclasses, $\hat{\beta}_{hK} > 0$ and $d_{ht} > 0$ for $t = 5$ to 8

TABLE IV.5 Frequency distribution of budget elasticities of cut flowers (1), flowering pot plants (2), and green pot plants (3)

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $EE(q_1,m)$ | Winter 1973-1974 | 125 | 0.01 | 5.71 | 1.05 | 0.82 | 10.67 | 2.69 |
| | Spring 1974 | 127 | 0.02 | 4.00 | 1.03 | 0.61 | 8.62 | 2.15 |
| | Summer 1974 | 124 | 0.01 | 4.00 | 0.88 | 0.56 | 8.25 | 1.98 |
| | Autumn 1974 | 123 | 0.01 | 7.07 | 0.97 | 0.75 | 36.54 | 4.78 |
| $EE(q_2,m)$ | Winter 1973-1974 | 113 | 0.01 | 6.38 | 1.04 | 0.98 | 9.66 | 2.49 |
| | Spring 1974 | 113 | 0.02 | 4.98 | 1.06 | 0.86 | 7.07 | 2.20 |
| | Summer 1974 | 83 | 0.02 | 12.87 | 1.55 | 1.81 | 19.47 | 3.79 |
| | Autumn 1974 | 97 | 0.03 | 9.24 | 1.34 | 1.57 | 11.11 | 2.97 |
| $EE(q_3,m)$ | Winter 1973-1974 | 63 | 0.18 | 16.04 | 1.90 | 2.25 | 25.70 | 4.47 |
| | Spring 1974 | 95 | 0.06 | 7.38 | 1.33 | 1.27 | 9.99 | 2.82 |
| | Summer 1974 | 70 | 0.02 | 6.72 | 1.29 | 1.12 | 7.62 | 2.28 |
| | Autumn 1974 | 80 | 0.07 | 12.21 | 1.37 | 1.71 | 21.62 | 4.17 |

TABLE IV.6 Frequency distribution of uncompensated price elasticities for the demand of cut flowers with respect to price changes in cut flowers (1), flowering pot plants (2), and green pot plants (3)

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $PE(q_1,p_1)$ | Winter 1973-1974 | 125 | -4.79 | -0.01 | -0.87 | 0.59 | 12.91 | -2.67 |
| | Spring 1974 | 127 | -2.76 | -0.02 | -0.87 | 0.38 | 4.42 | -0.43 |
| | Summer 1974 | 124 | -3.99 | -0.01 | -0.83 | 0.54 | 9.70 | -2.21 |
| | Autumn 1974 | 123 | -4.77 | -0.01 | -0.86 | 0.58 | 18.45 | -3.18 |
| $PE(q_1,p_2) = E(q_1,p_2)$ | Winter 1973-1974 | 104 | -2.72 | -0.00 | -0.21 | 0.43 | 13.80 | -3.42 |
| | Spring 1974 | 107 | -2.41 | -0.00 | -0.15 | 0.39 | 22.30 | -4.56 |
| | Summer 1974 | 70 | -0.71 | -0.00 | -0.06 | 0.12 | 14.34 | -3.50 |
| | Autumn 1974 | 86 | -2.29 | -0.00 | -0.11 | 0.28 | 46.01 | -6.15 |
| $PE(q_1,p_3) = E(q_1,p_3)$ | Winter 1973-1974 | 63 | -0.28 | -0.00 | -0.01 | 0.04 | 36.19 | -5.58 |
| | Spring 1974 | 93 | -0.80 | -0.00 | -0.05 | 0.12 | 23.45 | -4.47 |
| | Summer 1974 | 61 | -0.40 | -0.00 | -0.03 | 0.07 | 16.47 | -3.76 |
| | Autumn 1974 | 66 | -0.93 | -0.00 | -0.04 | 0.13 | 40.70 | -5.97 |

TABLE IV.7 Frequency distribution of uncompensated price elasticities for the demand of flowering pot plants in respect of price changes in cut flowers (1), flowering pot plants (2), and green pot plants (3)

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $PE(q_2,p_1)$ | | | | | | | | |
| $= E(q_2,p_1)$ | Winter 1973-1974 | 109 | -3.93 | -0.00 | -0.27 | 0.54 | 21.17 | -3.96 |
| | Spring 1974 | 113 | -3.38 | -0.00 | -0.24 | 0.52 | 18.21 | -3.92 |
| | Summer 1974 | 78 | -11.02 | -0.00 | -0.51 | 1.46 | 36.20 | -5.49 |
| | Autumn 1974 | 96 | -7.68 | -0.00 | -0.44 | 1.06 | 25.03 | -4.54 |
| $PE(q_2,p_2)$ | Winter 1973-1974 | 113 | -4.53 | -0.01 | -0.77 | 0.67 | 9.90 | -2.39 |
| | Spring 1974 | 113 | -2.54 | -0.02 | -0.79 | 0.50 | 1.86 | -0.93 |
| | Summer 1974 | 83 | -3.16 | -0.01 | -1.02 | 0.73 | 1.25 | -1.03 |
| | Autumn 1974 | 97 | -5.67 | -0.01 | -0.88 | 0.89 | 11.95 | -2.91 |
| $PE(q_2,p_3)$ | | | | | | | | |
| $= E(q_2,p_3)$ | Winter 1973-1974 | 58 | -0.58 | -0.00 | -0.03 | 0.11 | 21.84 | -4.66 |
| | Spring 1974 | 84 | -0.57 | -0.00 | -0.04 | 0.09 | 13.89 | -3.43 |
| | Summer 1974 | 44 | -1.26 | -0.00 | -0.08 | 0.22 | 20.93 | -4.25 |
| | Autumn 1974 | 58 | -0.48 | -0.00 | -0.04 | 0.09 | 11.18 | -3.21 |

TABLE IV.8 Frequency distribution of uncompensated price elasticities for the demand of green pot plants in respect of price changes in cut flowers (1), flowering pot plants (2), and green pot plants (3)

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $PE(q_3,p_1)$ | | | | | | | | |
| $= E(q_3,p_1)$ | Winter 1973-1974 | 61 | -6.19 | -0.00 | -0.44 | 0.93 | 24.47 | -4.43 |
| | Spring 1974 | 95 | -5.24 | -0.00 | -0.28 | 0.65 | 38.14 | -5.52 |
| | Summer 1974 | 67 | -3.50 | -0.00 | -0.27 | 0.53 | 21.32 | -4.07 |
| | Autumn 1974 | 79 | -9.09 | -0.00 | -0.46 | 1.23 | 32.11 | -5.22 |
| $PE(q_3,p_2)$ | | | | | | | | |
| $= E(q_3,p_2)$ | Winter 1973-1974 | 57 | -2.40 | -0.00 | -0.34 | 0.57 | 3.89 | -2.07 |
| | Spring 1974 | 82 | -2.08 | -0.00 | -0.16 | 0.34 | 15.80 | -3.67 |
| | Summer 1974 | 40 | -0.67 | -0.00 | -0.10 | 0.15 | 5.26 | -2.11 |
| | Autumn 1974 | 63 | -3.56 | -0.00 | -0.19 | 0.53 | 28.86 | -5.11 |
| $PE(q_3,p_3)$ | Winter 1973-1974 | 63 | -8.50 | -0.12 | -1.17 | 1.24 | 21.35 | -4.20 |
| | Spring 1974 | 95 | -4.05 | -0.04 | -0.92 | 0.07 | 7.30 | -2.28 |
| | Summer 1974 | 70 | -4.44 | -0.01 | -0.98 | 0.85 | 4.83 | -2.02 |
| | Autumn 1974 | 80 | -3.12 | -0.04 | -0.77 | 0.54 | 4.94 | -1.70 |

TABLE IV.9 Frequency distribution of the compensated price elasticity for the demand of products in subclass i in respect of a price change of products in subclass j calculated with the formulae in Table 6.3; i,j = 1,2,3; 1 = cut flowers; 2 = flowering pot plants; 3 = green pot plants

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $PE^*(q_1, p_1)$ | Winter 1973-1974 | 122 | -3.58 | 0.08 | -0.34 | 0.50 | 18.06 | -3.73 |
| | Spring 1974 | 125 | -2.26 | 0.21 | -0.34 | 0.33 | 8.63 | -2.10 |
| | Summer 1974 | 114 | -3.63 | 0.27 | -0.32 | 0.50 | 17.64 | -3.49 |
| | Autumn 1974 | 118 | -4.05 | 0.17 | -0.34 | 0.54 | 24.64 | -4.37 |
| $PE^*(q_1, p_2)$ | Winter 1973-1974 | 121 | -0.69 | 1.95 | 0.21 | 0.31 | 12.25 | 2.64 |
| | Spring 1974 | 123 | -0.21 | 1.59 | 0.21 | 0.28 | 6.36 | 2.12 |
| | Summer 1974 | 96 | -0.27 | 1.38 | 0.17 | 0.27 | 6.91 | 2.36 |
| | Autumn 1974 | 109 | -0.25 | 3.22 | 0.22 | 0.48 | 21.39 | 4.24 |
| $PE^*(q_1, p_3)$ | Winter 1973-1974 | 92 | -0.05 | 2.90 | 0.18 | 0.41 | 26.86 | 4.84 |
| | Spring 1974 | 114 | -0.03 | 0.67 | 0.15 | 0.17 | 1.20 | 1.34 |
| | Summer 1974 | 95 | -0.26 | 3.63 | 0.21 | 0.46 | 34.46 | 5.13 |
| | Autumn 1974 | 101 | -0.32 | 1.02 | 0.16 | 0.22 | 3.62 | 1.80 |
| $PE^*(q_2, p_1)$ | Winter 1973-1974 | 113 | -0.42 | 3.13 | 0.41 | 0.54 | 8.64 | 2.49 |
| | Spring 1974 | 113 | -0.30 | 2.31 | 0.36 | 0.40 | 5.73 | 1.93 |
| | Summer 1974 | 83 | -0.62 | 2.75 | 0.58 | 0.65 | 2.58 | 1.48 |
| | Autumn 1974 | 97 | -0.48 | 2.70 | 0.40 | 0.54 | 4.34 | 1.87 |
| $PE^*(q_2, p_2)$ | Winter 1973-1974 | 113 | -3.82 | 0.29 | -0.50 | 0.61 | 10.00 | -2.62 |
| | Spring 1974 | 113 | -2.31 | 0.08 | -0.52 | 0.47 | 2.60 | -1.49 |
| | Summer 1974 | 83 | -3.04 | 0.29 | -0.74 | 0.68 | 1.89 | -1.36 |
| | Autumn 1974 | 97 | -5.26 | 0.10 | -0.61 | 0.85 | 13.86 | -3.34 |
| $PE^*(q_2, p_3)$ | Winter 1973-1974 | 84 | -0.06 | 1.10 | 0.12 | 0.21 | 9.65 | 2.92 |
| | Spring 1974 | 102 | -0.03 | 1.23 | 0.17 | 0.24 | 7.86 | 2.55 |
| | Summer 1974 | 70 | -0.34 | 2.14 | 0.19 | 0.34 | 14.60 | 3.05 |
| | Autumn 1974 | 81 | -0.14 | 3.18 | 0.24 | 0.47 | 20.91 | 4.05 |
| $PE^*(q_3, p_1)$ | Winter 1973-1974 | 63 | -0.48 | 7.71 | 0.68 | 1.14 | 25.51 | 4.68 |
| | Spring 1974 | 95 | -0.15 | 3.94 | 0.40 | 0.52 | 22.83 | 3.95 |
| | Summer 1974 | 70 | -0.31 | 2.76 | 0.49 | 0.56 | 4.98 | 1.94 |
| | Autumn 1974 | 80 | -0.50 | 2.44 | 0.36 | 0.44 | 5.67 | 1.72 |
| $PE^*(q_3, p_2)$ | Winter 1973-1974 | 62 | -0.23 | 1.08 | 0.24 | 0.27 | 0.71 | 0.95 |
| | Spring 1974 | 94 | -0.44 | 2.10 | 0.28 | 0.41 | 5.84 | 2.16 |
| | Summer 1974 | 58 | -0.16 | 3.64 | 0.28 | 0.56 | 22.68 | 4.33 |
| | Autumn 1974 | 72 | -0.33 | 2.40 | 0.18 | 0.35 | 21.61 | 3.84 |
| $PE^*(q_3, p_3)$ | Winter 1973-1974 | 63 | -7.60 | -0.00 | -0.92 | 1.19 | 18.78 | -3.98 |
| | Spring 1974 | 95 | -3.92 | -0.01 | -0.68 | 0.68 | 9.97 | -2.81 |
| | Summer 1974 | 70 | -3.98 | 0.11 | -0.72 | 0.82 | 4.74 | -2.11 |
| | Autumn 1974 | 80 | -2.44 | 0.66 | -0.52 | 0.52 | 3.32 | -1.41 |

TABLE IV.10 Frequency distribution of uncompensated own price elasticities calculated with the formula in Table 6.2; 1 = cut flowers; 2 = flowering pot plants; 3 = green pot plants

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $E(q_1, p_1)$ | Winter 1973-1974 | 125 | -1.00 | 4.91 | -0.74 | 0.64 | 50.11 | 6.26 |
| | Spring 1974 | 127 | -1.00 | 0.61 | -0.80 | 0.33 | 4.50 | 2.15 |
| | Summer 1974 | 124 | -1.00 | 0.52 | -0.82 | 0.28 | 5.89 | 2.18 |
| | Autumn 1974 | 123 | -1.00 | 1.34 | -0.76 | 0.37 | 8.64 | 2.47 |
| $E(q_2, p_2)$ | Winter 1973-1974 | 113 | -1.00 | 0.71 | -0.73 | 0.36 | 1.51 | 1.39 |
| | Spring 1974 | 113 | -1.00 | 2.07 | -0.75 | 0.43 | 16.23 | 3.34 |
| | Summer 1974 | 83 | -1.00 | 0.60 | -0.82 | 0.37 | 6.47 | 2.62 |
| | Autumn 1974 | 97 | -1.00 | 2.71 | -0.71 | 0.61 | 17.77 | 3.88 |
| $E(q_3, p_3)$ | Winter 1973-1974 | 63 | -1.00 | 0.00 | -0.92 | 0.20 | 10.86 | 3.28 |
| | Spring 1974 | 95 | -1.00 | -0.08 | -0.87 | 0.24 | 3.19 | 2.08 |
| | Summer 1974 | 70 | -1.00 | 0.65 | -0.92 | 0.26 | 20.41 | 4.26 |
| | Autumn 1974 | 80 | -1.00 | 0.03 | -0.91 | 0.22 | 8.32 | 3.03 |

The means of $E(q_k, p_k)$ and $PE(q_k, p_k)$ for $k = 1, 2, 3$ (see also Tables IV.6-IV.8) are compared in Appendix IV.6

TABLE IV.11 Frequency distribution of compensated own price elasticities, calculated with the formula in Table 6.2; 1 = cut flowers, 2 = flowering pot plants, 3 = green pot plants

| Elasticity | | n | Minimum value | Maximum value | Mean | Standard deviation | Peakedness | Skewness |
|---|---|---|---|---|---|---|---|---|
| $E^*(q_1, p_1)$ | Winter 1973-1974 | 122 | -2.07 | -0.00 | -0.27 | 0.24 | 24.76 | -3.76 |
| | Spring 1974 | 125 | -1.35 | -0.01 | -0.31 | 0.23 | 2.66 | -1.32 |
| | Summer 1974 | 114 | -2.52 | -0.00 | -0.29 | 0.30 | 25.16 | -3.96 |
| | Autumn 1974 | 118 | -2.43 | -0.00 | -0.28 | 0.31 | 20.72 | -2.64 |
| $E^*(q_2, p_2)$ | Winter 1973-1974 | 113 | -2.40 | -0.00 | -0.47 | 0.42 | 3.89 | -1.63 |
| | Spring 1974 | 113 | -2.14 | -0.00 | -0.51 | 0.40 | 2.62 | -1.37 |
| | Summer 1974 | 83 | -2.79 | -0.00 | -0.66 | 0.55 | 3.05 | -1.52 |
| | Autumn 1974 | 97 | -3.33 | -0.00 | -0.54 | 0.59 | 7.17 | -2.46 |
| $E^*(q_3, p_3)$ | Winter 1973-1974 | 63 | -4.78 | -0.00 | -0.85 | 0.71 | 14.67 | -3.15 |
| | Spring 1974 | 95 | -3.27 | -0.03 | -0.61 | 0.49 | 9.27 | -2.31 |
| | Summer 1974 | 70 | -2.96 | -0.02 | -0.87 | 0.68 | 0.87 | -1.28 |
| | Autumn 1974 | 80 | -1.61 | -0.01 | -0.52 | 0.36 | 0.53 | -1.03 |

The means of $E^*(q_k, p_k)$ and $PE^*(q_k, p_k)$ for $k = 1, 2, 3$ (see also Table IV.9) are compared in Appendix IV.6.

## IV.6 Price elasticities calculated with different formulae

In order to examine the extent to which the price elasticities calculated with the formulae given in Table 6.3 (PE and PE*) differ from those given in Table 6.2 (E and E*), a comparison was made between the uncompensated and compensated own price elasticities for 127 habitual buyers with an evoked set of three subclasses. Differences between the mean uncompensated own price elasticities $PE(q_k,p_k)$ and $E(q_k,p_k)$ are given in Table IV.12; and differences between the mean compensated own price elasticities $PE^*(q_k,p_k)$ and $E^*(q_k,p_k)$ are given in Table IV.13. Mean price elasticities do not differ to such an extent to allow different conclusions to be derived from the results obtained. Precise comparisons between mean elasticities are not appropriate, because deviations from the true elasticities are caused by the size of the estimated disturbances in the Linear Expenditure System.

TABLE IV.12 Mean uncompensated own price elasticities of 127 habitual buyers with an evoked set of three subclasses and $\hat{\beta}_{hK} > 0$, $d_{ht} > 0$ for t = 5 to 8

| | Cut flowers | | Flowering pot plants | | Green pot plants | |
|---|---|---|---|---|---|---|
| | $PE(q_1, p_1)$ | $E(q_1, p_1)$ | $PE(q_2, p_2)$ | $E(q_2, p_2)$ | $PE(q_3, p_3)$ | $E(q_3, p_3)$ |
| Winter 1973-1974 | -0.87 | -0.74 | -0.77 | -0.73 | -1.17 | -0.92 |
| Spring 1974 | -0.87 | -0.80 | -0.79 | -0.75 | -0.92 | -0.87 |
| Summer 1974 | -0.83 | -0.82 | -1.02 | -0.82 | -0.98 | -0.92 |
| Autumn 1974 | -0.86 | -0.76 | -0.88 | -0.71 | -0.77 | -0.91 |

TABLE IV.13 Mean compensated own price elasticities of 127 habitual buyers with an evoked set of three subclasses and $\hat{\beta}_{hK} > 0$, $d_{ht} > 0$ for t = 5 to 8

| | Cut flowers | | Flowering pot plants | | Green pot plants | |
|---|---|---|---|---|---|---|
| | $PE^*(q_1, p_1)$ | $E^*(q_1, p_1)$ | $PE^*(q_2, p_2)$ | $E^*(q_2, p_2)$ | $PE^*(q_3, p_3)$ | $E^*(q_3, p_3)$ |
| Winter 1973-1974 | -0.34 | -0.27 | -0.50 | -0.47 | -0.92 | -0.85 |
| Spring 1974 | -0.34 | -0.31 | -0.52 | -0.51 | -0.68 | -0.61 |
| Summer 1974 | -0.32 | -0.29 | -0.74 | -0.66 | -0.72 | -0.87 |
| Autumn 1974 | -0.34 | -0.28 | -0.61 | -0.54 | -0.52 | -0.52 |

# APPENDIX V

## Statistical tests and characteristics of standard habitual buyers

V.1 Test for whether slope parameters in Equation 8.1 are equal to zero

Under the null hypothesis

$$b_h = c_h = d_h = e_h = o \tag{V.1}$$

the test statistic is

$$f_h = \tfrac{3}{4}\frac{R_h^2}{1 - R_h^2} \tag{V.2}$$

with an F distribution with degrees of freedom 4 and 3. The coefficient of determination $R_h^2$ belongs to the interval (0,1). The null hypothesis will be rejected for a large $R_h^2$ which is equivalent to a large $f_h$. The null distribution was tested by application of the Kolmogorov-Smirnov test to the H observations of $P_{oh}$, where

$$P_{oh} = P(F_4^3 < f_h) \tag{V.3}$$

For this purpose, the $P_{oh}$ were ranked in increasing order. The test statistic is the maximum deviation between the observed and theoretical distribution and equals

$$D = \underset{i=1,2,\ldots,H}{\text{maximum}} \left| P_{oi} - \frac{i}{H} \right| \tag{V.4}$$

The test was applied to all 363 habitual buyers and to the subsegment of 127 habitual buyers with three subclasses in their evoked set. The results, as well as critical values $D_\alpha^*$ (Appendix III.2.1) are given in Table V.1. As $D > D_{0.01}^*$, the null hypothesis was rejected. Thus, it may be concluded that estimates obtained with Equation 8.1 are appropriate.

TABLE V.1 Values of D and $D_\alpha^*$ in a Kolmogorov-Smirnov one-sample test for habitual buyers

| Segment | Number of households | Critical values $D_\alpha^*$ | | D |
|---|---|---|---|---|
| | | $\alpha = 0.005$ | $\alpha = 0.01$ | |
| Total number of habitual buyers | 363 | 0.071 | 0.085 | 0.239 |
| Habitual buyers with three subclasses in their evoked set | 127 | 0.121 | 0.145 | 0.558 |

V.2 Household characteristics of standard habitual buyers

Table V.2 Household characteristics of standard habitual buyers

| Number | Geographical area | Age group in years and household size | Social class | Size of residential municipality[a] | Access to a garden | Attitude to housekeeping | Price consciousness | Proportion of expenditure (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | for home use | at florist | at market or street stall |
| 1 | North | ≧ 65 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 2 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 3 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 4 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 5 | | 30–64 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 6 | | (4) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 7 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 8 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 9 | | <30 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 10 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 11 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 12 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 13 | South | ≧65 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 14 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 15 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 16 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 17 | | 30–64 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 18 | | (4) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 19 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 20 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 21 | | <30 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 22 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 23 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 24 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 25 | East | ≧ 65 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 26 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |

TABLE V.2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 28 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 29 | | 30–64 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 30 | | (4) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 31 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 32 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 33 | | <30 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 34 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 35 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 36 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 37 | West | ≧ 65 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 38 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 39 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 40 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 41 | | 30–64 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 42 | | (4) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 43 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 44 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |
| 45 | | <30 | AB | L | yes | neg. | no | .8 | .4 | .3 |
| 46 | | (2) | C | M | yes | neg. | yes | .8 | .3 | .4 |
| 47 | | | $D_1$ | L | yes | pos. | yes | .7 | .4 | .3 |
| 48 | | | $D_2$ | H | no | pos. | yes | .7 | .2 | .5 |

[a] H = high, M = medium, L = low.

V.3 Test on differences between cluster means for several combinations of parameter estimates

Multivariate analysis of variance was applied to test the null hypothesis of equal means of clusters on several parameter estimates. Wilks' lambda was used as test statistic, and the critical level P was obtained by transformation of Wilks' lambda in an approximate F test.

TABLE V.3 Multivariate analysis of variance applied to sets of parameter estimates

| Stage and parameter estimate | | | Sets of parameter estimates used | | | |
|---|---|---|---|---|---|---|
| Budget stage | | | | | | |
| | trend parameter | | x | x | x | x |
| | advertising parameter | | x | x | x | x |
| | price parameter | | x | x | x | x |
| Priority stage | | | | | | |
| | marginal budget share for | | | | | |
| | | flowering plants | | x | | |
| | | green plants | | x | | |
| Choice stage | | | | | | |
| | purchase probability for | | | | | |
| | | tulip | | | x | |
| | | daffodil | | | x | |
| | | rose | | | | x |
| | | chrysanthemum | | | | x |
| | | infrequently purchased flowers | | | | x |
| n (1973-1974) | | | 363 | 127 | | |
| n (1973) | | | | | 159 | 188 |
| n (1974) | | | | | 172 | 186 |
| Number of segments | | | 4 | 4 | 3 | 3 |
| Wilks' lambda | | | .95 | .89 | | |
| | | | | | .85 | .87 |
| | | | | | .88 | .84 |
| Critical level | | | .02 | .47 | | |
| | | | | | .01 | .01 |
| | | | | | .02 | .01 |

# REFERENCES


ALTMANN M. (1984), Konsumententypologie auf dem Zierpflanzenmarkt, Forschungsberichte zur Oekonomie im Gartenbau No. 47, Hannover und Weihenstephan.

ALTMANN M. and R. VON ALVENSLEBEN (1982), Bestimmungsgruende des Blumenverbrauchs in privaten Haushalten in Hannover, Institut fuer Gartenbau-oekonomie der Universitaet Hannover.

ASSAEL H. (1976), Segmenting Markets by Response Elasticity, Journal of Advertising Research, Vol. **16**, No. 2, 27-35.

BARTEN A.P. (1966), Theorie en Empirie van een Volledig Stelsel van Vraagvergelijkingen, Pasmans, Den Haag.

BARTEN A.P. (1968), Estimating Demand Equations, Econometrica, Vol. **36**, No. 2, 213-251.

BASS F.M. and D.R. WITTINK (1975), Pooling Issues and Methods in Regression Analysis with Examples in Marketing Research, Journal of Marketing Research, Vol. **12**, 424-425.

BERNDT E.R. and N.E. SAVIN (1975), Estimation and Hypothesis Testing in Singular Equation Systems with Autoregressive Disturbances, Econometrica, Vol. **43**, No. 5-6, 937-957.

BETTMAN J.R. (1979), An Information Processing Theory of Consumer Choice, Addison-Wesley Publ. Cy., Reading (Mass.).

BLATTBERG R.C. and S.K. SEN (1974), Market Segmentation using Models of Multidimensional Purchasing Behavior, Journal of Marketing, Vol. **38**, 17-28.

BRADLEY J.V. (1968), Distribution-Free Statistical Tests, Prentice Hall, Englewood Cliffs, N.J.

CARMAN J.M. (1974), Consumer Panels. In: R. Ferber (ed.), Handbook of Marketing Research, McGraw-Hill, New York, 2-200 to 2-216.

COLARD M. (1975), Dynamique du Marché et Comportement d'Achat, Université Catolique de Louvain, Faculté des Sciences Economiques, Sociales et Politiques, Nouvelles Serie No. 120.

DRIEL J. VAN (1974), Consumer Expenditure Allocation Models, Econometric Institute, Rotterdam, Report 7405E.

DURBIN J. and G.S. WATSON (1951), Testing for Serial Correlation in Least Squares Regression 2, Biometrika, Vol. **38**, 159-178.

ENGEL J.F. and R.D. BLACKWELL (1982), Consumer Behavior, 4th ed., The Dryden Press, Hinsdale (Ill.).

EVERITT B. (1974), Cluster Analysis, Heinemann Educational Books, London.

GREDAL K. (1966), Purchasing Behaviour in Households. In: Kjaer-Hansen M., Readings in Danish Theory of Marketing, Harcks Forlag, Copenhagen.

HOWARD J.A. (1977), Consumer Behavior: Application of Theory, McGraw-Hill, New York.

HOWARD J.A. and J.N. SHETH (1969), The Theory of Buyer Behavior, Wiley, New York.

JOHNSTON J. (1972), Econometric Methods, 2nd ed., McGraw-Hill, New York.

KALWANI M.U. and D.G. MORRISON (1977), A Parsimonious Description of the Hendry System, Management Science, Vol. **23**, No. 5, 467-477.

KINNUCAN H.W. and O.D. FORKER (1982), Seasonality in the Consumer Response to Milk Advertising: Implications for Milk Promotion Policy, Cornell University, Dep. of Agricultural Economics, A.E. Res. 82-29.

KLEIJN E.H.J.M. DE (1981), Ontwikkeling van de Sierteeltmarkt in West-Duitsland, Landbouw-Economisch Instituut, Den Haag, Mededelingen No. 249.

KONING C.C.J. DE (1979), Technical Aspects of Running Panels, Acta Horticulturae No. 97, 181-192.

KOTLER PH. (1980), Marketing Management: Analysis, Planning and Control, 4th ed., Prentice Hall, London.

LAAN P. VAN DER (1975), Parametervrije Methoden, Landbouwhogeschool, Vakgroep Wiskunde.

LEONTIEF W. (1947), Introduction to a Theory of the Internal Structure of Functional Relationships, Econometrica, Vol. **15**, 361-373.

LLUCH C., A.A. POWELL and R.A. WILLIAMS (1977), Patterns in Household Demand and Saving, Oxford University Press, New York.

MADDALA G.S. (1977), Econometrics, McGraw-Hill, Tokyo.

MASSY W.F., D.B. MONTGOMERY and D.G. MORRISON (1970), Stochastic Models of Buying Behavior, MIT Press, Cambridge, Mass.

MAXWELL A.E. (1961), Analysing Qualitative Data, Methuen and Co, London.

NAKANISHI M. and L.G. COOPER (1974), Parameter Estimation for a Multiplicative Competitive Interaction Model – Least Squares Approach, Journal of Marketing Research, Vol. **11**, 303-311.

NERLOVE M. and F.V. WAUGH (1961), Advertising without Supply Control: Some Implications of a Study of the Advertising of Oranges, Journal of Farm Economics, Vol. **43**, No. 4, 813-837.

NETHERLANDS CENTRAL BUREAU OF STATISTICS (1974/1975), Werknemers budgetonderzoek, deel I, Levensomstandigheden, 20, Staat 3.

NETHERLANDS CENTRAL BUREAU OF STATISTICS / AGRICULTURAL ECONOMICS RESEARCH INSTITUTE (1974), Tuinbouwcijfers (Horticultural Data).

NICOLAUS L. (1975), De Belgische Gezinskonsumptie van Snijbloemen in 1973, Landbouw-Economisch Instituut, Brussel.

NICOLAUS L. (1976). De Belgische Gezinskonsumptie van Potplanten en Bloemstukken in 1973, Landbouw-Economisch Instituut, Brussel.

OPTPACK 3 (1977), Non-Linear Optimisation Package, ISA-DSA, Scientific Computer Applications, Philips, Eindhoven.

OSTENDORF H.D. (1975), Household Comparisons of the Demand for Flowers in the Federal Republic of Germany, Paper Presented at the 4th Meeting on Horticultural Economics of the International Society for Horticultural Science.

PARFITT J. (1972), A General Summary of the Types of Panels in Use, their Common Characteristics and Some of the Technical Considerations Involved in their Operation. In: Proceedings of the ESOMAR Seminar on Panels.

PARKS R.W. and A.P. BARTEN (1973), A Cross-Country Comparison of the Effects of Prices, Income and Population Composition on Consumption Patterns, The Economic Journal, Vol. **83**, 834-852.

PARZEN E. (1960), Modern Probability Theory and its Applications, Wiley, New York.

PHLIPS L. (1974), Applied Consumption Analysis, North Holland Publ. Cy., Amsterdam.

POLLAK R.A. and T.J. WALES (1969), Estimation of the Lineair Expenditure System, Econometrica, Vol. **37**, No. 4, 611-628.

POWELL A.A. (1974), Empirical Analytics of Demand Systems, Lexington Books, London.

PRATT R.W. JR. (1965), Consumer Behavior: Some Psychological Aspects. In: G. Schwartz, ed., Science in Marketing, Wiley, New York.

PRODUKTSCHAP VOOR SIERGEWASSEN (1966), Consumentenonderzoek Snijbloemen en Potplanten, Nederlandse Stichting voor Statistiek.

SHETH J.N. and P.S. RAJU (1973), Sequential and Cyclical Nature of Information Processing Models in Repetitive Choice Behavior. In: Sc. Ward and P. Wright (eds.), Advances in Consumer Research, Vol. 1, Proceedings of the Association for Consumer Research.

SIEGEL S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill, New York.

SOMERMEYER W.H. and A. LANGHOUT (1972), Shapes of Engel Curves end Demand Curves: Implications of the Expenditure Allocation Model, Applied to Dutch Data, European Economic Review, Vol. **3**, 351-386.

STROTZ R.H. (1957), The Empirical Implications of a Utility Tree, Econometrica, Vol. **25**, 269-280.

SWAMY P.A.V.B. (1971), Statistical Inference in Random Coefficient Regression Models, Springer-Verlag, Berlin.

THEIL H. (1975), Theory and Measurement of Consumer Demand, Vol. **1**, North Holland Publ. Cy., Amsterdam.

THEIL H. (1976), Theory and Measurement of Consumer Demand. Vol. **2**, North Holland Publ. Cy., Amsterdam.

TIMM G. (1978), Analyse des Schnittblumen und Topfpflanzenmarktes in der BR Deutschland, Forschungsberichte zur Oekonomie im Gartenbau No. 30, Hannover und Weihenstephan.

WALSH G.R. (1975), Methods of Optimization, Wiley, New York.

WANSBEEK T.J. (1980), Quantitative Effects in Panel Data Modelling, PhD Thesis, Leiden.

WIERENGA B. (1974), An Investigation of Brand Choice Processes, Rotterdam University Press.

WIERENGA B., V. SRINIVASAN and A. VAN TILBURG (1981), Multi-brand Stochastic Choice Model Including the Effects of Marketing Variables, Paper Presented at the Annual Meeting of the European Academy of Advanced Research in Marketing, Copenhagen.

WISHART, D. (1978,1982), CLUSTAN, User Manual, 3rd ed., Program Library Unit, Edinburgh University.

ZWAN A. VAN DER and J. VERHULP (1980), Grondslagen en Technieken van de Marktanalyse, Stenfert Kroese, Leiden.

# SAMENVATTING

DE KEUZE VAN CONSUMENTEN TEN AANZIEN VAN SNIJBLOEMEN EN POTPLANTEN. EEN STUDIE GEBASEERD OP GEGEVENS UIT EEN CONSUMENTENPANEL VAN HUISHOUDINGEN IN NEDERLAND.

Het doel van deze studie was meer inzicht te verkrijgen in het consumentengedrag van Nederlandse huishoudingen met betrekking tot bloemen en planten, mogelijkheden tot segmentatie van de consumentenmarkt voor bloemen en planten te onderzoeken en na te gaan in hoeverre de methoden en modellen uit deze studie toepasbaar zijn in het marktonderzoek van de bedrijfstak. Het onderzoek is uitgevoerd met behulp van aankoopgegevens en huishoudkenmerken van 1000 huishoudingen die gedurende de gehele periode december 1972 tot en met november 1974 lid waren van het NIAM panel en daarnaast geacht kunnen worden een representatief beeld te geven van de toenmalige huishoudingen in Nederland.

De studie is in een breder kader geplaatst door verschillende aspekten van het consumentengedrag met betrekking tot bloemen en planten in een tiental West Europese landen met elkaar te vergelijken, vooral voor de jaren 1977 tot en met 1982 (hoofdstuk 2). Met behulp van deze vergelijking kon het Nederlandse consumentengedrag in 1980 als volgt worden gekarakteriseerd. Het percentage kopende huishoudingen was het hoogst in Nederland en de verdeling van de aankopen over het jaar was in verhouding zeer gelijkmatig. Nederlanders besteedden het meest aan snijbloemen en bestemden het hoogste percentage (60%) van de uitgaven voor bloemen en planten voor eigen huis. Zij kochten vaak bij relatief goedkope aankoopplaatsen als de markt, het bloemenstalletje, de supermarkt, of aan de deur. Zij kochten relatief veel verschillende bloemen- en plantensoorten. Bloemen werden per bos gekocht en niet per steel zoals in een derde deel van de aankopen in Frankrijk, en de bos bestond in negen van de tien aankopen uit bloemen van een enkel soort, en niet zoals in vier van de tien aankopen in West Duitsland uit een gemengd boeket.

Er is verondersteld dat consumenten die vaak produkten uit een brede produktklasse als die voor bloemen en planten kopen dit via een getrapt keuzeproces doen (hoofdstuk 3). In het getrapt keuzeproces voor bloemen en planten worden de budgetfase, de prioriteitsfase en de keuzefase onderscheiden. De budgetfase betreft de toewijzing van een budget uit het inkomen van de huishouding aan relevant geachte produktklassen, waaronder snijbloemen en potplanten. In de prioriteitsfase wordt het budget voor bloemen en planten verdeeld over deelgroepen, onderscheiden in snijbloemen, bloeiende planten en groene planten. In de keuzefase wordt beslist welke bloem of plant binnen een der genoemde deelgroepen zal worden gekocht. Er is verondersteld dat elk van deze fasen kan worden beinvloed door commerciele variabelen als reklame, sociale variabelen als referentiegroepen, demografische variabelen als leeftijd, socio-economische variabelen als welstand en situatiegebonden faktoren als verjaardagen.

Er zijn enkele methoden besproken hoe de markt voor bloemen en planten gesegmenteerd kan worden (hoofdstuk 4). Het betreft segmentatie op verschil in aankoopfrekwentie, segmentatie op verschil in huishoudkenmerken en segmentatie betrekking hebbend op verschil in reaktie van huishoudingen op variatie in marketing-variabelen als prijs en reklame, of een combinatie van deze methoden. Op grond van de aankoopfrekwentie zijn regelmatige ($n = 787$) van incidentele ($n = 213$) kopers onderscheiden, terwijl de regelmatige kopers, met als extra kriterium het percentage van de aankopen voor eigen huis, zijn onderverdeeld in gewoontekopers ($n = 363$) en gelegenheidskopers ($n = 424$). Gewoontekopers zijn gedefinieerd als kopers met een gemiddelde tussenaankooptijd van korter dan drie weken en met tenminste 50% van de aankopen voor eigen huis. Voor gelegenheidskopers was of de gemiddelde tussenaankooptijd langer, of het percentage van de aankopen voor eigen huis lager, of beide.

In hoofdstuk 5 is geanalyseerd welke faktoren van invloed waren op de hoogte van het bestede bedrag (budget) aan bloemen en planten. Voor alle 1000 huishoudingen in de gegevensverzameling werd het bestede bedrag gerelateerd aan de huishoudkenmerken waarover gegevens beschikbaar waren. Sociale klasse en urbanisatiegraad hingen positief samen met het bestede bedrag. Dit bedrag was relatief hoog in het westen en oosten van het land, mede tengevolge van de sterke positie van de straathandel daar. Ook het behoren van de vrouw tot de leefdtijdsklasse 30–64 jaar of het hebben van een negatieve houding ten opzichte van het huishoudelijk werk was positief gerelateerd aan de bestedingen aan bloemen en planten.

Voor regelmatige kopers werd geanalyseerd hoe zij in hun bestedingen aan bloemen en planten reageerden op variatie in marketing- en andere variabelen en vervolgens hoe de geschatte responsparameters samenhingen met socio-economische en demografische kenmerken van de huishoudingen. De groei in bestedingen aan bloemen en planten was groter voor regelmatige kopers wonende in gemeentes met meer dan 30000 inwoners dan voor regelmatige kopers wonende in kleinere gemeentes. Het aantal aankopen van bloemen en planten door regelmatige kopers wonende in gemeentes met meer dan 30000 inwoners was prijselastischer dan dat van andere regelmatige kopers. Nationale reklame bleek effektiever te zijn voor regelmatige kopers met een hoge welstand, of voor hen wonende in het oosten van het land, dan voor andere regelmatige kopers. Het bleek echter dat de mediaan van de geschatte reklameparameters voor alle regelmatige kopers nauwelijks positief was, hetgeen betekent dat een duidelijk positieve invloed van nationale reklame niet aangetoond kon worden. Wel kon worden vastgesteld dat de invloed van reklame op de bestedingen aan bloemen en planten groter was in perioden met een toenemende of grote vraag dan in perioden met een afnemende of geringe vraàg.

Voor gewoontekopers, dus de intensief kopende huishoudens, werd de analyse in hoofdstuk 5 verbijzonderd als de budgetfase uit een getrapt keuzeproces. Daarom werd in de analyse van de regelmatige kopers (n = 787) nagegaan of de geschatte parameters significant verschilden voor gewoontekopers (n = 363) en gelegenheidskopers (n = 424). Zo was het aantal aankopen van gewoontekopers prijselastischer dan dat van gelegenheidskopers, terwijl ook de groei in de bestedingen groter was voor gewoontekopers dan voor gelegenheidskopers. De vraag van gewoontekopers wonende in het oosten van het land was minder prijselastisch dan van die in het noorden, terwijl dit voor gelegenheidskopers precies andersom was.

De prioriteitsfase in het getrapt keuzeproces van gewoontekopers is geanalyseerd in hoofdstuk 6. De deelgroepen waaruit gekocht werd, snijbloemen, bloeiende planten, en groene planten, verschilden tussen gewoontekopers. Ongeveer 55% van deze kopers kocht zowel snijbloemen, bloeiende potplanten als groene potplanten; ongeveer 25% van de gewoontekopers kocht snijbloemen en potplanten, waaronder vooral bloeiende planten; ongeveer 15% van hen kocht vrijwel alleen snijbloemen, terwijl ongeveer 5% van de gewoontekopers snijbloemen en potplanten, waaronder vooral groene planten, kocht. Gewoontekopers wonende in het westen of oosten van het land gaven een groter deel van het bestede bedrag aan bloemen en planten uit aan snijbloemen, terwijl gewoontekopers wonende in het oosten of noorden van het land, of zij die behoorden tot de leeftijdsklasse 65 jaar en ouder een groter deel uitgaven aan bloeiende planten dan andere gewoontekopers. Zij die behoorden tot de leeftijdsklasse 30 jaar en jonger besteedden een groter deel aan groene planten dan andere gewoontekopers. Deze resultaten hangen vermoedelijk samen met het feit dat in het westen en oosten van het land de straathandel een relatief sterke positie inneemt en met het verschil in levensstijl tussen personen behorende tot verschillende leeftijdsklassen.

Wat het model betreft is er een keuze gemaakt uit een drietal budgetverdeelmodellen: het Rotterdam Model, het Indirekt Addilog Model en het Lineair Uitgaven Systeem. Aan de laatste twee modellen werd de voorkeur gegeven omdat andere variabelen dan budget en prijzen relatief eenvoudig in het model kunnen worden opgenomen. Bij het schatten van de parameters in deze twee modellen bleek dat de geschatte waarden in het Lineair Uitgaven Systeem veelal binnen de toegelaten grenzen bleven, terwijl dit voor het Indirekt Addilog Model nooit het geval was. Daardoor werd het Lineair Uitgaven Systeem gekozen. Uit de per gewoontekoper geschatte responsparameters en de daaruit afgeleide budget- en prijselasticiteiten kon onder meer het volgende worden afgeleid. Buiten de winter waren planten meer luxe produkt dan snijbloemen en in de winter en het voorjaar waren, in tegenstelling tot de zomer en de herfst, groene planten meer luxe produkt dan bloeiende planten. De vraag naar snijbloemen bij gewoontekopers die kozen uit snijbloemen en potplanten, waaronder vooral bloeiende planten, was prijselastischer dan deze vraag bij gewoontekopers die kozen uit alle drie de deelgroepen.

Uit de analyse van de relatie tussen marginale budgetaandelen en socio-economische en demografische kenmerken van huishoudingen bleek het volgende. Het marginale budgetaandeel voor snijbloemen, gedefinieerd als dat deel van een additioneel budget voor bloemen en planten dat besteed zal worden aan snijbloemen, was hoger bij gewoontekopers waar de vrouw een negatieve houding had ten opzichte van het huishoudelijk werk, en bij gewoontekopers met een relatief hoog aandeel van de bestedingen aan bloemen en planten voor eigen huis dan bij andere gewoontekopers. Het marginale budgetaandeel voor bloeiende planten was lager bij gewoontekopers in de hoogste sociale klasse, en bij gewoontekopers met een relatief hoog aandeel van de bestedingen voor eigen huis dan bij andere gewoontekopers, terwijl het hoger was daar waar de vrouw tot de leeftijdsklasse 30–64 jaar behoorde, en daar waar zij een positieve houding ten opzichte van het huishoudelijk werk had. Het marginale budgetaandeel voor groene planten was hoger bij gewoontekopers wonende in gemeentes met meer dan 100000 inwoners, en daar waar de vrouw jonger dan 30 jaar was dan bij andere gewoontekopers.

In hoofdstuk 7 is de keuzefase uit het getrapt keuzeproces van gewoontekopers geanalyseerd. Er is verondersteld dat de uiteindelijke keuze voor een bepaalde bloemensoort of voor een plant die in deze fase wordt bestudeerd, verloopt volgens een stochastisch proces, omdat elk van een reeks van faktoren als presentatie, prijs, weer, beschikbaarheid, en advies van de winkelier, geacht wordt deze keuze in geringe mate te beinvloeden. De analyse in deze fase werd uitgevoerd voor snijbloemen omdat de aankoopfrekwentie alleen voor deze subklasse groot genoeg was. Eerst werd onderzocht welk van de volgende stochastische modellen: het multinomiaal model, het Markov model en het lineair leermodel, de aankoop van snijbloemen het best beschrijft. Het bleek dat de veronderstelling die ten grondslag ligt aan het multinomiale model, namelijk dat de aankoopkansen stabiel zijn (binnen een seizoen), voor verreweg de meeste gewoontekopers opging. Vervolgens werd voor afzonderlijke snijbloemen de geschatte aankoopkans van elke gewoontekoper gerelateerd aan de huishoudkenmerken van die koper. Huishoudkarakteristieken die samenhingen met de aankoopkansen van snijbloemen zijn urbanisatiegraad, leeftijdsklasse, houding ten opzichte van het huishoudelijk werk, en het percentage van het bestede bedrag aan bloemen en planten besteed op de markt of bij de bloemenstal. Enkele voorbeelden van de gevonden resultaten zijn als volgt. Gewoontekopers, wonende in een gemeente met meer dan 100000 inwoners, hadden een hogere aankoopkans voor tulpen, en een lagere aankoopkans voor narcissen dan gewoontekopers uit andere gemeentes. In vergelijking met andere gewoontekopers hadden gewoontekopers behorende tot de leeftijdsklasse 65 jaar of ouder een hogere aankoopkans voor chrysanthen, terwijl zij die behoorden tot de leeftijdsklasse 30 jaar en jonger een hogere aankoopkans hadden voor rozen.

In hoofdstuk 8 is nagegaan of, met behulp van de analyses in de voorgaande hoofdstukken, marktsegmenten konden worden vastgesteld waarvoor geldt dat, gegeven de meetbaarheid van het koopgedrag, de kopers met een specifiek marktbeleid kunnen worden benaderd, en de gevonden segmenten groot genoeg zijn om de kosten van marktsegmentatie te kunnen dragen.

Allereerst werd nagegaan of de vooraf gedefinieerde segmenten van incidentele, gelegenheids- en gewoontekopers aan genoemde eisen voldoen. De geografische bereikbaarheid bleek voor de gewoontekopers gunstig te zijn, twee derde van hen woonde in het westen van Nederland en zes van de tien in een gemeente met meer dan 30000 inwoners. De incidentele en gelegenheidskopers woonden meer buiten het westelijk deel van Nederland en minder geconcentreerd in steden. De vraag van gewoontekopers naar snijbloemen was significant prijselastischer en groeide significant meer dan die van gelegenheidskopers. Het onderscheiden van gewoontekopers ten opzichte van gelegenheids- èn incidentele kopers lijkt op grond van deze analyses gerechtvaardigd.

Vervolgens werd nagegaan of de huishoudingen konden worden gesegmenteerd op grond van hun reaktie op wijzigingen in: het aangeboden assortiment, prijzen of reklame-inspanningen ten aanzien van bloemen en planten. Diverse resultaten hiervan zijn reeds in het voorgaande vermeld.

Tenslotte werden vier segmenten voor gewoontekopers verkregen uit de analyse van het koopgedrag als getrapt keuzeproces. De drie grootste van deze segmenten hadden de volgende karakteristieken.

De gewoontekopers in het eerste segment (44% van de gewoontekopers) waren relatief prijsgevoelig, maar tamelijk ongevoelig voor nationale reklame voor bloemen en planten. Zij behoorden niet tot de hoogste sociale klasse, woonden of in het geürbaniseerde deel van west Nederland, of in het oosten of zuiden van het land waar zij behoorden tot de leeftijdsklasse jonger dan 30 jaar. In dit segment werden relatief vaak tulpen en rozen gekocht.

De gewoontekopers in het tweede segment (40%) waren relatief ongevoelig voor prijswijzigingen en nationale reklame. Zij behoorden ook niet tot de hoogste sociale klasse, woonden of in gemeentes met minder dan 30000 inwoners in het westen van het land, of in het oosten of zuiden van het land waar zij behoorden tot de leeftijdsklasse 30 jaar en ouder. In dit segment werden relatief vaak chrysanthen gekocht.

De gewoontekopers in het derde segment (13%) waren relatief prijs- en reklamegevoelig. Zij behoorden tot de hoogste sociale klasse en woonden buiten noord Nederland. Gewoontekopers in dit segment kochten relatief vaak tulpen en minder gangbare bloemen.

In hoofdstuk 9 zijn een aantal conclusies van de studie samengevat en is een evaluatie van de studie gegeven. De conclusies betreffen de aankoopkarakteristieken van consumenten ten aanzien van bloemen en planten, de schattingen van responsparameters, en voorstellen voor marktsegmentatie. Verder is de analyse van het koopgedrag door middel van een getrapt keuzeproces geëvalueerd.

**Aankoopkarakteristieken.** Driekwart van alle aankopen waren voor eigen huis, ongeveer tweederde deel daarvan werd door de huisvrouw gedaan. Van het kwart van alle aankopen om weg te geven werd 90% door de huisvrouw gedaan. De aankopen werden vooral verricht in de bloemenwinkel (30%), markt (25%) en bloemenstal (20%). Zij waren geconcentreerd op het eind van de week: 27% op vrijdag en 45% op zaterdag. Zes soorten snijbloemen namen circa 80% van de binnenlandse bloemenaankopen voor hun rekening: chrysant (25%), freesia (13%), tulp (12%), roos (11%), anjer (9%) en narcis (9%). De aankopen van potplanten waren over meer soorten verdeeld. De belangrijkste waren cyclamen (13%), azalea (12%), en chrysant (9%).

**Schattingen van responsparameters.** De gemiddelde prijselasticiteit van de vraag naar snijbloemen en potplanten was -0,28 voor gelegenheidskopers en -0,81 voor gewoontekopers. Voor de gewoontekopers die zowel snijbloemen, bloeiende planten en groene planten kochten waren de gemiddelde prijselasticiteiten respectievelijk -0,86; -0,87; en -0,96. Dit impliceert dat de vraag naar snijbloemen en potplanten door gewoontekopers tamelijk prijselastisch was. Uit een analyse van de kruiselingse elasticiteiten bleek dat de aankoop van snijbloemen minder werd beinvloed door prijswijzigingen in de andere deelgroepen dan de aankoop van bloeiende planten of die van groene planten. Het effekt van nationale reklame op de vraag naar snijbloemen en potplanten was hoger in seizoenen met een toename in de vraag dan in seizoenen waarin de vraag terugliep. Dit komt overeen met de stelling dat reklame vooral effektief is om een groeiende vraag naar een produkt te stimuleren.

**Marktsegmentatie.** Er werden een tweetal suggesties gedaan om de markt te segmenteren. De eerste betrof segmentatie van alle kopers op grond van koopfrekwentie en percentage van de aankopen voor eigen huis, hetgeen leidde tot de segmenten van incidentele kopers (21% van de kopers en 3% van de detailhandelsomzet), gelegenheidskopers (43% van de kopers en 30% van genoemde omzet), en gewoontekopers (36% van de kopers en 67% van genoemde omzet). Het aantal aankopen van gewoontekopers was prijselastischer dan dat van gelegenheids- en incidentele kopers. De tweede suggestie betrof een verdere segmentatie van de gewoontekopers in 'geürbaniseerde westerlingen of jonge oosteren zuiderlingen' (44% van de gewoontekopers), welke relatief prijsgevoelig, doch tamelijk ongevoelig voor nationale reklame bleken te zijn; 'rurale westerlingen of ooster- en zuiderlingen boven de dertig' (40%), die relatief ongevoelig voor veranderingen in prijzen en reklame bleken te zijn; en 'welvarenden buiten noord Nederland' (13%), welke zowel relatief prijs- als reklamegevoelig bleken te zijn.

**Evaluatie van de benadering van het koopgedrag als een getrapt keuzeproces.** De resultaten van de studie versterken het idee dat bij gewoontekopers de aankoop van bloemen en planten volgens een getrapt keuzeproces tot stand komt. Dit blijkt onder meer uit de consistentie van de resultaten voor de prijsvariabele verkregen in de afzonderlijke fasen van het keuzeproces. In de budgetfase was de schatting van de prijsparameter in de vraagvergelijking negatief voor ongeveer 70% van de gewoontekopers. In de prioriteitsfase kwamen de schattingen van de parameters in het Lineair Uitgaven Systeem overeen met de restrikties vanuit de economische theorie voor ongeveer 60% van de gewoontekopers, hetgeen ook negatieve prijselasticiteiten impliceert. In de keuzefase bleek dat een verhoging van de relatieve prijs van een bloemensoort een kleine afname in de aantrekkelijkheid van dat soort in de markt tot gevolg had.

Veel van de methoden en modellen voorgesteld in deze studie lijken toepasbaar te zijn in de praktijk van het marktonderzoek wanneer men over panelgegevens van individuele huishoudingen beschikt. Vooral de gehanteerde analyse van het koopgedrag ten aanzien van bloemen en planten als een getrapt keuzeproces lijkt bruikbaar bij het vinden van marktsegmenten. Echter, het is noodzakelijk dat door middel van toegepast onderzoek meer inzicht in de kosten en opbrengsten van deze benadering wordt verkregen, alvorens deze kan worden aanbevolen ten behoeve van het marktbeleid voor bloemen en planten.

# CURRICULUM VITAE

A. van Tilburg

- werd op 11 juni 1945 te Berkel en Rodenrijs geboren;
- doorliep de H.B.S. aan het huidige Melanchton Lyceum te Rotterdam: 1958–1963;
- behaalde vakdiploma's groenten- en bloementeelt in 1964;
- vervulde zijn militaire dienstplicht: 1964–1966;
- studeerde econometrie aan de Erasmus Universiteit: 1966–1971;
- werkte halftijds op de afdeling Marktonderzoek van Shell Nederland Verkoopmaatschappij: 1968–1971;
- was medewerker van de afdeling Informatie Systemen en Automatie van Philips Nederland: 1971–1974;
- is sinds augustus 1974 verbonden aan de vakgroep Marktkunde en Marktonderzoek van de Landbouwhogeschool;
- verrichte in het kader van een interdisciplinaire studie van januari tot december 1982 onderzoek naar de afzetproblematiek van rijstboeren in een irrigatieschema in West-Maleisie.