Price elasticity
- A potential pricing tool at IKEA

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Preface

This Master thesis project has been performed during the fall of 2004 for the Business Area *Home Organisation*, BA10, at IKEA of Sweden, Älmhult. The purpose with the thesis has been to develop a theoretical pricing model that will assist as a quantitative tool for future pricing decisions. During the fall the authors have had the opportunity to work with professionals at IKEA of Sweden, who have contributed with valuable ideas and comments.

The authors would like to express their appreciation to their tutors/supervisors at IKEA of Sweden, Henrik Bergstrand, Mattias Carlsson and Jonathan Catlow, who have guided and assisted the authors throughout the project. Furthermore the authors would like to thank their tutor at Lund Institute of Technology, Ingela Elofsson, for her guidance, coaching and encouragement during the process of writing this Master thesis. Finally the authors would like to thank Jerker Holm, at the Department of Economics at Lund Institute of Economics and Management, for his theoretical advices and recommendations.

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Abstract

Title: Price elasticity - A potential pricing tool at IKEA

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Research questions: How will price altering affect sales volume for IKEA of Sweden Business Area 10's products? Is it possible to estimate the products' price elasticities? If so, what data is sufficient and how can these parameters contribute to future pricing procedures at BA10? What product properties are necessary in order to retain a reliable analysis? In which way are sales volumes influenced by macroeconomic factors such as real income, unemployment and business cycles? Is there an appropriate way to define homogenous markets for IKEA? If a model that describes the local behaviour is found, will this model be globally applicable or should it be modified to fit different markets? Are there any microeconomic substitution or complementary effects outside or within the IKEA range? Do internal factors, for example advertising and service levels, affect the demand and therefore sales turnover? How can a model take these effects into consideration?

Purpose: The purpose of this Master thesis is to develop a theoretical pricing model that will assist as a quantitative tool for future pricing decisions. The tool will become a complement to the internal company factors and external environmental factors, which today have the greatest impact on the pricing procedures. In addition the model should preferably be applicable on both existing and new products.

Methodology: In order to estimate the price elasticity for BA10's products, the authors first had to gain knowledge concerning BA10's products and the business areas' current pricing strategies and procedures. Thereafter the authors designed a regression model with the help of academic theory. A demand curve illustrating the relationship between quantity demanded, Q, and the price, P, of a BA10 product was defined. Thereafter additional measurable factors that affect demand were defined, in order to deduct heterogeneity among countries. With the aim to attain reliable regression results the authors finally created a program, which performed all calculations automatically. The research process has been iterative and both quantitative and qualitative methods have been applied.

Conclusions: The authors have designed a regression model that estimates the price elasticities for BA10 products. Products included in the model are currently in the range and have a sales history of at least one financial year. The authors draw the conclusion that price has a statistically significant impact on sales volumes for the majority of BA10's products. Suitable prices are therefore crucial, in order to maximize turnover. The products belonging to the two lowest price groups have been identified as the most price elastic. In addition the authors have concluded that the demand for BA10's products is positive correlated with income, i.e. the products should be classified as normal goods. The authors have identified three prior fields of application for the results of this thesis; optimization in price investments, forecasting and prioritisation in range development.

Key words: Price elasticity, pricing strategies, pricing model, regression model, forecasting of sales volumes.

Table of content

1. Introduction

The objective with this chapter is to provide the reader with a background and comprehension for this thesis. The introductory background is followed by the problem description that leads into the purpose. Furthermore the chapter contains selected delimitations, target audience, confidentiality and the thesis' disposition.

1.1 Background

Price is defined as the amount of money charged for a product or service. More broadly, it is the sum of all values that consumers exchange for the benefits of having or using a product or service. Perhaps the price of a product has a greater influence on the customers in poorer countries, but it is still an important factor in the rest of the world. In addition price is a flexible element since it can be changed quickly. At the same time, pricing and price competition is a great problem facing many marketing executives.[1]

The price a company charges will be somewhere between one that is too low to attain profitability and one that is too high to create any demand. Therefore product costs set a floor to the price and the consumers' perceptions set a ceiling. Further the company must consider competitors' prices and other external and internal factors in order to find the best price between the two extremes.[2] But for special reasons this fundamental theory is not always followed. This is, for example, the case for IKEA of Sweden.[3]

IKEA of Sweden, IoS, is a company within the IKEA group which was founded 1943 by Ingvar Kamprad.[4] Its responsibilities are development, sourcing, supply and steering of the IKEA product range.[5] IoS is divided into ten different Business Areas, whereas this thesis project takes place at BA10, Home Organisation.[6]

The business idea of IKEA is "To create good design that works and has a price that everybody can afford to pay".[7] The pricing procedures are therefore crucial and permeate the whole organisation. In line with the business idea IKEA always aims to offer the lowest market prices. As a consequence the products' gross margins are not necessarily positive. The absence of any clear pricing method and the high number of articles and countries, in which IKEA is represented, do not make the pricing strategies less complex. In order to facilitate the pricing procedures it would be useful to estimate future effects of price altering.[8]

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[1] Armstrong G, Kotler P (2000), Marketing: An Introduction, p289-290
[2] Armstrong G, Kotler P (2000), Marketing: An Introduction, p299
[3] Bergstrand Henrik, 2004-09-10
[4] IKEA Services AB (2003), Facts & Figures
[5] www.ikea.com, 2004-09-07
[6] Bergstrand Henrik, 2004-09-10
[7] Inter IKEA systems B.V. (2003), How We Create the Low Price, p1
[8] Bergstrand Henrik, 2004-09-10

1.2 Problem description

With the background in mind the most important issue in this thesis is how price altering affects the sales turnover at Business Area 10, IKEA of Sweden. To be able to answer this question several problems have to be considered.

Since sales turnover is a function of price and sales volume, both components must be taken into consideration. One important question, in order to make effective price investments, is to estimate how the quantity sold will change if the price is altered. Is it possible to calculate the price elasticity? If so, what data is sufficient and how can these parameters contribute to future pricing procedures at BA10? What product properties are necessary in order to retain a reliable analysis?

In which way are sales volumes influenced by macroeconomic factors such as real income, unemployment and business cycles? Are social factors significant? Is there an appropriate way to define homogenous markets for IKEA? If a model that describes the local behaviour is found, will this model be globally applicable or should it be modified to fit a different market?

Are there any microeconomic substitution or complementary effects outside or within the IKEA range? Do internal factors, for example advertising and service levels, affect the demand and therefore sales turnover? How can a model take these effects into consideration?

1.3 Purpose

The purpose of this Master thesis is to develop a theoretical pricing model that will assist as a quantitative tool for future pricing decisions. The tool will become a complement to the internal company factors and external environmental factors, which today have the greatest impact on the pricing procedures. In addition the model should preferably be applicable on both existing and new products.

1.4 Delimitations

The dynamic environment and the large number of factors, that affect the demand for IKEA's articles, made it necessary for the authors to demark their area of study.

The vague definition and complexity of complementary products within the IKEA range have implied that present complement effects are not considered in this thesis. In addition, the authors ignore shifts in demand that arise in the presence of competitors.

Since the task is to optimise the total sales turnover the authors do not consider how prices should be set in a cost perspective. Gross margin and gross profit are therefore ignored.

1.5 Target audience

There are two main target groups for this thesis. The first target group is students at Lund Institute of Technology, Lund School of Economics and other universities that have an interest in econometrics, microeconomics and pricing strategies. The second group is the employees at IKEA of Sweden, especially those who have had a tutoring part in this Master thesis, with the ambition to consider estimated price elasticities when setting future prices.

1.6 Confidentiality

Because of the IKEA confidentiality policies not all figures is presented in this version of the thesis and has been replaced by crosses, $\times$. However, this implication is not considered to affect the informative or academic value of the Master thesis.

1.7 Disposition and outline

In this section the authors want to introduce the reader to the disposition and outline of this thesis. The project consists of the six parts, which are illustrated in figure 1.1.

Chapter 1, 2 – INTRODUCTORY PART

Chapter 3 - METHODOLOGY

Chapter 4 – THEORETICAL FRAMEWORK

Chapter 5, 6, 7- EMPIRICAL STUDIES

Chapter 8 - ANALYSIS

Chapter 9 – CONCLUSIONS & RECOMMENDATIONS
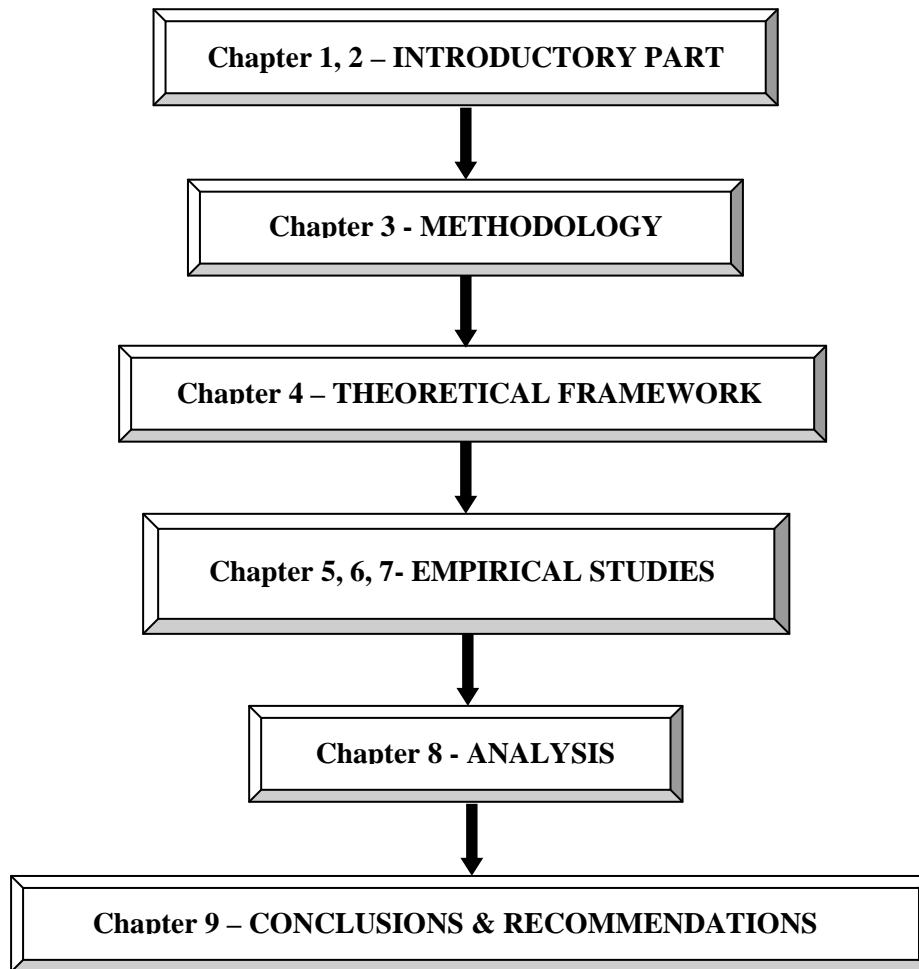
Figure 1.1 Disposition and outline in the thesis

The first part of this thesis consists of two chapters: the *Introduction* and *IKEA in brief*. The chapter *Introduction* provides a background and comprehension for this thesis, in which the reader will get presented to the problem description, purpose and delimitations that forms the basis for the study. In the chapter *IKEA in brief*, the organization structure of IKEA is outlined The aim with this chapter is to increase the knowledge regarding the Business Area Home Organization's position and responsibilities. In addition the Business Area's current pricing strategies and procedures are presented.

In the second part, the *Methodology* chapter, the authors declare the research methods applied in this thesis. In addition the authors will discuss how these methods have been implemented and interpreted by the authors.

The third part includes the *Theoretical framework*, which consists of microeconomic and econometric theory. This chapter aims to introduce the reader to necessary theories, in order to follow the empirical studies.

In the first empirical chapter, *Design of model,* the authors design a regression model based on the theoretical framework in chapter three. The regression model is later applied to selected products by the help of a program, created in Microsoft Excel. The procedures followed when creating this program are described in the second empirical chapter, *Practical approach.* In the third empirical chapter, *Preparations for the analysis,* the authors have defined criterion and tested hypothesis, which form the basis for the analysis in this thesis.

In the two final chapters, *Analysis* and *Conclusions and recommendations*, the regression results will be discussed and interpreted followed by conclusions and recommendations.

2. IKEA in brief

This chapter will give the reader an overview of the IKEA organisation, in order to understand BA10's position and responsibilities. Furthermore the current pricing strategies and procedures will be presented.

2.1 The IKEA organisation

IKEA is one of the biggest global home furnishing companies with more than 200 stores in over 30 countries. The IKEA concept was founded in 1943 by the 17 year old Ingvar Kamprad. The initial letters in the name of the profounder Ingvar Kamprad, the farm Elmtaryd and the village Agunaryd makes up the company name, IKEA. Elmtaryd and Agunaryd are located in Småland, Sweden. Pencils, Christmas cards and socks formed a part of the initial product range, that today consists of about 10 000 articles[9].

2.1.1 Vision and business concept

IKEA's vision is to "Create a better day for the many people". To realise their vision IKEA offers a wide range of design- and functional home furnishing products to prices so low that as many people as possible will afford to buy them. This demands close co-operation between designers, product developers, purchasers and suppliers to insure that the IKEA products are designed, manufactured, transported, sold and assembled in the most cost effective manner. IKEA's customers contribute to keeping prices low, by transporting their purchased items home and assemble them.[10,11]

2.1.2 Ownership structure

The ownership structure and organisation of IKEA, illustrated in figure 2.1, stand for long-term independence and security. The main owner of the IKEA group is the foundation "Stiching INGKA Foundation" and it is registered in the Netherlands. Stiching INGKA Foundation owns INGKA Holding B.V., which is the parent company of all companies within the IKEA group.

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[9] IKEA Services AB(2003), Facts & Figures
[10] IKEA Services AB(2003), Facts & Figures
[11] www.ikea.com 2004-09-07
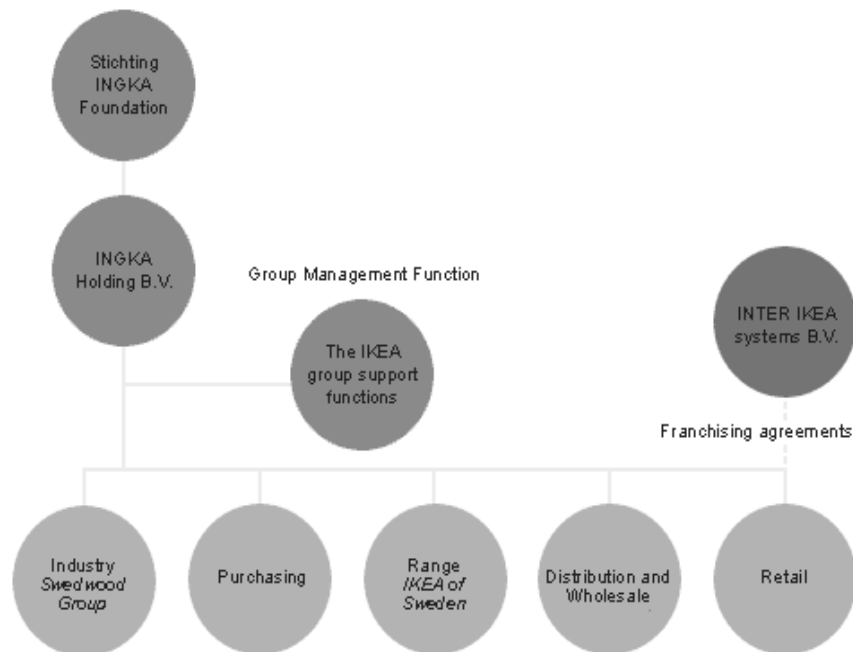
Figure 2.1 0wnership structure and organisation of the IKEA Group
(www.ikea.com, 2004-09-07)

Inter IKEA Systems B.V. is the owner and world-wide franchiser of the IKEA concept. According to a detailed expansion plan Inter IKEA systems B.V. grants new franchises to new or already existing markets/territories. The IKEA group is the biggest franchisee of Inter IKEA systems B.V. [12]

2.1.2.1 IKEA of Sweden

IKEA of Sweden is located in Älmhult, Sweden and is responsible for development, sourcing, supply and steering of the product range of IKEA. Furthermore they name all articles. For example, fabrics and curtains are given female names, carpets Danish place names and armchairs Swedish place names.[13]

IoS is divided into ten different business areas where every business area operates as "a company in the company". Some examples of different business areas are *Kitchen & Dining*, *Textiles*, *Children's IKEA*. This projects takes place at *Home Organisation*, BA10, which includes storage articles such as shelves, boxes and folders.[14]

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[12] www.ikea.com 2004-09-07
[13] IKEA Services AB(2003), Facts & Figures
[14] Bergstrand Henrik, 2004-09-10
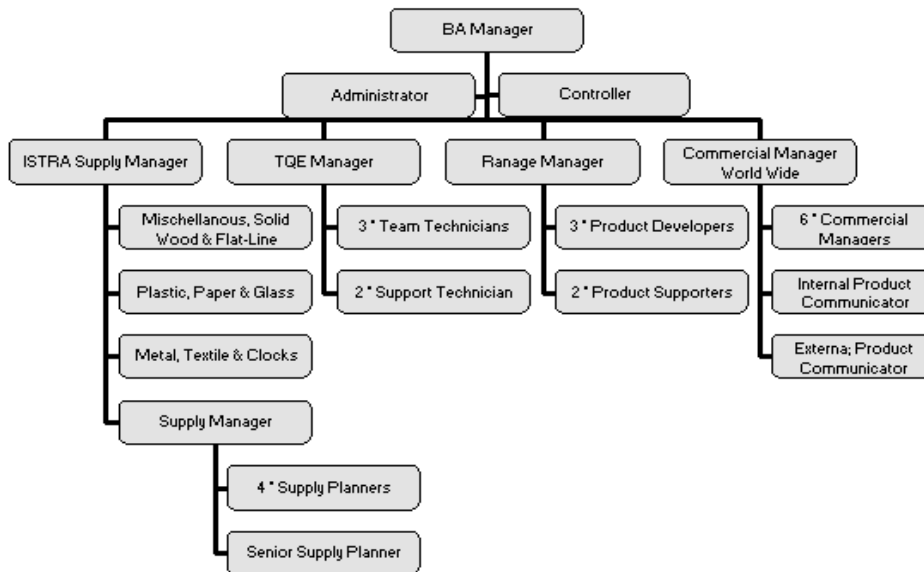
Figure 2.2 Organisation Chart, BA10 (Bergstrand Henrik, 2004-09-10)

In figure 2.2 the organisation chart for BA10 is shown. ISTRA stands for strategically purchasing and is a crucial division within the IKEA organisation. The purchasing mechanism is divided into three different units depending on the material to be bought. The supply planners make the forecast on an 18 months basis and they ensure that the suppliers' capacity is matched with the demand, in order to retain a good service level. A good service level is essential for BA10, since their customers in general do not visit IKEA with the single aim to purchase BA10 articles. This means that the customer might be lost if the demanded article is out of stock. From year to year the range manager completes a range plan, where both style and price are taken into account. The commercial managers are responsible for implementing the business strategy at the stores and the technicians are responsible for construction and packing.[15]

In addition to the business areas, every IKEA represented country has a division that is responsible for development, marketing and profitability within all different business areas. This leads to a two-dimension organisation, where communication is important, though IoS has the greatest influence. [16]

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[15] Bergstrand Henrik, 2004-09-10
[16] Bergstrand Henrik, 2004-09-10

2.2 The pricing procedures at IKEA

Pricing IKEA's products is a complex procedure because of the large number of articles. Both internal company factors and external environmental factors affect the pricing decisions[17]. Costs, marketing objectives, merchandising and marketing mix strategy are example of internal factors whereas the nature of the market and demand, competition and other environmental factors represent external factors.[18]

2.2.1 Price style matrix

At IKEA, all articles are divided into sixteen different categories considering their style and price. In this thesis the authors have chosen to refer to the four styles as *Style1, Style2, Style3* and *Style*4 whereas the four price groups are referred to as A, B, C and D. The products in the price group A are more aggressively merchandised and positioned out in the stores than products belonging to the other price groups.

Not all price groups are represented in each style category, for example there might not exist "*Style1* and price group *C*" boxes. A possible style matrix for a group of products is shown in figure 2.3 below, where a cross indicates that there exist products in the corresponding price style group.

Figure 2.3 Example of a price-style matrix
Jonathan Catlow 2004-09-10

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[17] Bergstrand Henrik, 2004-09-10
[18] Armstrong G, Kotler P (2003), Marketing: an introduction, p354

2.2.2 Pricing new products

When BA10 decides on developing a new product they examine if there is a market demand for the product. Thereafter the position in the price style matrix and the absolute price-tag are established. When placing a product group into the matrix its target groups' ability to pay is taken into consideration. An introduction of a new article often results in price adjustments for related products, in order to retain the price balance within the matrix. [19]

2.2.3 Activities and time restricted offers

All price altering are not permanent, but restricted for a limited period of time. Activities and time restricted offers are the two existing time limited pricing strategies at IoS. The purpose with the activities is to entice the customers to the stores, by offering low prices. An additional purpose might be to get rid of overage stock. The time restricted offers have the same purpose as the activities, but lasts during a shorter period of time. An example of a time restricted offer could be 0.05 €champagne glasses for New Years Eve. [20]

2.2.4 Implementing prices

BA10 sets recommended sales prices to all IKEA stores worldwide. These prices are normally followed, but countries can also choose to alter these prices with some restrictions. For example the price-style matrix must be retained. [21]

Printed in 145 million copies each year, IKEA's catalogue is the company's principal marketing channel. The catalogue is given out once yearly and the prices of products presented in the catalogue must not be raised during that year.

2.2.5 Price meeting

The recommended prices are set during an annual three-day meeting in October. Those taking part of the meeting are the controller, commercial managers and product developers. In order to get a better insight and understanding of the pricing procedures at BA10, the authors were invited to attend the pricing meeting fall of 2004. The pricing meeting's structure is illustrated in figure 2.4.

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[19] Bergstrand Henrik, 2004-09-10
[20] Bergstrand Henrik, Carlsson Mattias, 2004-11-09
[21] Bergstrand Henrik, 2004-09-10

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┌───────────┐     ┌─────────────┐     ┌──────────────┐     ┌────────────┐
│ Overview  │ ──▶ │ Pricing in  │ ──▶ │ Presentations,│ ──▶ │ New prices │
│           │     │separate groups│    │  discussion  │     │            │
└───────────┘     └─────────────┘     └──────────────┘     └────────────┘
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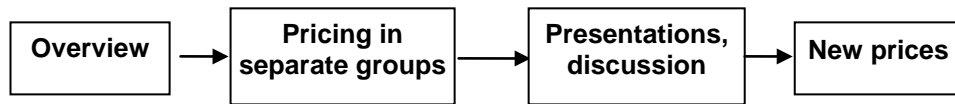
Figure 2.4 Structure of pricing meeting

First the global commercial manager held a short presentation, in which he mapped IKEA's current market position, main competitors and pricing strategies. The participants reported if there were any specific products, which prices must be reconsidered. These products were put on the so called "Wish list". As mentioned earlier, IKEA's vision and business idea is to "create a better every day for the many people, by offering products to such low prices that as many people a possible can afford to buy them". Hence IKEA has to lead with the lowest prices and must therefore continually make price investments. The maximum limit for BA10's total price reductions, FY2006, was five percentages.

Second the pricing team was divided in two subgroups. Each subgroup was responsible for certain product areas within BA10, such as Shelves & Systems, Boxes & Drawers and Bins & Bags. New prices were suggested by using so called "pricing tools"; one measured the effect a price altering would have on margins and turnover and the other mapped the availability and prices of similar products in different countries. The aim with the tools was to set new prices that would increase the turnover and were consistent with the IKEA vision and business idea. In addition to the concrete tools personal values and ideas had a great impact.

Once the separate subgroups had agreed on recommended prices for their product areas, these suggestions were presented for the rest of the pricing team. Through discussions and calculations the prices were either changed or approved.

Finally the new recommended prices were added into the records and the estimated effect on turnover and margins were registered.[22]

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[22] Bergstrand Henrik, Catlow Jonathan, Hansson Claes, 2004-10-18 – 2004-10-20

3. Methodology

In this chapter the reader will be introduced to the methodology framework used in this thesis. Every section is divided into two parts. The authors start with a description of basic method theories and thereafter explain how these theories will be implemented into following chapters.

3.1 Investigations

Depending on the purpose of an analysis, there are different categories under which an investigation may be classified. These categories include the *explorative, descriptive, diagnostic, explanatory,* and the *evaluative* study.[23]

3.1.1 Explorative, descriptive, diagnostic, explanatory and evaluative study

If the examiner wants to gain basic knowledge about a topic, an *explorative* study may be appropriate. The authors should question what needs to be investigated, how they should perform the investigation and which variables that will be of importance. To avoid later confusion it is important do identify what the problem comprises and what it does not.

A *descriptive study* is often performed to determine the properties of the research object. The descriptive studies are applied when the problem is structured and there is no intention to investigate the relationships between different causes of behaviours. In a descriptive study you gather information and determine the values of the variables.

If the purpose of an investigation is to find the reason for a certain phenomenon a *diagnostic study* will be the most appropriate.

An *explanatory study* may be suitable if the investigator faces problems where several theories may be applied. Explanatory studies are often constructed as hypothesis tests and they determine which explanation that is relevant and why.

Finally, if the investigator wants to measure the effect of a certain operation, he may also choose to perform an *evaluative study*.[24]

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[23] Wallén G (1993), Vetenskapsteori och forskningsmetodik, p46
[24] Wallén G (1993), Vetenskapsteori och forskningsmetodik, p46f

3.1.2 Investigations in this thesis

When writing this Master thesis the authors initially wanted to get as much information as possible about BA10's previous pricing methods, product range and pricing strategies, in order to understand the underlying aim with the Master thesis project. For this purpose an *explorative* study was performed. Secondly, the investigation was descriptive, since it aimed at describing the sales turnover, prices and store statistics for the period FY2000-2004. To realize the descriptive study the authors got access to BA10's historical sales data for all countries they operate in. These data files were complex and a lot of time was spent in order to select and structure relevant tables. Finally an *evaluative* study was performed, in order to evaluate how changes in price affect the sales turnover.

3.2 Sources of information

In this session the authors will describe two different sorts of data, primary and secondary. [25] The different methods for finding data that are used in this thesis will also be described.

3.2.1 Primary data

Primary data have never been used in any study before and must therefore be collected by the authors themselves. [26]

3.2.1.1 Interviews
Interviews are a method for finding relevant primary data for a research. They make it possible to attain a deeper understanding for the subject, since the questions can be adjusted to special individuals. To make the interviews as efficient as possible, they can be structured with already formulated questions. [27]

It is important to understand the difference between a conversation and an interview. The most important difference is that, in an interview one part is steering the dialog and its progress against an in advance determined course. The greatest drawback with an interview is that they are time-consuming and that the answering part may answer differently depending on the interviewer. An advantage is that the interviews are flexible and that they do not demand a lot of equipment. [28]

Interviews can be divided into three different categories: *structured, semi-structured and unstructured interviews*. A structured interview implies that the interviewer controls the questions asked. This interview can be resembled with a

[25] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare och ekonomer, p52
[26] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare och ekonomer, p52
[27] Denscombe M (2000), Forskningshandboken, p130f
[28] Lantz A (1993), Intervjumetodik, p5f

questioner that is answered face to face. A more flexible form is the semi-structured interviews. The method lets the answering part develop the ideas and speak more detailed about the questions. In unstructured interviews the scientist's role is to speak as little as possible since the answering part's thoughts are in focus.[29]

3.2.1.2 Observations

Information obtained by direct observations is characterized by the absence of written sources, interviews or surveys. In contrary all information is entirely based on real events. The observation may be of systematic or participative character. The systematic observation is mostly associated with quantitative data and statistical analysis whereas the participative observation is of a qualitative nature. The main advantage with this research methodology is that the observer will get access to data without disturbing the natural environment and thereby eliminating a wide array of possible misunderstandings and disillusions. A disadvantage is that the data collected will highly depend on the observer's perception. Possible influences of personal values may therefore reduce the method's reliability.[30]

3.2.2 Secondary data

Materials collected by another scientist than the author are called secondary data. Secondary data might be preferable, since it usually is time consuming to find primary data. In addition internet and telecommunication make secondary data easy accessible.[31]

3.2.2.1 Written sources

Examples of written sources are *books and periodicals, internet, newspapers and official statistics*. Books and periodicals are easy accessible and have a high credibility. Therefore, in the academic point of view, they should be the first source to look for information. Internet has an higher accessibility than books, which makes them a good medium to look for information. The drawback with internet is that there are no restrictions of the information published and therefore a big perusal from the scientist is required. [32]

In order to find topical data newspapers is a good source of information. Relevant newspapers should be identified before initiating the information research. Official statistics appears to be highly reliable, impartial and based on facts and is therefore an attractive source of information.[33]

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[29] Denscombe M (2000), Forskningshandboken, p134-136
[30] Denscombe M (2000) Forskningshandboken, p166-176
[31] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p131f
[32] Denscombe M (2000), Forskningshandboken, p187-196
[33] Denscombe M (2000), Forskningshandboken, p187-196

3.2.3 Primary and secondary data in this thesis

In this thesis secondary data constructs the basic framework. In addition primary data is used, in order to describe and clarify assumptions and statements. More details about the data used can be found in section 3.3.3.

3.3 The research method

Data collecting methods can be classified into two separate categories; *quantitative* and *qualitative*. These methods can be applied separately, but can also be combined in order to take advantage of the qualities in both methods.[34]

3.3.1 Quantitative methods

Quantitative methods draw conclusions from measurements of statistical data. Usually this method transforms the information into numbers and quantities. The problem with this kind of survey is the measuring and difficulties in finding the accurate data.[35] An advantage with the quantitative method is the high level of standardization, which makes the data comparable. Standardized interviews and questionnaires are examples of quantitative methods.[36]

3.3.2 Qualitative methods

Qualitative methods are recognized by the absence of numerical data.[37] In a thorough qualitative study the scientist is not interested in how the world functions, but how it is interpreted.[38] This information can not be valued in numbers and can therefore be influenced by the authors' objectives. Qualitative methods, such as personal interviews, are working in the depth and have an explaining purpose.[39]

3.3.3 Quantitative and qualitative methods in this thesis

In this thesis both quantitative and qualitative methods are present. The qualitative method will be applied when understanding and describing the IKEA organisation and the current pricing procedures at IoS. This will be realized with the help of secondary data, such as information at the IKEA website and documents published by IKEA. In order to obtain additional information the authors will utilize primary

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[34] Holme M, Solvang B (1997), Forskningsmetodik, p76f
[35] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p202
[36] Holme M, Solvang B (1997), Forskningsmetodik, p76f
[37] Eriksson L, Wiedersheim-Paul F (2001), Att utreda forska och rapportera, p63
[38] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p101f
[39] Holme M, Solvang B (1997), Forskningsmetodik, p76f

data, such as unstructured interviews with employees at IoS. In addition qualitative data and methods will be used when constructing the theoretical framework in this thesis. Academic literature and published articles were the two main sources of secondary data.

The empirical part of this project will be written with the quantitative method in mind and will resemble the process illustrated in figure 3.1.
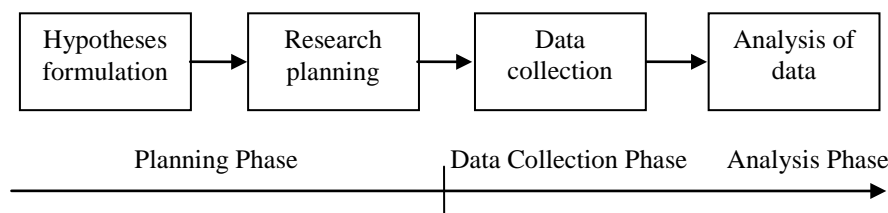
Figure 3.1 The research process when using the quantitative method
(Lundahl U, Skärvad P (1999), p95)

BA10's historical sales data will be of quantitative nature and is classified as secondary data.

Furthermore the authors will attend a price meeting, in which they will participate as observers. The aim with the participation is to get an insight in how the Master thesis project may fit into the current pricing routines.

No questionnaires will be used in this thesis. Instead primary data will be obtained through personal interviews. The authors will predominantly use unstructured interviews to let the interviewed persons develop their theories. These interviews will be well prepared, in order to obtain relevant data. Furthermore it is important to understand the objective with each interview. Since there are two authors, one can interview and the other can register the answers. Therefore no tape recorder, which may disturb the interviewed person, will be needed.

3.4 Inductive, deductive and hypothetic-deductive

Conclusions can be drawn either via induction or deduction. If the reality is approached without the support from established theories, the method is called *induction*. Generalizations, concepts, premises and hypothesis arise from the data gathered and the context of the situation.[40] In contrary, *deduction* means that existing theories are applied to a specific situation in order to examine the validity of the theories.

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[40] Merriam S B (1994), Fallstudien som forskningsmetod, p33

Induction is often described as moving from the specific to the general and the argument is often based on experience or observations. In contrary deduction is moving from the general towards the specific.[41]

In addition to the two approaches described above there is a third way of relating theory to reality. This method is a combination of the inductive and deductive approaches and is called the hypothetic-deductive approach. The hypothetic-deductive technique formulates arguments in the form of hypothesis, which consists of statements with a testable validity. Based on the hypothesis a model of the reality, that finally is tested empirically, is constructed. Through such empirical investigations a specific theory can be verified or discarded. [42]

3.4.1 Hypothetic-deductive approach in this thesis

This thesis is characterized by a hypothetic-deductive approach. Both empiric and logic approaches are used. Initially historical sales data for selected markets will be studied and the authors will estimate demand curves for different products. Thereafter generalizations, premises and hypothesis will form a base for different models, which will be tested empirically on new data. Through iterative testing, modelling and investigations a final model will be created. In figure 3.2 the hypothetic-deductive mode of procedure can be followed.

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[41] Halvorsen K (1992), Samhällsvetenskaplig metod, p43-46
[42] Eriksson L, Wiedersheim-Paul F (2001), Att utreda forska och rapportera, p201
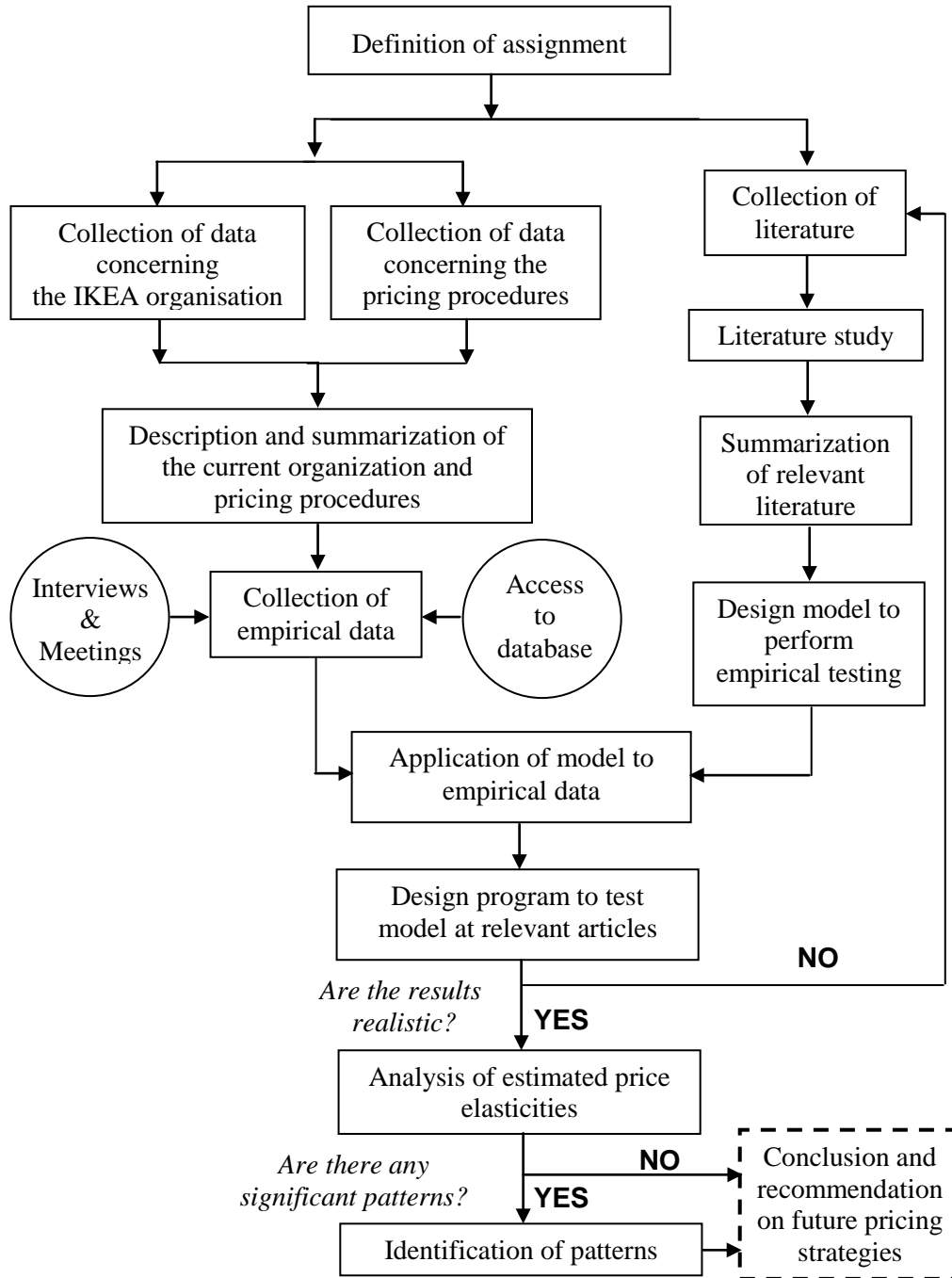
Figure 3.2 Mode of procedure

3.5 Creditability

Independent of the chosen mode of procedure, the result always has to be reviewed. The following sections aim to describe the terms *validity, reliability, objectivity, generalization* and *criticism of the sources*. Subsequently the authors will discuss the creditability in this thesis.

3.5.1 Validity

Validity can be defined as the absence of systematic errors. There is a distinction between *internal* and *external* validity. Internal validity is defined as a gauge's ability to measure what it is supposed to measure. Complete internal validity is rarely obtainable. Therefore it is important to be aware of the risk that the gauge's measurements may be too small, too large or misleading.[43]

The external validity is defined as the accordance between the gauge's response and what was actually supposed to be measured. If individuals are consciously or unconsciously lying, when answering a questionnaire, this would imply incomplete external validity. As a consequence the measurement will be a bad indicator of the factor that was supposed to be measured.[44]

3.5.2 Reliability

Reliability is defined as the absence of random errors. If the measurement is not influenced by the measurer or the current circumstances, a high reliability will be attained. In order to increase the reliability the measurements should be performed in such an identical way as possible. Furthermore high reliability presumes high validity.[45]

3.5.3 Objectivity

Objectivity implies that the researcher does not influence the research results.[46] It is difficult to achieve total objectivity. Therefore restricted objectivity is in general desirable and sufficient.[47] To attain restricted objectivity the researcher must be able to distinguish facts from values and be aware of the importance of versatility and completeness, in order to maintain unbiased[48].

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[43] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p150f
[44] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p150f
[45] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p152
[46] Arvidsson P, Rosengren K (1992), Sociologisk metodik, p77
[47] Eriksson L T, Finn Wiedersheim-Paul (2001), Att utreda forska och rapportera, p37
[48] Lundahl U, Skärvad P (1999), Utredningsmetodik för samhällsvetare & ekonomer, p75

3.5.4 Criticism of the sources

When using sources, primary as well as secondary, it is vital to keep a distance to the information used. The researcher should question whether if the sources of information, are valid, relevant and reliable. The importance of criticism of the sources should not be underestimated since incorrect or misleading information affects the research project's result.[49]

3.5.5 The creditability in this thesis

When writing the thesis the authors have had to do several demarcations because of the complexity of the project. The demarcations may have affected the internal validity negatively since the authors have not been able to measure or analysis all data and its implications. The internal validity relies on the knowledge and reminiscence of BA10's employees.

The factor that greatly determines the reliability in this thesis is the accuracy of the historical sales and range data collected and received at BA10. If the data includes standard errors the conclusions and results will be misleading. The authors' skillfulness in software programs, programming languages and theoretical knowledge is also essential for this project's reliability.

The quantitative nature of this thesis made it possible for the authors to remain unbiased and to obtain objectiveness. Conclusions are drawn from numerical models and regressions, which have minimized possible impacts of personal values. The fact that there are two authors, that gather and analyse the sources of information in this thesis, has lowered the risk of biased thoughts and lack of constant awareness.

Historical sales data at BA10 is confidential. Because of this confidentiality the authors did not have any possibility to test and examine its soundness. Academic course books, papers and published articles that the authors refer to in the thesis can be regarded as objective and valid because of their theoretical character. Possible misunderstandings between the authors and the employees at BA10, which may occur during interviews, would have affected the thesis validity negatively.

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[49] Eriksson L, Wiedersheim-Paul F (2001), Att utreda forska och rapportera, p150-151

4. Theoretical framework

In order to provide any numerical measure of the relationship between the demand and price of specific products at BA10, the authors will in this chapter introduce the reader to basic microeconomic and econometric theory. Detailed derivations and proofs will not be treated in this thesis but may be found in references.

4.1 Demand

For an article to be demanded the following three criteria must be satisfied: The purchaser must desire, afford and have a definite plan to buy the item. Sometimes the quantity demanded, which for example is measured in articles per week, is greater than the amount of goods available. This means that the quantity bought will be less than the actual quantity demanded. The main factors in which the quantity demanded depends on are *income, the price of the good, the price of related goods, population, expected future prices* and *preferences*.[50] These six factors will all be discussed in this section. But the focus in this thesis will be on the first four.

4.1.1 Income

The variable income, *I*, has a significant influence on quantity demanded, *Q*, but the correlation can be either positive or negative. If the correlation is positive, i.e. $\partial Q/\partial I$ is greater than zero, the goods are called *normal*. For some goods, however, the quantity may decrease as income increases in some range. A good for which $\partial Q/\partial I$ is negative is called *inferior*. Some examples of inferior goods are rotgut whiskey, potatoes and second-hand clothing.[51]

4.1.2 The price of the good

Two different aspects to look into when discussing the price of a good are *the substitution* and *the income effect.*[52]

4.1.2.1 Substitution effect
A substitute is a good that serves almost as well as the original article. If the price of the original article increases, other things remaining the same, more of the substitute and less of the original good will be demanded.[53]

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[50] Parkin M, Powell M, Matthews K (2003),Economics, p46
[51] Nicholson W (1998), Microeconomic Theory, p128-129
[52] Nicholson W (1998), Microeconomic Theory, p806
[53] Nicholson W (1998), Microeconomic Theory, p806

4.1.2.2 Income effect

A decrease in the price has the same effect as an increase in the purchaser's real income. After buying equal quantity of the now cheaper good the purchaser will have some income remaining. In case of a normal good the purchaser will use this money to buy more of the product. On the other hand, if an inferior good, a lower price may lead to a decrease in the purchaser's consumption of the good. [54]

4.1.3 Prices of related goods

The quantity demanded also depends on the price of related goods and can be observed in two different aspects: substitutes and complements.[55] Since complements are disregarded in this thesis the authors will only present the relevant theory for substitutes.

- **Substitutes:** In addition to the example described in section 4.1.2.1 regarding substitutes there is another possible scenario. The case could be that the price of the substitute is altered. This will then, in the same way as before, affect the demand of the good.[56]

  Two goods, X_i and X_j are said to be gross substitutes if:

  $$\partial X_i / \partial P_j > 0,$$

  where P_j is the price for good j. In other words, a rise in price of one good causes more of the other good to be bought. [57]

4.1.4 Population

The demand depends on the size and the age structure of the population.[58] In addition cultural differences also have a significant impact.[59]

4.1.5 Expected future prices

People substitute over time. This means that they buy less of a good before its price is expected to fall, which implies that the demand for the good decreases. The reverse case will happen if the price is expected to increase.[60]

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[54] Schotter A (1997), Microeconomics, p68
[55] Parkin M, Powell M, Matthews K (2003), Economics, p48-49
[56] Parkin M, Powell M, Matthews K (2003), Economics, p48-49
[57] Nicholson W (1998), Microeconomic Theory, p168
[58] Parkin M, Powell M, Matthews K (2003), Economics, p48-49
[59] Armstrong G, Kotler P (2003), Marketing: An introduction, p141f
[60] Parkin M, Powell M, Matthews K (2003), Economics, p48-49

4.1.6 Preferences

Preferences are an individual's attitude towards and taste for goods and services. These preferences will affect the demand structure. Past experience, genetic factors, advertising information, religious beliefs and other cultural and social factors are factors that will shape individuals preferences.[61]

4.2 The demand curve

A demand curve shows the relationship between the quantity demanded of a good and its price, when all other influences on consumers' planned purchases remain the same. Another way of looking at the demand curve is as a willingness-and-ability-to-pay curve that measures marginal benefit. It illustrates the highest price that someone is willing to pay for the last unit bought. The smaller the quantity available the higher price but as the quantity available increases the price decreases. In figure 4.1 an example of a demand curve is shown. All the factors that influence the demand also influence the demand curve.[62]
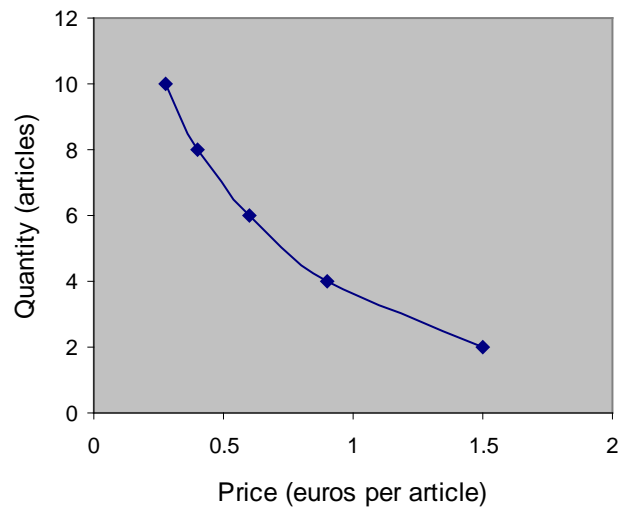
Figure 4.1 An example of a demand curve
(Parkin M, Powell M, Matthews K (2003), p46)

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[61] Parkin M, Powell M, Matthews K (2003), Economics, p48-49
[62] Parkin M, Powell M, Matthews K (2003), Economics, p46-48

4.3 Elasticity

In the section below the mathematical implications of the theoretical framework in 4.1 and 4.2 will be represented.

4.3.1 Price elasticity of demand

The demand for a product is, as mentioned in section 4.2, a function of the related price. Therefore a price altering does affect the sales turnover. An instrument to measure this effect is the price elasticity of demand, which is defined by:

$$\text{Price elasticity of demand} \ = \ \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$e_{Q,P} = \frac{\Delta Q / Q}{\Delta P / P} \rightarrow \frac{\partial Q}{\partial P} * \frac{P}{Q} \quad \text{when } \Delta \rightarrow 0$$

First, assume that the two variables Q and P stand for demanded quantity respectively price. Second, suppose that the demand variable Q depends on the price variable P, so that $Q=f(P,.....)$, where the dots in the equation indicates that Q may depend on additional variables than P.[63] The elasticity of Q with respect to P, $e_{Q,P}$, is a units- free measure of the responsiveness of the quantity demanded of a good to a change in its price when all other variables remain the same.[64] The measure is units-free because the percentage change in each variable is independent of the units in which the variable is measured, hence it does not matter if the price is in Euro or in US Dollars.[65]

Since a positive percentage change in price usually results in a negative percentage change in quantity demanded, $e_{Q,P}$ is mostly negative.[66] To measure how elastic the demand is only the absolute value may be considered.[67] A distinction is often made among absolute values of $e_{Q,P}$ that are less than, equal to or greater than one. The terminology used is shown in table 4.1.[68]

Absolute value of $e_{Q,P}$ at a point	Terminology curve at this point
$\|e_{Q,P}\| > 1$	Elastic
$\|e_{Q,P}\| = 1$	Unit elastic
$\|e_{Q,P}\| < 1$	Inelastic

Table 4.1 Terminology for a demand curve to distinguish values of $e_{Q,P}$
(Nicholson W (1998), p191)

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[63] Nicholson W (1998), Microeconomic theory, p189
[64] Parkin M, Powell M, Mattews K (2003), Economics p74
[65] Parkin M, Powell M, Mattews K (2003), Economics p75
[66] Nicholson W (1998), Microeconomic theory, p190
[67] Parkin M, Powell M, Mattews K (2003), Economics, p75
[68] Nicholson W (1998), Microeconomic theory, p191

For an elastic curve a price increase implies by a more than proportional quantity decrease, or increase if $e_{Q,P}>1$, which indicates that price has a great affect on demand. If the demand curve is unit elastic the increase in price and quantity are of identical proportional magnitudes. An inelastic demand curve is less responsive to price changes than the elastic and unit elastic demand curves.[69]

4.3.2 Income elasticity of demand

Price is not the only variable that affects the demand for a particular good. The income levels vary in business cycles and have an impact on the public purchasing power and demand. The income elasticity of demand, $e_{Q,I}$, is a measure of the responsiveness of demand to a change in income, when all other variables remain the same.[70]

Income elasticity of demand $=$ $\dfrac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$

$$e_{Q,I} = \frac{\Delta Q / Q}{\Delta I / I} \rightarrow \frac{\partial Q}{\partial I} * \frac{I}{Q} \quad \text{when } \Delta \rightarrow 0$$

The values of $e_{Q,I}$ can be positive or negative and can be categorized into three ranges shown in table 4.2.

Value of $e_{I,P}$	Good classification
$e_{Q,I} > 1$	Normal good, income elastic
$0< e_{Q,I} <1$	Normal good, income inelastic
$e_{Q,I} < 0$	Inferior good

Table 4.2 Terminology to distinguish values of $e_{Q,I}$
(Parkin M, Powell M & Mattews K (2003),p80f)

[69] Nicholson W (1998), Microeconomic theory, p190-191
[70] Parkin M, Powell M & Mattews K (2003), Economics, p80

4.3.3 Cross-price elasticity of demand

Cross elasticity of demand measures the responsiveness of demand for one good to a change in the price for another good, *P'*. It captures the change in demand that occurs if a substitute or complement good rises or falls in price.[71]

Cross price elasticity of demand = Percentage change in quantity demanded
                                                    Percentage change in price of related good

$$e_{Q,P'} = \frac{\Delta Q / Q}{\Delta P' / P'} \rightarrow \frac{\partial Q}{\partial P'} * \frac{P'}{Q} \quad \text{when } \Delta \rightarrow 0$$

4.4 Price elasticity and different demand curves

In this section the reader will get an overview of the implications different demand curves have on the properties of the corresponding price elasticity of demand.

4.4.1 Elasticity along a straight-line demand curve

The simplest form of recording the relationship between quantity demanded *Q*, the price of the good *P*, income *I* and the price of other goods *P'* is by means of a linear function of the form:[72]

$$Q = a + bP + cI + dP'$$

where *a, b, c* and *d* are parameters.

It is important to distinguish elasticity from the slope of the demand curve although they are related. Along a linear demand curve the derivative $\partial Q / \partial P$, the slope, is constant. For example if $\partial Q / \partial P$ equals –3 that would imply that a rise in price with one dollar always decreases demand with three units. The price elasticity is therefore a constant, *b*, times *P/Q* and obviously varies along a linear demand curve. Demand is unit elastic at the midpoint of the demand curve, elastic above the midpoint and inelastic below, which is illustrated in figure 4.2.[73]

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[71]Parkin M, Powell M & Mattews K (2003), Economics, p87
[72]Nicholson W (1998), Microeconomic theory, p198
[73]Parkin M, Powell M & Mattews K (2003), Economics, p76

Quantity
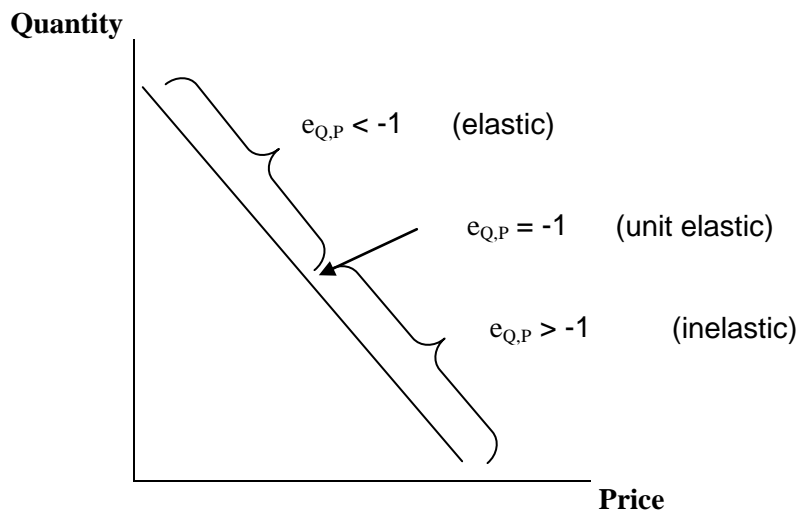
Figure 4.2 Elasticity along a straight-line demand curve (Nicholson W (1998), p199)

4.4.2 Elasticity along an exponential demand curve

The exponential demand curve also implies certain properties on the price elasticity of demand. Here the elasticity is constant over a range of prices. The definition for an exponential demand curve is:

$$Q = aP^b I^c P'^d$$

where *a, b, c* and *d* are parameters.

If we are to study the price elasticity, i.e. for particular values of *I* and *P'*, the equation can be written as

$$Q = a'P^b$$

where $a' = a\, I^c P'^d$. The equation can alternatively be written as a linear function in the natural logarithms of Q and P.

$$\ln Q = \ln a' + b \ln P$$

$$e_{Q,P} = \partial Q / \partial P * P / Q = ba'P^{b-1} * P /(a'P^b) = b$$

Hence the parameter *b*, which is the exponent of *P*, is the price elasticity of demand. Note that the price elasticity of demand is constant for an exponential demand curve. In addition exponential demand curves exhibit constant income and cross-price elasticity.

In this case: [74]

$$e_{Q,I} = c$$
$$e_{Q,P'} = d$$

4.5 Data for economic and econometric analysis

The success of any econometric study depends highly on the availability of the appropriate data. There are three types of data that may be available for empirical analysis: time series, cross section and pooled data.[75]

4.5.1 Time series data

A *time series* is a set of observations on the values that a variable takes at different times. Such data may be collected at regular time intervals such as daily, weekly, monthly, quarterly, annually etc. Although time series are frequently used in econometrics they present a special problem. Most empirical work assumes that the underlying time series is stationary, i.e. its mean and variance do not vary systematically over time. An example of such a time series is the temperature measured in Celsius in a specific city during a year. It is stationary because the mean and variance only depend on the month and day the measurement has taken place, not which year. A rising problem is that trends can often be observed out of time series data and hence the series is not stationary.[76]

4.5.2 Cross section data

Cross section data is data on one or more variables collected at the same point in time. An example is sales figures for a company, in different countries. As with time series, cross sectional data have their own problems where heterogeneity often is the biggest issue. Size and scale effects must be taken into account in order to compare data.[77]

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[74] Nicholson (1998), Microeconomic theory, p199-201
[75] Damodar N. Gujarati (2003), Basic econometrics, p26
[76] Damodar N. Gujarati (2003), Basic econometrics, p26
[77] Damodar N. Gujarati (2003), Basic econometrics, p27-28

4.5.3 Pooled data

Pooled or combined data is a combination of both time series and cross sectional data. For example sales data in different countries for several time periods is a set of pooled data.[78]

4.6 The classic linear regression model

Regression analysis is concerned with the study of the dependence of one variable, the dependent variable, on one or more other variables, the explanatory variables. The analysis aims to estimate and/or predict the mean or average value of the dependent variable, **y**, in terms of the known values of the explanatory variables, **X**.[79] The analysis includes estimation of regression coefficients, their standard errors and some of their properties. There exist several regression models whereas the *Classical Linear Regression Model* is the most common. [80] Note that further on in this thesis following notations hold:

- $\mathbf{x_i}$, $\boldsymbol{\beta}$ and **b** are vectors of $1 \times K$ elements.
- **y,** $\mathbf{\hat{y}}$ **,** $\boldsymbol{\varepsilon}$ and **e** are vectors of $n \times 1$ elements.
- **X** is a $n \times K$ matrix.
- **'** denotes the transpose of a vector or matrix.
- x_{ij}, y_i, $\hat{y}_i$, b_i, e_i, ε_i and β_i denote single 1×1 elements from the corresponding matrix and vectors **X**, **y**, $\mathbf{\hat{y}}$, **b**, **e**, $\boldsymbol{\varepsilon}$ and $\boldsymbol{\beta}$**.**

The CLRM assumes a linear relationship between the dependent variable, **y,** and, either the explanatory variables, **X,** or the parameters, $\boldsymbol{\beta}$. Linearity in the variables means that the conditional expectation of **y**, $E(\mathbf{y}|\mathbf{X})$ is a linear function of **X**. In this interpretation the power of the elements in **X** may only be of the order one or zero, in order for the definition of linearity to hold. The second interpretation, linearity in the parameters, implies that the conditional expectation of **y**, $E(\mathbf{y}|\mathbf{X})$ is a linear function of the parameters, the elements in $\boldsymbol{\beta}$. It may or may not be linear in the variable **X**. In this interpretation the population regression function, $E(y|X_i) = \beta_1 + \beta_2 X_i^2$, is a linear regression model.[81] When using the term linearity in this thesis, the authors refer to the linearity in the parameters.

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[78] Damodar N. Gujarati (2003), Basic econometrics, p28
[79] Damodar N. Gujarati (2003), Basic econometrics, p18
[80] Damodar N. Gujarati (2003), Basic econometrics, p42
[81] Damodar N. Gujarati (2003), Basic econometrics, p42

4.6.1 Assumptions of the classical linear regression model

In order to use and to draw conclusions from the CLRM as an econometric model, the following assumptions must hold:

1. *Linearity:* The regression model is linear in the parameters:
   $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}$, $y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \varepsilon_i$

2. *No multicollinearity:* The rank of the n×K data matrix of explanatory variables, $\mathbf{X}$, is *K* with probability 1. *K* is the number of unknown parameters and *n* is the number of observations.

3. *Strict exogeneity:* Given the value of $\mathbf{X}$, the expected value of the random disturbance term ε_i is zero. In other words the conditional mean value of $\boldsymbol{\varepsilon}$ is zero, $E[\varepsilon_i|\mathbf{X}]=0$, $i=1.2….n$

4. *Spherical error variance:* Given the values of $\mathbf{X}$, the variance of ε_i is the same for all observations. This property is also called homoscedasticity. In addition there must be no correlation between observations, that is the conditional variance of ε_i is identical for all $i=1,2….n \Rightarrow Var[\boldsymbol{\varepsilon}|\mathbf{X}]= E[\boldsymbol{\varepsilon}\boldsymbol{\varepsilon}'|\mathbf{X}]=\sigma^2\mathbf{I}$, where $\boldsymbol{\varepsilon}'$ denotes the transpose of $\boldsymbol{\varepsilon}$. [82] That is $Var[\boldsymbol{\varepsilon}|\mathbf{X}]$ is a n×n matrix, in which all diagonal elements equal σ^2 and all other elements equal zero.

5. ***X values are fixed:*** Values taken by the regressor $\mathbf{X}$ are considered fixed in repeated sampling, i.e. $\mathbf{X}$ is a nonstochastic matrix.[83]

6. *Normality of the error term:* $\boldsymbol{\varepsilon}|\mathbf{X}\in N[\mathbf{0},\sigma^2\mathbf{I}]$, given the value of X, the random disturbance term $\boldsymbol{\varepsilon}$ is assumed to be normal distributed with mean zero and variance σ^2. This assumption is optional when solely estimating the parameters.[84]

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[82] Hayashi F (2000), Econometrics. p4-12
[83] Damodar N. Gujarati (2003), Basic econometrics, p66
[84] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p68

4.6.2 The unobserved error term

The error term, also called the random disturbance term, ε, is a surrogate for all those variables that are omitted from the model but collectively affect **y**. A way to reduce the error term is to develop a multiple regression model with as many variables as possible. Despite the decrease this may have on the values of the disturbance term there are several negative reasons to not introduce too many variables explicitly. Some important issues are:

1. *Unavailability of data*: Even if the excluded variables are known and it therefore is possible to develop a multiple regression rather than a simple regression, quantitative information about these variables may not be available. For example it may not be possible to measure trends and cultural preferences.

2. *Core variables versus peripheral variables*: Assume that there are a number of factors except price that affects the demand for a specific product. Such factors could be; sex, nationality, age, geographical region, bad design, bad quality. These factors do affect the demand but it is also possible that the joint influence is so small and at best non-systematic or random that as a practical matter it does not pay to introduce these into the model explicitly. Hopefully their combined effect can be treated as a random variable, ε.

3. *Wrong functional form*: Despite theoretically correct variables and available data, the form of the functional relationship between the regressand and the regressors is most probably not known, i.e. it is not certain that the demand function is a linear or nonlinear function. In two-variable models the functional form of the relationship can often be judged from a so-called scatter gram, but these cannot be visualized in multiple dimensions.[85]

4.6.3 Degrees of freedom

The term degrees of freedom measures the total number of observations in the sample, n, less the number of linear independent constraints present, K. In other words, the number of degrees of freedom, df, is the number of independent observations out of a total of n observations. [86]

 df = number of total observations - number of parameters estimated = n – K

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[85] Damodar N.G (2003), Basic econometrics, p46-47
[86] Damodar N.G (2003), Basic econometrics, p77

4.6.4 The coefficient of determination, R^2

A crucial issue when performing regressions is to evaluate how well the sample regression line fits the data. The objective is not only to obtain the estimated value of β but also to draw interferences about the true β and how close the fitted value of $\mathbf{y}$, $\hat{\mathbf{y}}$, is to the true value of $E(\mathbf{y}\,|\,\mathbf{X})$. If all observations where to lie on the regression line, the regression result would be a perfect fit, i.e $\mathbf{y} = \hat{\mathbf{y}}$. However this is rarely the case and there will in contrary exist both positive and negative residuals, e_i. The hope is that the residuals around the regression line are as small as possible.[87] The coefficient of determination r^2, two-variable case, or R^2, multiple regression, summarizes how well the sample regression line fits the data, i.e. the extent to which the variation in the dependent variable is explained by the variation in the explanatory variables.[88] R^2 takes a value between zero and one and the closer the fitted value tracks the dependent variable, the closer R^2 is to one, which is illustrated in figure 4.3.[89] On the other hand a R^2 of zero indicates that there is no relationship between the regressand and the regressor.[90]

(a) (b) (c) (d)
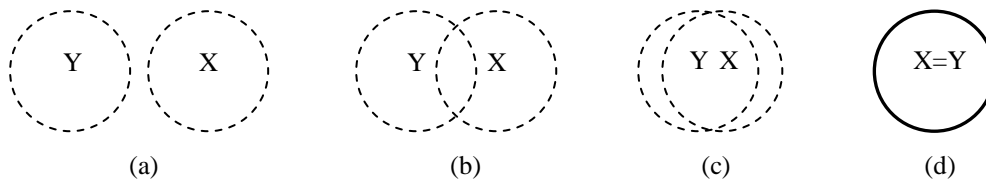
Figure 4.3 The Ballentine view of r^2: (a) $r^2 = 0$ (d) $r^2 = 1$. (Damodar N G (2003), p82)

In order to compare two models on the basis of the coefficient of determination, the sample size, *n*, and the dependent variable must be the same for both models; the explanatory variables may take any form[91]. In addition it must be said that one should not exclusively concentrate on getting a high value on R^2. The objective with a regression analysis is not to obtain a high R^2 per se but to obtain dependable estimates of the true population regression coefficients and draw statistical interference about them and to examine whether if they agree with a priori expectations or not. Therefore the researcher should be more concerned about the logical or theoretical relevance of the explanatory variables to the dependent variable and their statistical significance, instead of trying to solely maximize R^2.[92] The measure is descriptive but by itself it does not measure the quality of the

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[87] Damodar N. G (2003), Basic econometrics, p81
[88] Damodar N. G (2003), Basic econometrics, p81-82
[89] Hayashi F (2000), Econometrics, p20
[90] Damodar N. G (2003), Basic econometrics, p84
[91] Damodar N G (2003), Basic econometrics, p219
[92] Damodar N G (2003), Basic econometrics, p222

regression model.[93] Hence a high R^2 is not complete evidence in favour of a model and a low R^2 is not evidence against it.[94]

4.6.5 The ordinary least squares method

The most common and basic method of estimating the parameters of the linear regression model is called *the Ordinary Least Squares* method.[95] Before defining the method it is relevant to introduce and clarify definitions and notations.

The unknown parameters, β, of the stochastic relation $y_i = x_i'\beta + \varepsilon_i$ are objects of estimation[96]. It is important to distinguish between the "real" population quantities, such as β and ε, and our sample estimates of them, denoted **b** and **e**. Note that:

- The population regression: $E[y_i|x_i] = x_i'\beta$
- Estimate of population regression: $\hat{y} = x_i'b$ where x_i is a vector of $1 \times K$ elements[97]
- The disturbance associated with the *i*th data point is $\varepsilon_i = y_i - \mathbf{x_i}'\boldsymbol{\beta}$
- For any value of **b** we shall estimate ε_i with the residual $e_i = y_i - \mathbf{x_i}'\mathbf{b}$
- By definition: $y_i = \mathbf{x_i}'\boldsymbol{\beta} + \varepsilon_i = \mathbf{x_i}'\mathbf{b} + e_i$ [98]

As described in previous section the population quantity, β, is a vector of unknown parameters of the probability distribution of **y**, whose values are to be estimated with the sample data. The principle or method of least squares chooses the estimator **b** in such a matter such that for a given sample or set of data the sum of squared residuals, $\sum e_i^2$, is minimized. In other words the least square coefficient vector, **b**, minimizes the function:

$$\sum_{i=1}^{n} \varepsilon_{i0}^2 = \sum_{i=1}^{n}(y_i - \mathbf{x_i}'\mathbf{b})^2 = (\mathbf{y} - \mathbf{Xb})'(\mathbf{y} - \mathbf{Xb})$$

where **b** is a hypothetical value of β.[99] Hence the OLS estimate, **b**, minimizes the sum of squared residuals also called the *error sum of squares* (ESS) or the *residual sum of squares* (RSS).[100] By having squared residuals in the objective function this method imposes a heavy penalty on large residuals, which implies that the OLS

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[93] Hill R C, Griffiths W E, Judge G G (2001), Undergraduate econometrics, p124
[94] Damodar N G (2003), Basic Econometrics, p223
[95] Hayashi F (2000), Econometrics, p3
[96] Greene W H. (2000), Econometric Analysis, p22
[97] Greene W H. (2000), Econometric Analysis, p223
[98] Greene W H. (2000), Econometric Analysis, p223
[99] Greene W H. (2000), Econometric Analysis, p224
[100] Damodar N.G (2003), Basic Econometrics, p83

estimate is chosen to prevent large residuals for a few observations at the expense of tolerating relatively small residuals for many other observations.[101]

4.6.5.1 Properties of the OLS estimators

The ordinary least squares estimators (b_1, b_2… b_K) are random variables, since their values depend on the random variable **y** whose values are not known until the sample is collected. Since the least square estimators are random variables they have variances, covariances and probability distributions, which characteristics are of great importance. If the probability distributions are known they can be used to make probability statements about the OLS estimate, **b**. The means and variances of the random variables provide information and spread of their probability distribution and hence about the range of values that b_1, b_2… b_K are likely to take. Knowing this range is valuable since the objective is to obtain estimates that are close to the true parameter values.[102]

4.6.5.2 The expected value

An estimator is said to be unbiased if the expected value of any estimator of a parameter equals the true parameter, that is if $E[b_i] = \beta_i$. A great property for the OLS estimators is that if and only if all statistical model assumptions are correct, all estimators will be unbiased. However if the assumptions made are not correct the estimator may be biased. Thus the importance of having an econometric model that includes all relevant explanatory variables is a must in order for the OLS estimators to be unbiased. The unbiased property does also depend on having many samples from the same population. Just because an estimator is unbiased it does not have to imply anything about what might happen in just one sample. An individual estimate b_i may be near to or far from the real coefficient β_i.[103]

4.6.5.3 The variance and covariance

Given the expected values of the OLS estimators the corresponding variances and covariances may be calculated. The variance of a random variable is the average of squared distances between the value of the random variable and its expected value. Hence,

$$Var(\mathbf{b}) = E[\mathbf{b} - E[\mathbf{b}]]^2$$

The variances for the OLS estimators, **b**, are the diagonal elements in the K×K matrix below:

$$Var(\mathbf{b} \mid \mathbf{X}) = \sigma^2 (\mathbf{X'X})^{-1}$$

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[101] Hayashi F (2000), Econometrics, p15
[102] Hill R C, Griffiths W E, Judge G G (2001), Undergraduate econometrics, p68-70
[103] Damodar N.G (2003), Basic Econometrics, p222-223

In other words element i,i in the covariance matrix $\sigma^2(\mathbf{X'X})^{-1}$ is the variance of the parameter b_i and element i,j stands for the covariance of b_i and b_j, when $i{\neq}j$. The standard deviation is defined as the square root of the variance: [104]

$$Std(\mathbf{b}) = \sqrt{Var(\mathbf{b})}$$

4.6.5.4 The best linear unbiased estimators

A unique and well-used property for the Ordinary Least Square estimators is that under the assumptions in 4.6.1, the OLS estimators have the smallest variance of all linear and unbiased estimators of β. They are the Best Linear Unbiased Estimators (BLUE) of β.[105]

4.6.5.5 The probability distribution

The previously defined properties of the OLS estimators do not depend on the sixth assumption in 4.6.1, i.e. $\varepsilon|\mathbf{X}{\in}N[\mathbf{0},\sigma^2\mathbf{I}]$. If we add this assumption that the random errors are normally distributed with mean zero and variance σ^2, the probability distributions of the OLS estimators will also be normal $\Rightarrow \mathbf{b}|\mathbf{X}{\in}N[\boldsymbol{\beta},\sigma^2\mathbf{I}]$.[106]

4.7 Elasticity and the log-linear model

As discussed in section 4.6, models that are linear in the parameters may or may not be linear in the variables. In this section the authors will consider regression models that are nonlinear in the variables but are linear in the parameters or that can be made so by suitable transformations of the variables. The most relevant regression in this thesis is the log-linear model earlier mentioned in section 4.4.2.

Consider an example of an exponential regression model:

$$y_i = \gamma x_{ij}^{\beta_i} e^{\varepsilon_i}$$

where γ is a parameter. Taking the log of the expression implies:

$$\ln y_i = \ln \gamma + \beta_i \ln x_{ij} + \varepsilon_i$$

The introduction of a new parameter $\alpha{=}\ln \gamma$ implies:

$$\ln y_i = \alpha + \beta_i \ln x_{ij} + \varepsilon_i$$

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[104] Hayashi F (2000), Econometrics, p27-30
[105] Hayashi F (2000), Econometrics, p27-28
[106] Hill R C, Griffiths W E, Judge G G (2001), Undergraduate econometrics, p79

The model is now linear in the parameters α and β_i, i.e. linear in the logarithms of the variables y_i and x_{ij}, and can be estimated by the OLS regression. An important feature of this model is that the slope coefficient β measures the elasticity of y_i with respect to x_{ij}, that is the percentage change in y_i for a given percentage change in x_{ij}. As in section 4.4.2 the elasticity coefficient between y_i and x_{ij} is assumed to remain constant throughout.[107]

4.8 Hypothesis tests

Many economic decision problems require some basis for deciding whether or not a parameter is a specified value, or whether it is positive or negative[108]. In this section the authors will discuss the *t-distribution*, *p-value* and *significance* in order to perform *hypothesis tests*.

4.8.1 The t-distribution

Since the least squares estimators are linear functions of dependent variables, it follows, as mentioned above, that they are normally distributed, i.e.

$$b_k \in N\big[\beta_k, \mathrm{var}(b_k)\big]$$

By subtracting its mean and dividing by the square root of its variance, the normal random variable b_k is transformed into the standard normal variable z,

$$z = \frac{b_k - \beta_k}{\sqrt{\mathrm{var}(b_k)}} \in N(0,1), \qquad \text{for k = 1,2,…,K}$$

that has the mean zero and a variance of one. The variance of b_k depends on the unknown variance, σ^2, of the error term, b_k-β_k. If σ^2 is replaced by its estimator $\hat{\sigma}^2$, i.e. var(b_k) is replaced by vâr (b_k), the *t* random variable is obtained instead of the normal variable. That is,

$$t = \frac{b_k - \beta_k}{\sqrt{\mathrm{v\hat{a}r}(b_k)}} \in t_{(n-K)}$$

where *n–K* is the number of degrees of freedom for the *t*-statistics.

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[107] Damodar N.G (2003), Basic Econometrics, p176-177
[108] Hill R C, Griffiths W E, Judge G G (2001), Undergraduate econometrics, p98-99

The t random variable can also be expressed as

$$t = \frac{b_k - \beta_k}{std(b_k)} \in t_{(n-K)}$$

since the square root of the variance estimator vâr(b_k) is called the standard error of b_k, std(b_k).[109]

4.8.2 Interval estimation

Interval estimates of unknown parameters are based on the probability statement that

$$P(-t_c \leq t \leq t_c) = 1 - \alpha$$

or

$$P\left(-t_c \leq \frac{b_k - \beta_k}{std(b_k)} \leq t_c\right) = 1 - \alpha$$

where t_c is the critical value for the t-distribution. This critical value is dependent on α and the degrees of freedom. The different values of t_c can be looked up in statistical tables, for example in referred literature. [110]
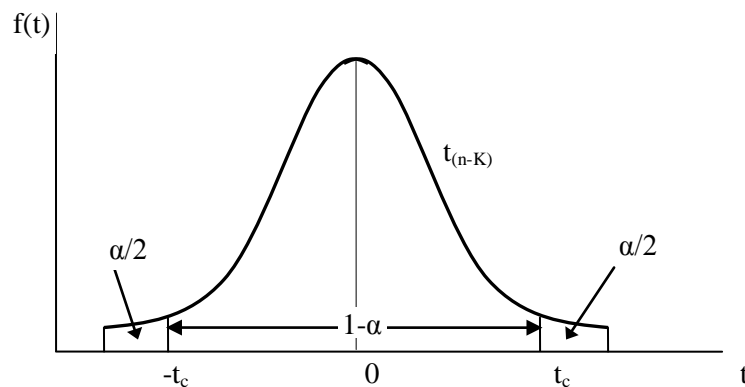
Figure 4.4 Critical values from a t-distribution
(Hill R C, Griffiths W E, Judge G G (2001), p95)

In figure 4.4 the values t_c and $-t_c$ are depicted. Each of the "tail areas" contains $\alpha/2$ of the probability, that the absolute value of t is greater than t_c.[111]

[109] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p156-157
[110] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p157-158

Rearranging the probability statement the following expression is obtained

$$P\left[b_k - t_c se(b_k) \leq \beta_k \leq b_k + t_c se(b_2)\right] = 1 - \alpha$$

This means that the interval $b_2 \pm t_c$ se(b_2) has the probability of 1 - α of containing the true, but unknown, parameter β_2. [112]

The interval end points,

$$\left[b_k - t_c std(b_k), b_k + t_c std(b_k)\right]$$

define a 100(1 - α)% confidence interval estimator of β_k. [113]

4.8.3 Hypothesis testing

Hypothesis testing procedures compare a conjecture about a population to the information contained in a sample of data. In other words, the conjectures tested concern the unknown parameters of the economic model. In every hypothesis test there must be:

1. A *null* hypothesis, H_0
2. An *alternative* hypothesis, H_1
3. A test *statistic*
4. A *rejection* region[114]

The null hypothesis, denoted H_0, specifies a value for a parameter. Hypothesis of the form H_0: $\beta_k = c$ versus H_1: $\beta_k \neq c$, where c is a specified constant, are called *two-tailed tests.*[115] The null hypothesis is the belief that will be maintained until there are enough evidence that it is not true, in which case the null hypothesis is rejected. The alternative hypothesis, H_1 will be accepted if the null hypothesis is rejected. H_1 must contain all the possible outcomes that are not included in H_0. [116]

The rejection region, depicted in figure 4.5, is the range of values of the test statistic, *t,* that leads to rejection of the null hypothesis. In practise, the rejection region is a set of test statistic values that, when the null hypothesis is true, are unlikely and have low probability of occurring. The probability of obtaining a sample value of test statistic that falls in either tail area is therefore small and,

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[111] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p90-98
[112] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p90-98
[113] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p158
[114] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p99
[115] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p159
[116] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p98-110

combined, is equal to α. Sample values of the test statistic that are in the tail areas are incompatible with the null hypothesis and are evidence against the null hypothesis being true.

On the other hand, if the null hypothesise H_0: β_k = c is true, then the probability of obtaining a value of the test statistic t in the central nonrejection region $P(-t_c \leq t \leq t_c) = 1 - \alpha$, is high. This is shown in figure 4.5. Sample values of the test statistic in the central non rejection area are compatible with the null hypothesis, but are not enough evidence for the null hypothesis being true. Therefore, if the value of the test statistic falls between the critical values $-t_c$ and t_c, in the nonrejection region, we *do not reject* the null hypothesis.[117]
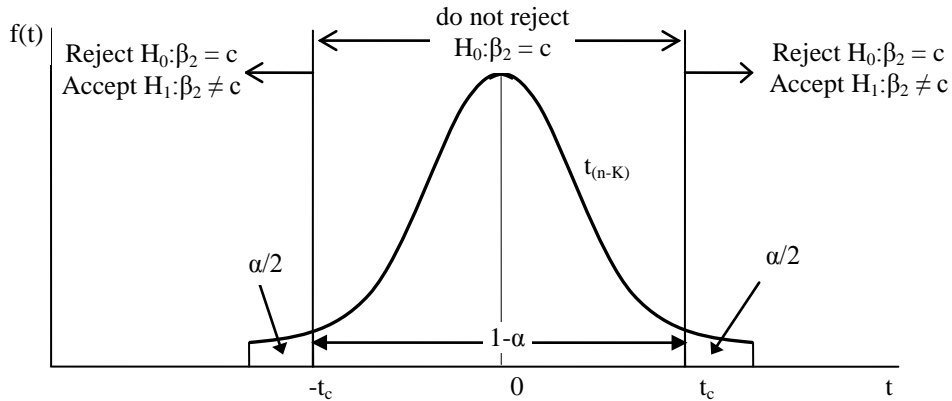
Figure 4.5 Rejection region for a test of H_0:β_2 = c against H_1:$\beta_2 \neq$ c
(Hill R C, Griffiths W E, Judge G G (2001), p102)

4.8.3.1 Test of significance
One important hypothesis is H_0: β_k = 0. The hypothesis states if the independent variable has no effect upon the dependent variable and are called tests of significance. If the hypothesis is rejected it implies that there is a "statistically significant" relationship between the dependent and the independent variable. It should also be mentioned that "statistically significant" do not necessarily imply "economically significant".[118]

To carry out the significance test the following formula is used

$$t = \frac{b_k - \beta_k}{std(b_k)} \in t_{(n-K)}$$

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[117] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p101
[118] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p105

Which if the null hypothesis is true, i.e. $\beta_k = 0$, is

$$t = \frac{b_k}{std(b_k)} \in t_{(n-K)}$$

Thus the null hypothesis is rejected if $|t| \geq t_c$.[119]

4.8.3.2 The p-value of a hypothesis test

When reporting the statistical hypothesis tests, it is common to report the *p*-value. The *p*-value of a test is calculated by finding the probability that a *t*-distribution can take a value greater than or equal to the absolute value of the sample test statistic. When the *p*-value of a hypothesis test is smaller than the chosen value of α, the null hypothesis should be rejected. Conversely, if the *p*-value is greater than or equal to α, we do not reject the null hypothesis.[120] I.e. do reject the null hypothesis if

$$P\left(\left|t_{(n-K)}\right| \geq t\right) < \alpha$$

and the tested variable is then significant.

Figure 4.6 makes clear why the rule reject H_0 if $p \leq \alpha$ gives the same result as the *t*-test.
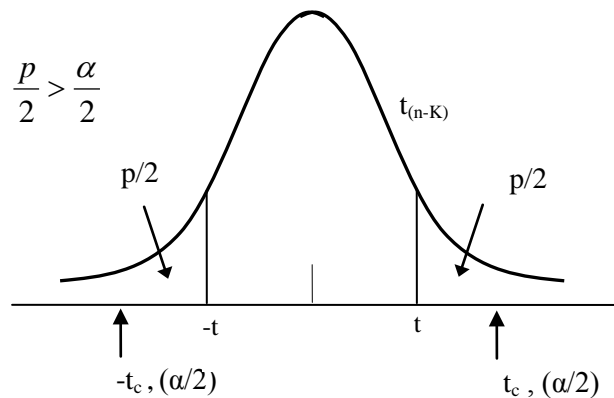
Figure 4.6 The *p*-Value for a two tailed test
(Hill R C, Griffiths W E, Judge G G (2001), p105)

When $p < \alpha$, the value of the *t*-statistic must fall in the rejection region. When $p > \alpha$, the value of the test statistic falls in the non-rejection region.[121]

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[119] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p159-160
[120] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p104
[121] Hill R C, Griffiths W E, Judge G G (2000), Undergraduate Econometrics, p104-105

4.9 Macroeconomic factors

4.9.1 Gross national income

A country's gross national income, GNI, also called gross national product, GNP, is the value of all final goods and services produced by its factors of production and sold on the market in a given time period.[122] Since the total value of the goods and services produced must equal the total income paid to the factors that produced these goods and services, GNP=GNI. GNI is calculated by adding up the market value of all expenditures on final output and is often used as a measure of people's welfare.[123]

4.9.2 Big Mac index

Indices based on the theory of purchasing power parity, PPP, are used as a guide to determine whether if currencies are at their "correct" level. In the long run countries exchange rates should move towards rates that would equalise the prices of an identical basket of goods and services. In the Big Mac index the basket is a McDonald's Big Mac, which is produced in 120 different countries. The Big Mac PPP is the exchange rate that would leave hamburgers costing the same in USA as elsewhere. Comparing these with actual rates indicates if a currency is under- or overvalued. The Big Mac index is composed and published by the newspaper, THE ECONOMIST.[124]

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[122]Krugman P, Obstfeld (2003), International Economics Theory and Policy, p295f
[123] www.fact-index.com, Measures of National Income and Output, 2004-11-07
[124] www.licenseenews.com, Big Mac Currencies, 2004-10-07

5. Design of model

The aim with this chapter is to describe relevant data, regressors and a proper demand curve in order to define a regression model to estimate the price elasticity for BA10's products.

5.1 Pooled data

The access to historical sales data, has been a necessary tool in this thesis. The data includes both time series and cross-sectional observations and is therefore by definition a set of pooled data. The authors chose to study still existing products with a minimum sales history of one financial year, in countries with non-franchising IKEA stores. The sales period chosen is FY2000-2004, i.e. five years, and the average number of selected countries during this period is 20.[125] The presence of heterogeneity among countries has been taken into consideration and has affected the choice of plausible regressors. Further the authors have assumed, based on interviews with their supervisors, that seasonal trend for the demand of BA10 products is not significant and may therefore be disregarded. In addition the quantity demanded is assumed to equal the sales volume.

5.2 Demand curve

Regressions based on historical sales data, formed the base for assumptions about the hypothetical demand curve for individual articles with a sales history above 12 months. Underlying data for the regressions were of both time series and cross-sectional character for individual IKEA icon products. The cross-sectional data sets were not reliable until scaling effects, in order to eliminate heterogeneity among countries, had been taking under consideration.

Results, based on OLS regression analysis of various BA10 products, indicated that the exponential relationship between the price of a product, *P,* and the quantity demanded, *Q,* was most efficient in illustrating demand and hence the following exponential demand model was chosen:

$$Q = a' P^{\beta_1}$$

where a' stands for all other factors, but price, that affect the quantity demanded of a good. The equation can alternatively be written as

$$\ln Q = \ln a' + \beta_1 \ln P$$

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[125] Sales Database, BA10, IoS, FY2000-2004

Since both the dependent variable, $\ln Q$, and the regressor, $\ln P$, are natural logarithms, the function is log-linear. As a consequence the price elasticity is a constant, β_1, and indicates the percentage change in quantity demanded when the price is altered with one percentage.

The authors evaluated the reliability of different models based on the coefficient of determination, R^2, and corresponding t-tests. In addition the authors assessed whether if the estimated value of the price elasticity, b_1, agreed with a priori expectations. Results obtained when applying the initial model at the product *BITS grey*, a magnetic noteboard, solely based on historical time series data in Germany are displayed in table 5.1. Note the low number of degrees of freedom, df.

Statistics	**BITS Germany, 2000-2004**
R^2	0,907
Price elasticity, b_1	-1.1557
t-stat, b_1	-5,4191
p-value, b_1	0,0123
df	4

Table 5.1 Output summary, *BITS grey*. Time series data, DE

5.3 Regressors and parameters

The next step was to identify relevant factors included in a', with the aim to deduct heterogeneity among countries. The issue was to find the measurable factors, in a specific country i year j, that affect the exponential demand curve. After several testing procedures Gross National Income, percentage share of BA10 and number of stores, at a country level, were chosen as the three main factors that together with the price affect the sales quantity. These factors will further on be referred to as *GNI, ShOfBa10, NbrOfStrs* and *P* in the mathematical expressions. In the text they will be denoted as *GNI*, *Share of BA10*, *Nbr of Stores* and *Price*. The definition of *Share of BA10* is illustrated below, where n denotes the total number of non-franchising IKEA represented countries in year j.

$$ShOfBa10_{i,j} = TurnoverBa10_{i,j} / \sum_{i=1}^{n} TurnoverBa10_{i,j}$$

Further analysis and justification of chosen regressors can be found in section 8.1.2. The number of regressors had to be limited in order to maintain a reasonable level of degrees of freedom. Hence the final model, illustrating the demand $Q_{i,j}$ for a specific product in country i year j, is:

$$Q_{i,j} = \gamma * P_{i,j}^{\beta_1} * GNI_{i,j}^{\beta_2} * ShOfBa10_{i,j}^{\beta_3} * NbrOfStrs_{i,j}^{\beta_4} * e^{\varepsilon_{i,j}}$$

where $\varepsilon_{i,j}$ is the error term.

Taking logs and replacing ln γ with δ will result in the log-linear function:

$$\ln Q_{i,j} = \delta + \beta_1 \ln P_{i,j} + \beta_2 \ln GNI_{i,j} + \beta_3 \ln ShOfBa10_{i,j} + \beta_4 \ln NbrOfStrs_{i,j} + \varepsilon_{i,j}$$

in which the natural logarithms of $P_{i,j}$, $GNI_{i,j}$, $ShOfBa10_{i,j}$ and $NbrOfStrs_{i,j}$ denote the regressors and the corresponding parameters are β_1, β_2, β_3 and β_4. All other factors that affect $Q_{i,j}$ are represented in $\varepsilon_{i,j}$, the error term. Examples of such factors are differences in cultural values, demographics and customers' expectations of future prices. In addition the sales quantities might be affected by differences in marketing, merchandising and available substitutes outside IKEA.

5.3.1 Derivation of the model's price elasticity

The calculation of the price elasticity for the specific model in this thesis can be performed by combining the expression for the quantity demanded:

$$Q_{i,j} = \gamma * P_{i,j}^{\beta_1} * GNI_{i,j}^{\beta_2} * ShareOfBa10_{i,j}^{\beta_3} * NbrOfStrs_{i,j}^{\beta_3}$$

with the definition for price elasticity:

$$e_{p,q} = \partial Q/\partial P * P/Q$$

The derivative of Q with respect to P equals:

$$\partial Q / \partial P = \beta_1 * \gamma * P_{i,j}^{\beta_1 - 1} * GNI_{i,j}^{\beta_2} * ShareOfBa10_{i,j}^{\beta_3} * NbrOfStrs_{i,j}^{\beta_4}$$

In next step this expression is multiplied with P and divided with Q and the following result of the price elasticity is received:

$$e_{p,q} = \partial Q/\partial P * P/Q = \beta_1$$

Hence the price elasticity for the model equals the parameter for *Price*, β_1. With similar calculations the elasticities for *GNI*, *Share of Ba10* and *Nbr of Stores* can be calculated. As a consequence respective elasticity equals the corresponding parameter β_2, β_3 and β_4. The elasticity with respect to *GNI*, β_2, corresponds to the income elasticity in this thesis.

5.4 Justification of ordinary least square

To justify the use of the least squares regression method, the regressors have to be defined in such matter that they are consistent with the basic assumptions for OLS in section 4.6.1. Note that from now on **X** is the matrix of the explanatory variables, *Price*, *GNI*, *Share of BA10*, *Nbr of Stores* for country *i* and year *j*.

By definition the model is linear in the parameters. Furthermore the number of observations, *n*, will always exceed the number of unknown parameters, *K,* and since there should be no reason to expect that the regressors are perfectly multicollinear, the assumption of *no multicollinearity* is satisfied. In verifying the assumption of strict exogeneity the authors have, as most econometricians do when treating cross-sectional data, assumed that the regressors that correspond to country *c* are independent of the error term for country *d* when *c≠d,* for every year *j.* [126]

The authors have assumed that the joint influence of all factors that together form the variable *ε* is so small and that their combined effect can be treated as a random variable, with mean zero. As a result the random vector, *ε,* is independent of the regressors. Since the error term is composed by several unmeasurable factors the characteristic of its variance matrix, $Var[\varepsilon|\mathbf{X}] = E[\varepsilon\varepsilon'|\mathbf{X}]$, is difficult to establish. If the random error term is independent of corresponding year and country, for which the observation took place, the assumption of homoscedasticity would be satisfied. From now on the authors have assumed spherical error variance, homoscedasticity.

In addition the matrix of regressors, represented by a set of pooled historical data, is nonstochastic. Hence all assumptions necessary for using OLS are satisfied and the obtained regressors are therefore the best linear unbiased estimators, BLUE.

5.5 The regression model as a black box

The regression model in this thesis resembles a black box in which unspecified calculations are performed. The input factors are the explanatory variables *Price, GNI, Share of BA10* and *Nbr of Stores* as well as the economic signal, the sales volume, *Q.* The black box represents the OLS regression, which estimates the unknown parameters $\beta_1, \beta_2, \beta_3,$ and β_4, also referred to as the elasticities with respect to *Price, GNI, Share of BA10* and *Nbr of Stores*. Regression and calculations in the black box will result in the output statistics which among others consists of the estimators, denoted b_1, b_2, b_3 and b_4, *p*-values and the coefficient of determination. The error term represents all other factors' effect on the sales volume and implies an uncertainty in the estimated parameters, since the model may not be optimal in illustrating the demand for BA10's products. The connections between the black box, the input and the output variables in this thesis are illustrated in figure 5.1. Note that the figure is a modified version of a theoretical model, published in the

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[126] Hayashi F (2000), Econometrics, p64

textbook *Undergraduate Econometrics*, written by Hill R C, Griffiths W E and Judge G G.
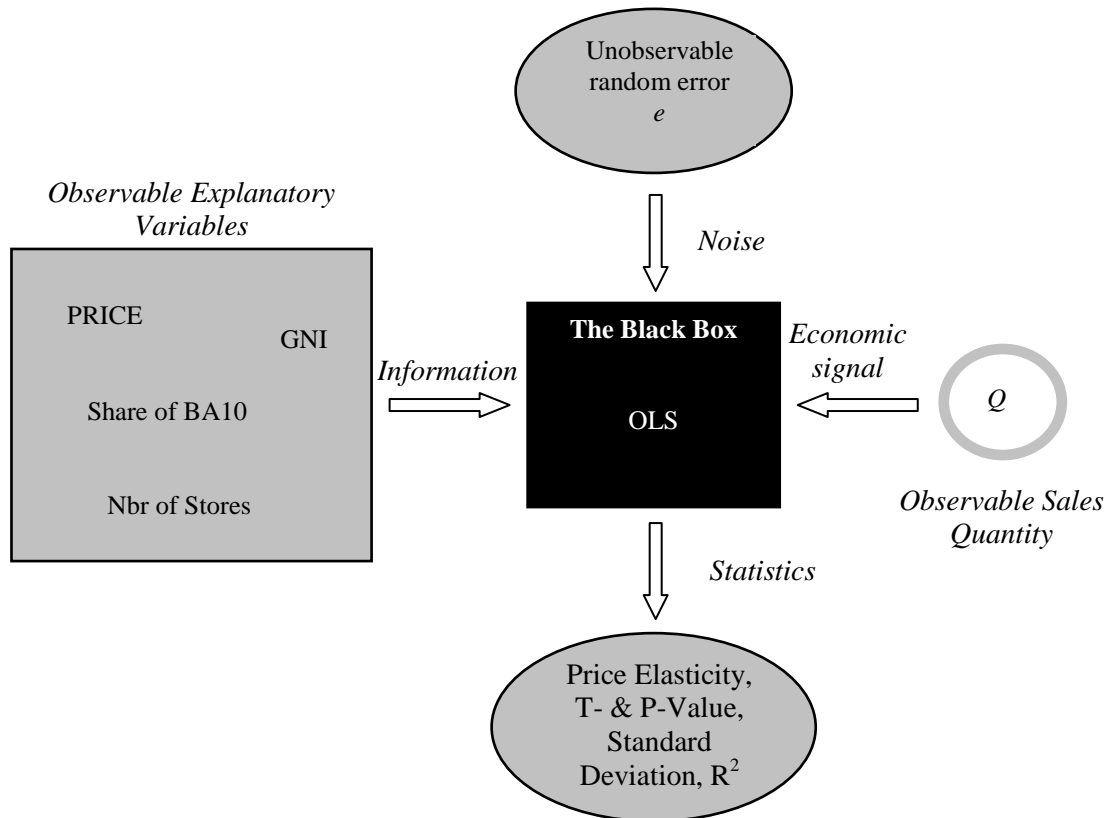
Figure 5.1 The regression model as a black box
(Inspiration: Hill R C, Griffiths W E, Judge G G
(2001), p6)

5.6 Substitutes

Effects caused by present substitutes were taken into consideration for a chosen group of BA10 icon products. The natural logarithm of the price of the substitute was added as an additional regressor in the model. The results for *BITS grey* are displayed in table 5.2 below. Originally the notice board was only manufactured in grey, but a white version was introduced FY 2003. The cross price elasticity indicates the percentage change in quantity demanded of *BITS grey* when the price of *BITS white* increases by one percentage.

Statistics	Regression without substitute	Regression with Substitute
R^2	0.81193	0.83203
Price elasticity, b_1	-1.14587	-0.37350
t-stat, b_1	-4.01213	-1.05650
p-value, b_1	0.00011	0.29335
Cross price elasticity, b_5	-	0.36168
t-stat, b_5	-	3.40729
p-value, b_5	-	0.00095
df	98	97

Table 5.2 Output summary, *BITS grey,* with and without substitute

Including substitutes in the regression had a significant impact on the price elasticity, the *t*-value and the *p*-value. Despite this, the authors chose not to include substitutes in any further regression analysis. The decision was taken after discovering that the presence of substitutes will lead to invalid results. The relationship between all regressors must be nonlinear, in order to justify the OLS method. The prices of two substitutes within BA10 are highly correlated and their relationship is close to linear. Hence the prices can not be used simultaneously as regressors when applying the OLS method.

6. Practical approach

The final model, described in previous chapter, will here be applied to a selection of articles within BA10. Performing the regression manually, for one article at the time, is time consuming. In addition the authors want to ensure high reliability in this thesis, by eliminating mistakes caused by the human factor. Therefore the authors will, in this chapter, describe how they created a program that performs all calculations automatically.

6.1 Preparations

6.1.1 Historical sales data

In an early stage of the project the authors received historical sales data for each product within the BA10 range. This data, received in Microsoft Access, is specified in table 6.1.

DATA	DESCRIPTION OF DATA
RangeName	Name of product family
Name	Name of article
ArticleNumber	Article number
PRA	Product range area
PA	Product area
Style	Style category
Price	Price category
SumOfSale-Qty	Number of articles sold in respective country and year
SalesEUR	Sales in Euro in respective country and year
FY	Financial year
StartDateSale	Date when the article was launched
EndSateSale	If the article is out of range, the last sale date is displayed
RecSalesPrice	Sales price recommended from BA10, IoS
RU	Country
ComClass	Commercial Class

Tabel 6.1 The different data included in the database received from IKEA
(Sales Database, BA10, IoS, FY2000-2004)

Every year 20 percent of the products in the IKEA range are exchanged.[127] Sales data older than five years was therefore not included in the database, in order to minimize the amount of data to a manageable quantity. Furthermore the authors disregarded products no longer in the range. The authors found that new products are not interesting to analyse because of the very short time horizon of accessible data, and therefore chose to exclude products with a start of sale date later than 2003-09-01. Since the original data was received in Microsoft Access the above described restrictions were implemented by dedicating different criteria, as queries, for begin and end of sales date.

6.1.1.1 Product classification

IKEA has chosen to divide their products into product range areas, PRAs. This classification describes the function of the product. Next to the PRA name all products also have a PA classification which is a more detailed description of the function of the product. In addition to the name each PRA and PA is dedicated a number. The most detailed description of the product is then the article number which comes along with the name of the article.[128] The PRA and PA classifications for BA10 are depicted in table 6.2.

PRODUCT RANGE AREA		PRODUCT AREA	
105	Systems & Units	1051	Systems
		1052	Shelf Bar
		1053	Racks & Stands
106	Small Storage	1061	Boxes & Drawers
		1062	Bins & Bags
		1063	Clothes Organisers
		1064	Work & Media Organisers
		1065	Home Communication & Clocks
107	Home Care & Maintenance	1071	Clothes Care
		1072	Treatment & Organising Accessories

Table 6.2 PRA and PA classification within BA10
(Sales Database, BA10, IoS, FY2000-2004)

6.1.1.2 Commercial class

The queries in Microsoft Access were further used when combining different databases. Since IKEA's product classification, the commercial classes, where stated in separate databases they had to be linked with the main database with a query. The authors got access to four different databases of commercial classes for the FY 2001-2004. Note that the commercial classes for FY 2000 are missing. The different commercial classes at IKEA are *Bas*, *Extra* and *Utg*. Those articles that are sold at every IKEA store are called *Bas*. There are some articles, which individual stores can choose to include in their range or not. These articles are

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[127] Bergstrand Henrik, 2004-09-10
[128] Bergstrand Henrik, 2004-09-10

assigned the commercial class *Extra*. If a product is said to be *Utg*, it will be out of range next coming financial year.[129]

The commercial class can differ from year to year which then, with high probability, yields high fluctuations in sales volumes. Hence the authors found it important to examine if the commercial classes, for each article studied, had been the same during the FY 2001-2004. Since the commercial classes for FY 2000 are missing this must be taken into consideration when analysing the reliability of the regression results.

6.1.2 Choice of program

The choice of software program, in which the regression should be performed, was an important issue. Even though both authors have good knowledge about programming in Matlab there are some advantages with using Microsoft Excel. Handling a big amount of data in Microsoft Excel makes sense since there is a good connection with Microsoft Access. In addition Microsoft Excel is frequently used by the employees at BA10 and it would therefore be easier to implement the outcome of this project. Even if the programming facilities in Matlab were more convenient to the authors, the possibility to design and use Macros in Microsoft Excel had to be considered. All the functions, the authors wanted to use in this project, are available in Microsoft Excel. After considering advantages and disadvantages the authors therefore decided to utilize Microsoft Excel when building their program.

The Macro function in Microsoft Excel can be compared with a tape recorder. After pressing the record button, the computer records every click that is made on the screen. By assigning the Macro to a button this sequence can then be played over and over again. The information in the Macros is saved in Microsoft Visual Basic code, which can be viewed in the Visual Basic editor. This code is therefore easy to increase and modify, in order to make it fit perfectly for the purpose.

Since none of the authors, at this time, had any knowledge about programming in Visual Basic some time had to be spent on learning the basic features of the language.

6.1.3 Variables

As described in section 5.3 the authors have, in addition to the *Price,* decided to include the variables *GNI, Share of BA10* and *Nbr of Stores* in the regression. *Share of BA10* can be calculated from the data received from IKEA, by dividing the BA10 turnover in each country and year with the total BA10 turnover for respective year. The gross national incomes for 2000-2004 were found on the

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[129] Bergstrand Henrik, 2004-11-02

internet at the World Development Indicators database, published by the World Bank. The information concerning the number of stores in each country was received from IoS. The values of these three variables were then added into separate worksheets in Excel. The corresponding tables are shown in table appendix II. In addition all countries included in the study with notations are declared in appendix I.

6.2 Construction of the program

Before recording feasible Macros the authors formulated what the program should accomplish.

6.2.1 Subroutines

1. When entering an article number in Microsoft Excel a connection to Microsoft Access collects the start of sale date for that product.

2. When knowing the start of sale date, it must be investigated if the article has a commercial class for each of the four years. The commercial classes, together with other needed information, are then received from Microsoft Access.

3. The program will thereafter check whether if the commercial class has been unchanged during the years of the regression.

4. Calculating the price in respective country and year.

5. Depending on country and year the values of *Share of BA10*, *GNI* and *Nbr of Stores* were inserted.

6. Since the demand curve is assumed to be log-linear the program has to calculate the logs of *Sum of Sale-Qty, Price, Share of BA10, GNI* and *Nbr of Stores.*

7. The regression shall be performed.

6.2.2 Procedures when constructing the subroutines

Though using Macros is an efficient and easy way to construct a program, all subroutines had to be carefully considered. Note that the numbers below relate to the subroutines in section 6.2.1 and the corresponding Visual basic code can be found in appendix III

1. Visual Basic has a function for creating an input box where the article number could be entered. The data needed from Microsoft Access was then received by recording a Macro, which inserted external data into Microsoft Excel. This Macro was then linked with the input box.

2. The authors had some problems with getting the data about different commercial classes correct. As described in 6.1.1 the information about commercial classes is saved in separate databases. Therefore these databases needed to be linked by the products article number. The problem was that if one article has a start of sale date in financial year 2003 it is not present in the list for commercial classes 2002. This would therefore lead to an unwanted reduction of article numbers.
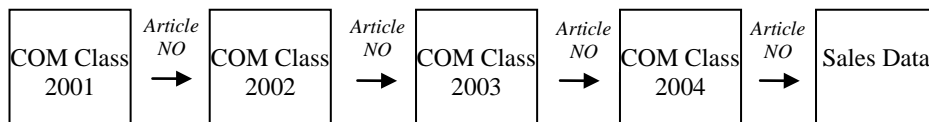
Figure 6.1 The incorrect way of linking *Commercial class* and *Sales Data*

The way of linking the commercial class databases, shown in figure 6.1, where therefore not correct, since it only would yield the articles that are represented in all four commercial class databases. Therefore the authors had to create four different queries, shown in figure 6.2 The program then received the needed data from different queries depending on the start of sale date for the product.

If sales started before September 2000

| COM Class 2001 | → *Article NO* → | COM Class 2002 | → *Article NO* → | COM Class 2003 | → *Article NO* → | COM. Class 2004 | → *Article NO* → | Sales Data |
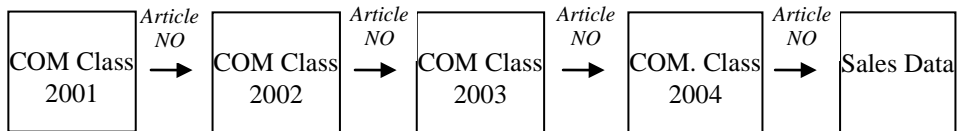
If sales started between September 2001 and September 2002

| | | COM Class 2002 | → *Article NO* → | COM Class 2003 | → *Article NO* → | COM Class 2004 | → *Article NO* → | Sales Data |
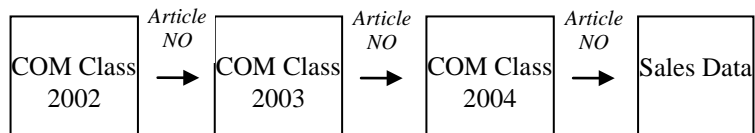
If sales started between September 2002 and September 2003

| | | | | COM Class 2003 | → *Article NO* → | COM Class 2004 | → *Article NO* → | Sales Data |
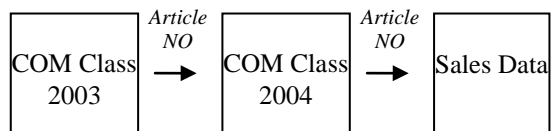
If sales started between September 2003 and September 2004

| | | | | | | COM Class 2004 | → *Article NO* → | Sales Data |
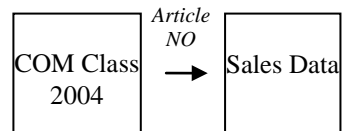
Figure 6.2 The correct way of linking *Commercial Class* and *Sales Data*

3. If the commercial class was unchanged for FY 2001-2004 the commercial class in question was registered. In contrary, if the commercial classes differ between years there will be a notice declaring: "The commercial class has been changed". The products with this feature will be excluded when analysing the regression results in order to increase the reliability of this thesis.

4. The price per article in respective country and year is calculated by dividing *SalesEUR* with *SumOfSale_Qty*.

5. When the values of respective variable were supposed to be looked up in their respective worksheet, Microsoft Excel has a very helpful function called *lookup*. Combining this function with the *if* function the authors where able to solve the task.

6. Taking the logarithm is an easy calculation and did not cause any problems.

7. The regression was performed with the regression function found in the Microsoft Excel toolbox. This function returns all the needed statistics, shown in table 6.3, for this project. When performing the regression the

authors had to find a way to count the number of rows, since non numeric values are non regressionable. The task was solved by using the Visual Basic prepared function, *len*. This function returns the number of characters and this was therefore done until the number returned was equal to zero. By counting the number of loops the authors received the number of rows containing numerical data.

STATISTICS	EXPLANATION
γ	Intercept on y-axis
b_1	Price elasticity
b_2	Elasticity for *ShareOfBA10*
b_3	Elasticity for *GNI*
b_4	Elasticity for *NbrOfStores*
R^2	Coefficient of determination
std b_1	Standard variation for b_1
p-value γ	p-value for intercept
p-value b_1	p-value for price
p-value b_2	p-value for *ShareOfBA10*
p-value b_3	p-value for *GNI*
p-value b_4	p-value for *NbrOfStores*
t-value intercept	t-statistic for intercept
t-value b_1	t-statistic for price
t-value b_2	t-statistic for *ShareOfBA10*
t-value b_3	t-statistic for *GNI*
t-value b_4	t-statistic for *NbrOfStores*
α	Chosen alpha, equal to 0,05
Lower b_1	Lower bound for price elasticity
Upper b_1	Upper bound for price elasticity
Nbr of Obs	Number of observations
df	Degrees of freedom

Table 6.3 Received statistics when performing the regression

6.2.3 Record of information

The worksheet containing all information about the article and the corresponding regression analysis contained a lot of data that was not essential for further analysis. Therefore a new worksheet, which just contained the necessary data was created. Each article that runs through the regression is represented by one row in the new worksheet.

6.2.4 Further adjustments

In order to avoid manual input of selected article numbers the authors adjusted the program so that the regression procedures automatically were performed for chosen products. Hence the program was complete and the authors solely had to press a start button in order to retain the regression results.

The regression was performed for 240 BA10 products. The total number of articles within the BA10 range FY2005 is 376.[130] During the selected time period FY2000-2004 the commercial class had been changed for nine articles. Hence these articles were excluded from the final regression results, which now consisted of data for 231 articles.

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[130] Sales Database, BA10, IoS, FY2000-2004

7. Preparations for the analysis

The purpose with this chapter is to define criteria and test hypothesis, which will form the basis for future analysis. In addition the authors will classify data in order to capture behavioral differences for diverse markets.

7.1 Significance

A preparation for the coming analysis was to determine for which articles, the relationship between the quantity demanded and price is statistically significant. Furthermore the authors chose to analyze the corresponding relationship between quantity demanded and GNI. In this section the authors will first describe how they tested the significance and second present the results, with respect to the price and GNI.

7.1.1 Price and GNI significance

To determine for which articles the price is a significant factor, the authors formed a two-tailed test with the null hypothesis H_0: $\beta_1 = 0$ and H_1: $\beta_1 \neq 0$. As declared in section 4.8.2.1 the parameter β_1 has a significant impact on quantity if the null hypothesis can be rejected. The same hypothesis was formed with respect to GNI, i.e H_0: $\beta_2 = 0$ and H_1: $\beta_2 \neq 0$. The authors chose to set α equal to 15 % when testing the null hypothesis. The hypothesis may therefore be rejected for an article if the corresponding p-value is less than 0,15. The hypothesis was tested for all articles included in the regressions.

7.1.1.1 Results in price significance
The results showed that the null hypothesis, that price has no impact on quantity demanded, could be rejected for 61 % of all products included in the original regression. Notice that this result does not imply that the price has no impact on the quantity demanded for the remaining 39 % of the products, but that the null hypothesis that β_1 equal zero can not be rejected.

7.1.1.2 Results in GNI significance
Of all the products included in the regression the null hypothesis, that GNI has no impact on quantity demanded, could be rejected for 72%. This result implies that for 28% of the products the hypothesis can not be rejected.

7.2 Elasticity

In addition to significance the authors wanted to determine the products' elasticities with respect to price and GNI. Not that the authors will from now on assume that the GNI elasticity equals the income elasticity.

7.2.1 Price elasticity

The value and size of the price elasticity is of great importance, since it indicates the price altering effects on turnover. In this section the authors will first describe the relationship among the price elasticity, turnover and sales volume. Furthermore the authors will formulate a hypothesis, which has to be satisfied in order to define a product as elastic. Finally an overview of the results will be presented.

7.2.1.1 Price elasticity and turnover
A price investment, at IoS, is justifiable if it will lead to an increased turnover, i.e if

$$P_0 * Q_0 < P_1 * Q_1$$

where P_1 and Q_1 are the post altering price and quantity. The definition of the price elasticity of demand implies that the expression alternatively can be written as:

$$P_0 * Q_0 < P_1 * Q_1 = P_0 (1 + \Delta P / P_0) * Q_0 (1 + e_{p,q} * \Delta P / P_0)$$

Consider the following scenario that IoS is to reduce the price of a product with one percentage. A price altering of -1% would imply following restrictions on the price elasticity, in order to increase the turnover:

$$P_0 * Q_0 < P_0 (1 - 0.01) * Q_0 (1 - 0.01 * e_{p,q})$$
$$1 < (1 - 0.01) * (1 - 0.01 * e_{p,q})$$
$$1 < 0.99 + 0.99 * 0.01 * e_{p,q}$$
$$e_{p,q} < -1.010101$$

Hence a price investment with 1% is justified for all products with a price elasticity less than -1,010101. More general, for any price altering, the following condition must hold in order to increase the turnover:

$$- \Delta P / P_0 < \Delta P / P_0 * e_{p,q} * (1 + \Delta P / P_0)$$

If a negative price altering is assumed, i.e. $\Delta P / P_0 < 0$ it follows that:

$$e_{p,q} < -1/(1 + \Delta P / P_0)$$

If the price altering is positive, i.e. $\Delta P / P_0 > 0$ it follows that:

$$e_{p,q} > -1/(1 + \Delta P / P_0)$$

Hence the critical values for the price elasticity, in order to boost the turnover, depend on the relative size of a price altering. Because of the lack of a concrete criterion on the absolute value of the price elasticity, the authors have chosen to modify the theoretical framework in the following section.

7.2.1.2 Price elasticity and sold volume

Theoretically a product is defined as elastic if the absolute value of the corresponding price elasticity is greater than one. Because of IoS's aim to continually lower their prices, the authors chose to identify the products that had a price elasticity, $e_{p,q}$, less than -1. The confidence interval for the estimator $e_{p,q}$ varies among the range of selected products and is at the most 7,64. For that reason the expected value of $e_{p,q}$ was not regarded as a sufficient indicator of the correct price sensitivity. The authors developed arguments in form of the following hypothesizes:

If $P(e_{p,q}<-1)\geq 0.85$, a price investment with x % will lead to an increased sold volume with y %, where $|y|>|x|$

Or statistically:

If $P(e_{p,q}<-1)\geq 0.85$, we can with 85% probability not reject that a price reduction with x% will increase the sold volume with y%, where $|y|>|x|$.

In other words if the probability, that the price elasticity is less than -1, is greater than or equal to 0,85 the product is defined as elastic and a price investment is justifiable. Note that this definition deviates from the theoretical in 4.3.1 since it only considers negative elasticities. The articles with positive price elasticities will be studied separately. Since the OLS estimators, b_1, b_2, b_3 and b_4 are assumed to be normally distributed, the authors applied the cumulative normal distribution when calculating the probabilities.

7.2.1.3 Results of price elasticity

When performing the hypothesis test of elasticity, the hypothesis was satisfied for 81 of the 231 articles (34%) included in the original regression. Out of the products, for which the price was a significant factor, 78 out of 142 articles (55%) were classified as elastic.

7.2.2 Income elasticity

The authors have decided to examine the value of the income elasticity since it indicates how altering in income affect the demand for BA10 articles. As illustrated in table 4.2 an income elasticity greater than zero implies that the product is classified as normal and a negative income elasticity leads to that the product is defined as an inferior good.

7.2.2.1 Results of income elasticity

The regression results show that solely ten products of the 231 included in the original regression has an expected value of an income elasticity less than zero.

7.3 Modification of underlying data set

With the purpose to capture behavioural differences between markets, IoS requested that geographical regions should be analyzed separately. One of the commercial managers at BA10 recommended the following classification of countries within Europe;

- *North;* Denmark, Finland, Norway, Sweden,
- *West;* Belgium, Great Britain, the Netherlands,
- *East;* Czech Republic, Hungary, Poland, Russia, Slovakia
- *Central;* Austria, Germany, Switzerland
- *South:* France, Italy, Spain,

Countries outside Europe were not included in this classification.

After performing the regression, based on data from the different regions declared above, it became clear to the authors that the results obtained were highly unreliable. The coefficient of determination was remarkable lower, than when all IKEA non-franchising countries were included in the underlying data set. In addition the price parameter showed lower significance. The decline in reliability primarily depends on the reduced degrees of freedoms that automatically follow when using less underlying data. Remember that the number of degrees of freedom equals the number of observations less the number of parameters. To retain a high number of degrees of freedom, the authors chose the perform the regression for the group containing following countries;

- *Group West;* Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland

Group West can be defined as all non-franchising IKEA represented European countries excluding those with the most visible differences in culture, industrial development and purchasing behaviour.

Furthermore the authors chose to classify all non-franchising IKEA represented countries with respect to GNI per capita. The level of 17 000 USD/capita was chosen as the separating GNI level. Hence the countries were divided into two groups; those with a GNI per capita greater than 17 000 and those with a GNI per capita less than 17 000.

The aim was to capture different levels of price elasticity between the two groups of countries which were:

- *GNI High;* Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland
- *GNI Low;* China, Czech Republic, Hungary, Poland, Russia, Slovakia, Spain

The program was run with the new regions as underlying data. The results obtained from these regressions will later be compared separately and with the overall results.

8. Analysis

In this chapter the empirical results are analyzed and interpreted with respect to the theoretical framework. Features, results and delimitations of the model will be treated as well as reliability and validity. Finally the authors will comment the price meeting attended.

8.1 Comments on model

When designing the model the authors had to decide on which data and regressors that most effectively would lead to reliable results. In following sections the underlying reasons and implications of these choices will be treated.

8.1.1 Pooled data

As declared in chapter five the relationship between price and quantity is assumed to be exponential in this thesis. In order to use sales data for different financial years and countries, i.e. pooled data, the authors had to consider differences in sales quantities, which were not related to the price of the good. The regressors price, gross national income, number of stores and percentage share of BA10 made it possible to treat all countries as a homogenous market. In other words the differences in sales quantity, which depend on dissimilarities among countries and financial years, should be captured by these factors. For example business cycles, purchasing power and income levels are included in GNI.

The advantage with using pooled data is the high number of degrees of freedom obtained. There are in average 20 numbers of countries, with IKEA non-franchising stores. Therefore the degrees of freedom is in general 20 times greater when using pooled data instead of time series. A disadvantage with pooled data is that there might be other important factors that have such a large impact on demand that their absence in the model will lead to misleading results.

8.1.2 Choice of regressors

An important issue is whether if the chosen regressors, included in the model, are the most optimal variables in order to estimate the price elasticity. Examples of other possible measurable factors that affect the sales volume at IKEA are:

- the Big Mac Index
- IKEA's turnover
- BA10's turnover
- size of IKEA stores (m^2)

These factors were all tested as possible regressors, but were for different reasons not included in the final model. These reasons will be considered below.

The Big Mac index could probably have been useful as a regressor, since it indicates differences in price levels for different countries and years. Unfortunately the Big Mac index accessible at the Economist web page does only display Big Mac prices for a group of 32 countries, in which not all IKEA represented countries were found. Additional values were found at other websites but because of the doubtable validity the authors chose not to include these in the model. The chosen regressor *GNI* will instead capture differences in price levels and consequently purchasing power

The IKEA turnover, as well as the BA10 turnover, in separate countries is a function of sales volume. Therefore these factors could be used to scale for data heterogeneity. The purpose was to capture differences in sales of BA10 products between countries and financial years. Since the BA10 turnover captures these differences more effectively than the IKEA turnover, the latter was neglected as a regressor. Relative measures simplify the possibility to compare figures from year to year. Therefore *Share of Ba10* was preferred as a regressor in front of BA10 turnover though the information captured by the factors is of equal value.

As a further regressor the authors wanted to capture the absolute IKEA growth from year to year. Since the IKEA turnover per country is linear correlated with the regressor *Share of BA10* the factor could not be used as an additional regressor. Therefore *Nbr of Stores* was initially chosen as a regressor with the purpose to measure the IKEA growth. Its appropriateness could be questioned, since not all stores have a comparable yearly turnover. A hypothesis is that the results obtained would become more reliable if the sizes of the stores, in square meters, was measured and included in the model. Therefore the total area of all stores in each country for respectively financial year was added as an additional regressor. The results showed that the regressor was neither significant nor did its presence have a positive effect on the coefficient of determination. Hence, the authors chose not to include the variable in the final model. Instead *Nbr of Stores* was chosen as the single regressor indicating the absolute growth of IKEA.

8.1.3 Reliability

The results' trustworthiness is an important subject. Therefore the authors, in addition to the discussion in section 3.5.5, would like to examine features that may have reduced the reliability of the regression results.

In the sales data received from IoS the commercial class for financial year 2000 was missing. Therefore the authors do not know if any products' commercial class has been changed between the financial years 2000 and 2001. Nevertheless this

lack of commercial class has a negligible effect for the overall results, since only a small amount of products change commercial class each year.

Gross national income, the single external variable included in the model, is based on annual data from the World Bank. Since the calendar year differs from IKEA financial year, the IoS historical sales data and GNI are measured over slightly different periods of time. However the authors have assumed that this feature has not had a significant impact on the reliability of the results.

Performing the regression for each product manually would have implied a low level of reliability in this thesis. Since the authors chose to build a program, which performed the regressions identically, the regression results' reliability is relative high. However the authors do not want to neglect the possibility that they have influenced the reliability of the thesis.

8.2 Analysis of results

The authors chose to analyze the products out of two dimensions; price classification in the price/style matrix and function. First all the products, for which the price is a significant variable, will be studied and second the elasticity among these products will be evaluated. Furthermore the authors will separately analyze the products for which the price elasticity is positive. In addition the income elasticity results will be interpreted.

The first section consists of analysis based on the results obtained when using sales data for all IKEA represented non-franchising countries. Thereafter the authors will analyze the results obtained when performing the regression based on sales data from *Group West, GNI high* and *GNI low*.

8.2.1 Analysis of overall results

8.2.1.1 Patterns within the price ladder

Significance
The 142 articles for which the price was a significant parameter formed the basis when analyzing and evaluating the results. First the authors chose to study how the significance differed among different price groups, i.e. *A, B, C* and *D*. Table 8.1 illustrates how many percentages of the articles in each price group for which the price was significant. The far right column provides data with the total number of articles in each price group that were included in the regression.

PRICE NAME	SIGNIFICANCE, *price*	TOTAL
D	53,57%	28
C	53,42%	73
B	69,70%	99
A	61,29%	31
Total	**61,47%**	**231**

Table 8.1 Percentage of significant products, Price Group classification

The price group *B,* followed by *A*, turned out to have the highest percentage share of price significant products, whereas the prices for products belonging to the price group *C* and *D* were less significant.

The products belonging to price group *A* are much more aggressively merchandised and positioned out in the stores than those belonging to the price group *B*. This may explain why the volume sold of *A*-articles is less responsive to price than those belonging to the price group *B*.

When interpreting the results for the price groups *C* and *D* it is important to remember that quality, design and function are further developed and prioritized for these products than for those in the price groups *A* and *B*. Therefore the price for these products should be less significant than for those in the other two price classes. More surprising is the fact that the price group *D* shows a slightly higher significance that the group *C*. A possible explanation is that the differences in the price ladder for BA10 products is relative vague between *C-* and *D-products*. As a consequence it is sometimes unclear why a product belongs to a specific price group and the price significance should therefore be approximately the same for the two groups.

Elasticity
The next step was to identify the number of articles that were elastic, given price significance. In other words the authors wanted to examine how many of the 142 price significant products for which $P(e_{p,q}<-1)$ was greater than or equal to 0,85. The results for the different price groups are shown in table 8.2. Note that all products that were found elastic were also price significant.

PRICE NAME	ELASTIC, *price*	TOTAL, *significant*
D	53,33%	15
C	43,59%	39
B	56,52%	69
A	73,68%	19
Totalt	**54,93%**	**142**

Table 8.2 Percentage of elastic products given significance, Price Group classification

A high percentage of elastic products within a price group indicates that historical price investments of x% have resulted in an increased sold volume with y %, where |y/>/x/, in a greater extent than for those price groups with a low percentage of elastic products. The table does not specify the absolute value of the price elasticities, other than its expected value is less than -1 with a probability of 85%.

The price group *A* has the highest percentage of elastic products. A price investment would lead to a more than a proportional increase in volume for 74% of the products. The price groups *B* and *D* have a share of elastic products of 57% respectively 53%, whereas the same criterion is only fulfilled for 44% of the products belonging to the price group *C*. Hence, according to the model, products belonging to the price group *C* have been less responsive to price altering than those in the price group *D*. It would have been more realistic and credible if the results would have been the reverse, since the customers price sensitivity should be a decreasing function of the products' design and quality. A possible explanation, also mentioned in the previous section, is that the vague classification of products between the prices groups *C* and *D* may lead to misleading results. Another scenario, that would have caused unexpected results in price sensitivity, would be if BA10 have had more unique and popular products in the price class *C*. The uniqueness and popularity may have made the customers less sensitive to the price. Alternatively BA10 has failed to create high quality and unique design in the price group *D*, which have caused a greater share of price sensitive products than expected.

8.2.1.2 Patterns within PRA and PA

Significance
In table 8.3 the products´ price significance is shown with respect to the PRA and PA structure. As described in section 6.1.1.1 the product range area, PRA, is a classification of the function of the product. The product area, PA, is a more detailed method of grouping the products.

Home Communication & Clocks, *Work & Media Organisers, Clothes Care* and *Racks & Stands* contains a high amount of price significant products. Therefore the authors have chosen to analyze these product areas in this section, though it is difficult to distinguish any clear patterns. In addition the authors will analyze the results obtained for the PA *Treatment & Organising Accessories,* since the PA

contains, in contrary to the earlier mentioned PAs, a low share of price significant products.

PRA	PA	SIGNIFICANCE, *price*	TOTAL
Home Care & Maintenance	Clothes Care	75,00%	4
	Treatment & Organising Accessories	28,57%	14
Home Care & Maintenance Total		*38,89%*	*18*
Small Storage	Bins & Bags	68,75%	16
	Boxes & Drawers	66,00%	50
	Clothes Organisers	55,00%	20
	Home Communication & Clocks	81,48%	27
	Work & Media Organisers	80,00%	20
Small Storage Total		*69,92%*	*133*
Systems & Units	Racks & Stands	100,00%	1
	Shelf Bar	53,13%	32
	Systems	51,06%	47
Systems & Units Total		*52,50%*	*80*
Total		**61,47%**	*231*

Table 8.3 Percentage of significant products, PRA and PA classification

The result, that the price has a significant influence for the sale of *Clocks*, disagreed with a priori expectations. The authors had expected that high importance of design and quality would have implied that the price was a less important parameter. In contrary the results showed that the price of a clock is significant for sold volume.

A possible explanation for the great share of price significant products within the PA *Work & Media Organisers* might be the high level of external competition. In addition the products on the market have similar quality and design and in some cases BA10 and the competitors have contracts with the same suppliers. Therefore the prices for the products belonging to this PA must be carefully considered since they do affect sales volume.

The final two groups that contain a high level of price significant products are the PAs *Clothes Care* and *Racks & Stands*. The results for these PAs are rather unreliable since the total number of articles in each PA is four respectively one. Therefore each product has an immense impact on the results. The *Clothes Care* products have been in the range for a very short amount of time. The small number of degrees of freedom implied low validity in the results. *Racks & Stands* will be disregarded in this analysis, since the PA only contains one product.

A low share of price significant products is found in the PA *Treatment & Organising Accessories,* which primary contains the family *BEHANDLA*. The family´s products are used to prepare and treat different sorts of wood. An

implication of the result would be that once an untreated wooden product is purchased the price of the secondary product *BEHANDLA* is of less importance. That is, the customer is glad to spare a visit to the paint shop.

Elasticity

As displayed in table 8.4 the PA C*lothes Care* contains the highest amount of elastic, given price significant products, 67 %, whereas W*ork & Media Organisers* include the lowest level of elastic products, 38 %. In general the functions' elasticity percentage is scattered around the total average for the whole range. Therefore it is difficult to distinguish any clear patterns. The authors would also like the reader to consider the amount of products included in each PA. A low number of products might lead to ambiguous and unreliable conclusions.

PRA	PA	PRICE, *elastic*	TOTAL, *significant*
Home Care & Maintenance	Clothes Care	66,67%	3
	Treatment & Organising Accessories	50,00%	4
Home Care & Maintenance Total		*57,14%*	*7*
Small Storage	Bins & Bags	63,64%	11
	Boxes & Drawers	57,58%	33
	Clothes Organisers	54,55%	11
	Home Communication & Clocks	63,64%	22
	Work & Media Organisers	37,50%	16
Small Storage Total		*55,91%*	*93*
Systems & Units	Racks & Stands	0,00%	1
	Shelf Bar	41,18%	17
	Systems	62,50%	24
Systems & Units Total		*52,38%*	*42*
Total		**54,93%**	**142**

Table 8.4 Percentage of elastic products given significance, PA and PRA classification

Many clocks satisfied the definition for price elasticity which did not agree with the prior assumption that customers prefer quality, in front of a low price, when purchasing clocks. The assumption was based on the conjecture that low price involves bad quality, which would imply that clocks have a low price sensitivity. An explanation to the unexpected result might be that the authors overestimated the importance of quality. Further, another interpretation might be that IKEA has a good reputation for retailing high quality clocks, which implies that the parameter price becomes a more explanatory factor to changes in sold quantity.

8.2.1.3 Positive price elasticity
In this section the authors will analyse the products that have a positive price elasticity, given price significance. By definition positive price elasticity implies that a raise in price has a positive effect on turnover. Therefore the following hypothesis was formulated:

If $P(e_{p,q}>0)\geq 0.85$, a raise in price will have a positive effect on turnover

The hypothesis was tested for all price significant products and the results are displayed in table 8.5. Solely the articles *Järpen shelf 79×19 white* and *Endel wall upright 90 silver* satisfied the hypothesis. Hence for these products the price has a statistically satisfied impact on demand. Furthermore the quantity demanded is an increasing function of the price.

PRODUCT NAME	STYLE GROUP	PRICE GROUP	$E[e_{p,q}]$
Endel wall upright, 90 silver	Style2	B	0.36
Järpen shelf, 79X19 white	Style2	C	2.51

Table 8.5 Price significant products satisfying $P(e_{p,q}>0)\geq 0.85$

The authors were surprised by the fact that *Järpen shelf 79×19 white* had a positive price elasticity. This result was unexpected since the shelf has been actively prioritized in price investments. When consulting BA10 the authors found out that the positive price elasticity results for *Järpen shelf 79×19 white* and *Endel wall upright 90 silver* may be a consequence of severe supply complications.

8.2.1.4 Analysis of income elasticity results
When analyzing the income elasticity results the authors concluded that none of the articles included in the original regression can be classified as an inferior good. This assumption is based on the fact that the parameter GNI / income was not significant for any of the ten articles, which showed a negative expected value of the income elasticity.

8.2.2 Analysis of results obtained for Group West

8.2.2.1 Patterns within the price ladder

Significance
The results obtained when applying the model to the group of countries, classified as *Group West*, differ from the results obtained when including all countries in the regression. For *Group West* the price was a significant factor for only 104 of the 231 products, i.e 45% compared to previous 61%. This implies that excluding Australia, Canada, China, Czech Repiblic, Hungary, Poland, Russia, Slovakia and USA leads to a lower significance in price, than when including all countries. A possible interpretation could be that the excluding countries are in average more price sensitive than the *Group West* countries. Therefore it is justifiable that BA10 allows lower prices in countries not included in *Group West.*

The patterns identified for significance among different price groups, were the same as in section 8.2.1.1 and are illustrated in table 8.5.

PRICE NAME	SIGNIFICANCE, *price*	TOTAL
D	32,14%	28
C	32,88%	73
B	55,56%	99
A	51,61%	31
Total	**45,00%**	**231**

Table 8.5 Percentage of significant products (Group West), Price Group classification

Elasticity
The elasticity results for *Group West* differed highly from those obtained when studying all countries. The exception was the price group *D*, which still had the largest percentage of elastic products. The price group *C* is the second most elastic price group, followed by the price groups *B* and *D*. The figures can be found in table 8.6.

PRICE NAME	ELASTIC, *price*	TOTAL, *significant*
D	44,44%	9
C	58,33%	24
B	50,91%	55
A	68,75%	16
Total	**54,63%**	**104**

Table 8.6 Percentage of elastic products given significance *(Group West)*,
Price Group classification

8.2.2.2 Patterns within PRA and PA classification

Significance
In this section the authors will compare the price significance patterns for *Group West* and the overall results, from a PRA and PA perspective. The product area *Clothes Care* is less price significant in *Group West*, whereas the *Treatment & Organizing Accessories* are more price significant compared to the overall results. As a consequence the average value of price significance for the product range area *Home Care & Maintenance* is unchanged. For all other product range areas the price significance is lower for *Group West*, than those obtained in section 8.2.1.2. The results might be explained by that *Treatment & Organization Accessories* are facing a higher level of competition in *Group West* than the other PAs, compared to the competition in the excluded countries.

PRA	PA	SIGNIFICANCE, *price*	TOTAL
Home Care & Maintenance	Clothes Care	25,00%	4
	Treatment & Organising Accessories	42,86%	14
Home Care & Maintenance Total		*38,89%*	*18*
Small Storage	Bins & Bags	56,25%	16
	Boxes & Drawers	52,00%	50
	Clothes Organisers	35,00%	20
	Home Communication & Clocks	51,85%	27
	Work & Media Organisers	65,00%	20
Small Storage Total		*51,88%*	*133*
Systems & Units	Racks & Stands	100,00%	1
	Shelf Bar	37,50%	32
	Systems	31,91%	47
Systems & Units Total		*35,00%*	*80*
Total		**45,02%**	**231**

Table 8.7 Percentage of significant products *(Group West)*, PRA and PA classification

Elasticity
The total amount of elastic products, given price significance, is the same for *Group West* as for all non-franchising IKEA countries. Despite this the elasticity patterns for various PAs differ, but has been disregarded since each PA contains few articles. Therefore comparing the results for different PRA is more relevant. The overall conclusion is that the variation in elasticity between *Group West* and all countries is negligible.

PRA	PA	PRICE, *elastic*	TOTAL, *significant*
Home Care & Maintenance	Clothes Care	100,00%	1
	Treatment & Organising Accessories	33,33%	6
Home Care & Maintenance Total		42,86%	7
Small Storage	Bins & Bags	44,44%	9
	Boxes & Drawers	65,38%	26
	Clothes Organisers	28,57%	7
	Home Communication & Clocks	50,00%	14
	Work & Media Organisers	46,15%	13
Small Storage Total		52,17%	69
Systems & Units	Racks & Stands	0,00%	1
	Shelf Bar	41,67%	12
	Systems	86,67%	15
Systems & Units Total		64,29%	28
Total		**54,81%**	**104**

Table 8.8 Percentage of elastic products given significance *(Group West)*,
PRA and PA classification

8.2.3 Analysis of results with respect to GNI classification

In section 7.3 the authors explained the classification of countries due to dissimilarities in *Gross National Income*. The two groups defined were *GNI High* and *GNI Low*. The results obtained will be discussed below.

The countries within *GNI Low* showed a higher level of price significance than the *GNI High* countries. In addition the overall result contained a higher share of elastic products than the groups *GNI High* and *Low*. An explanation for these odd outcomes might be the great differences in degrees of freedom. Performing the regression for all countries imply a greater number of degrees of freedom than when the regression is performed in the two smaller groups. Note that *Group West* contained a higher number of countries than *GNI High* and *GNI Low*. Hence the *GNI* related results will have a considerably lower level of reliability. Due to this unreliable result the authors have decided not to analyse the *GNI* classification any further. For the interested reader the results can be found in appendix IV.

8.3 Comments on price setting meeting

In October the authors attended the BA10 price meeting. The features of this meeting were described in section 2.2.6. Below the authors will analyze and comment on how the meetings were structured, what the authors found positive and recommendations for future improvements.

The quantitative tools, which were applied during the meetings, were effective in calculating the prices' impact on turnover, margins and profit. In a pedagogical way the tool illustrated how a price altering of for example 0.5 €would affect the turnover, given that the volume remained unchanged.

The market supervision report was easy comprehendible in illustrating the competition different countries are confronting. In order to increase the reliability and the scope of the market supervision report, the national management divisions must get better in keeping IoS informed about present competitors.

The informal "Wish list" that was created in the beginning of the meeting, was a good tool in order to structure the pricing procedure and to indicate how products should be prioritized. The authors believe that a good idea for coming years might be to compile the list in advance. As a consequence the participants will be better prepared and would have the possibility to present well thought-out proposals. This could be realized by letting each participant in advance e-mail a list of articles to the controller or the commercial managers, who would compose the final "Wish list".

Gut feelings, strong wills and persistence were other factors that had a significant impact on final prices. The experience and market knowledge that the participants possess legitimates these factors influence. Nevertheless there is a risk that quantitative measurements are neglected in favor of personal values.

To summarize, many factors influence the price decisions and there is a trade-off for how these factors should be prioritized. A way to facilitate and clarify the procedures would be to first analyze the need and strategic purpose with a price altering. Is the purpose with a new price to increase turnover, volume, be the market price leader or/and to offer good value for money? The answer to the previous question will highly depend on market competition, size of stocks, future commodity prices and will form the basis for further discussions and decisions. Awareness of the purpose and prerequisites of a price altering, will simplify the task to set the new price.

9. Conclusions and recommendations

The analysis has lead to statements and assumptions that will be described and summarized as conclusions in this chapter. The authors will begin with describing the conclusions followed by recommendations of future fields of application and research.

9.1 Conclusions

The purpose of this Master thesis has been to develop a theoretical pricing model that will assist as a quantitative tool for future pricing decisions, through estimating the price elasticities for BA10's products.

The authors have designed a regression model that estimates the price elasticities for the majority of BA10's products. Products included in the model are currently in the range and have a sales history of at least one financial year. The underlying data set consists of historical sales data provided by IoS and external data of GNI per capita. In order to facilitate the estimating procedures the authors have built a program. The model was applied at 240 articles belonging to the business area Home organisation, BA10.

A feature with the model was to estimate the statistical impact a product's price has on demand. According to the regression results this condition was satisfied for 61% of the articles included in the study. In addition 55% of the price significant products were defined as elastic. Hence a price investment will lead to a higher proportional increase in sales volume for 34% of all the articles included in the regression.

The price group *B,* followed by price group *A*, had the highest percentage share of price significant products, whereas the prices for products belonging to the price group *C* and *D* were less significant. Solely two articles satisfied the criterion for positive price elasticity, given price significance. The positive price elasticity for these products is a result of severe supply complications. In addition the authors draw the conclusion that price has a statistically significant impact on sales volumes for the majority of BA10 products. Suitable prices are therefore crucial, in order to maximize turnover, where the prices for *A*- and *B*-articles are of highest importance.

The analyses of the estimated values of BA10 products' income elasticities lead to the conclusion that none of the articles are inferior goods. Hence all the articles included in the original regression, for which the income was a significant parameter, can be classified as normal. An increase in income has a positive effect on quantity demanded for these products.

In this thesis the homogenous market is defined as all IKEA represented countries, with non-franchising stores. The separate study of the regression results, for the group of countries classified as Group West, lead to the conclusion that a higher price level is justifiable for Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, Norway, Spain, Sweden and Switzerland. Therefore the appropriateness of setting recommended prices on a global level is questioned. Dividing the countries into two or three smaller groups might lead to more feasible prices. In addition there would be a chance that the countries will follow the recommended prices in a greater extent.

Analyses have lead to the conclusions that service levels, marketing and merchandising have a great impact on demand. Therefore the price elasticity is not a sufficient tool in order to forecast sales volumes, but can serve as a floor when forecasting the effect of activities and time restricted offers.

9. 2 Fields of application

In this section the authors will present possible fields of application for the results obtained in this thesis. In order to make these recommendations realistic, additional features but the price elasticity has to be taken into consideration.

9.2.1 Optimize price investments

While attending the price meeting, analyzed in section 8.4, the authors learned more concerning one field of application for their model. In addition to analyses of competition and supplementary tools their model would serve as a further device. Many ideas about coming price investments were discussed at the meeting. Since not all requested price investments can be fulfilled the elasticity results could become a helpful rule of prioritizing. As a result price reductions might become more effective, so that price investments will focus on those products for which the quantity demanded is highly related to the price.

9.2.2 Forecasting

For all businesses it is important to obtain a forecasting method with high quality. A good forecasting method implies less storing costs due to overage stock. In addition losses in sold quantity, due to lack in supply, is delimited. The estimated price elasticities could become a helpful tool during the forecasting procedures. The authors have previously in this thesis declared all factors that affect demand. Though this thesis focus on the price effect on demand, it will be important to take other demand factors into consideration when forecasting sales volumes. Therefore the authors have chosen to illustrate a possible forecasting procedure for IKEA of Sweden in figure 8.1.

MERCHANDISING

MARKETING

PRICE

Figure 8.1 A possible forecasting procedure for IKEA of Sweden

The bottom square illustrates the additional sales volume caused by a price altering. Hence a product's price elasticity will be applied in the first step in the forecasting model. Remember that the estimated price elasticity is based on historical data. Therefore the future market behavior must resemble the historical in order to justify the use of the estimated price elasticity when forecasting volumes.

As a second step the parameter marketing needs to be taken into consideration. A change in marketing strategies will affect the sales volume. Examples of different marketing strategies are ads in papers and commercials.

The final parameter, merchandising, is important for the total sales of IKEA, since an article placed in the front attains a considerably higher sale than a product placed in the background.

Considering all these three parameters, IoS would attain a good forecast of future sales volumes. Note that parameters such as cultural and demographical differences are not taken into consideration in this procedure. These features are not of interest for IoS, if the forecast should be applicable to all countries. As a consequence only parameters that are equal for all countries can be taken into consideration. Further, since the price elasticity model is based on data, received from all IKEA non-franchising countries, the price elasticity result preferably should be interpreted as a result for all countries as one market. Therefore the price elasticity result is not a good tool for forecasting sales quantities on country level.

9.2.3 Activities and time restricted offers

The forecasted quantities for the events, *activities* and *time restricted offers*, are frequently much higher than the actually sold quantities. Out of curiosity the authors tested the model on past BA10 activities, i.e. estimating sales volume with price elasticity. It followed that the model is constantly underestimating the events' influence on sold quantity, which is in line with the hypothesis in section 9.2.2. On the other hand an additional issue arose when applying the model to activities and time restricted offers. The prices during the activities and time restricted offers are in general much lower than the previously experienced prices. Since the model is based on historical data, the price elasticities may therefore not be applicable as a forecasting tool.

9.2.4 Prioritisations in range development

Prioritisation among high quality and a competitive price sets the framework for range development within different product areas. Forecasting the products' price significance and elasticities would therefore be of great value. Such a forecast is not possible with the model developed in this thesis, because of the lack of historical data. Nevertheless the price elasticities for related products can be estimated. If the majority of the related products shows price significance this should be taken into consideration, when developing products with similar characteristics. Hence a competitive price is essential. In contrary, if the majority of the related products are not price significant, additional resources should be spent on design and quality with a higher price as a consequence.

9.3 Further research

In this section the authors will give two examples on further research that is of importance but is beyond the scope of this thesis:

- When designing the price elasticity model the authors neglected the affects on sold quantity caused by changes in substitutes and complements within the IKEA range. A further research could therefore be to adjust the model in order to take these effects into consideration.

- IoS has currently no accurate methods for estimating the effects of different marketing and merchandising strategies. A future project at IoS could be to develop a tool, in order to classify and measure the effects of different marketing and merchandising strategies.

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10.4 Interviews

Bergstrand Henrik, Business Navigator
Carlsson Mattias, Supply Planner
Catlow Jonathan, Commercial Manager
Hansson Claes, Commerercial Manager

Since there have been a continuous conversation with these people, the authors have chosen not to specify the dates for these interviews.

Appendix I

NOTATION	COUNTRY	NOTATION	COUNTRY
AT	Austria	FR	France
AU	Australia	GB	Great Brittan
BE	Belgium	HU	Hungary
CA	Canada	IT	Italy
CH	China	NL	Netherlands
CN	Switzerland	NO	Norway
CZ	Czech Republic	PL	Poland
DE	Germany	RU	Russia
DK	Denmark	SE	Sweden
ES	Spain	SK	Slovakia
FI	Finland	US	United States

Table I.1 IoS country classification
(Sales Database, BA10, IoS, FY2000-2004)

Appendix II

	AT	AU	BE	CA	CH	CN	CZ	DE	DK	ES	FI	FR	GB	HU	IT	NL	NO	PL	RU	SE	SK	US
2000	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2001	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2002	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2003	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2004	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×

Table II.1 *Share of BA10,* relative share of turnover (Sales Database, BA10, IoS, FY2000-2004)

	AT	AU	BE	CA	CH	CN	CZ	DE	DK	ES	FI	FR	GB	HU	IT	NL	NO	PL	RU	SE	SK	US
1999	26130	20860	26060	20600	39140	780	5120	25740	32240	14710	24640	24400	24070	4480	20350	25270	34530	4320	1760	28540	3900	32250
2000	25220	20240	24540	21130	38140	840	5250	25120	32280	15080	25130	24090	24430	4710	20160	24970	34530	4190	1660	27140	3700	34100
2001	23940	19900	23850	21930	38330	890	5310	23560	30600	14300	23780	22730	25120	4830	19390	24330	35630	4230	1750	25400	3760	34280
2002	23860	19530	22940	22390	36170	960	5490	22740	30260	14580	23890	22240	25490	5240	19080	23390	38730	4670	2130	25970	4050	35400
2003	26720	21650	25820	23930	39880	1100	6740	25250	33750	16990	27020	24770	28350	6330	21560	26310	43350	5270	2610	28840	4920	37610

Table II.2 *GNI*, US dollars per capita (www.worldbank.org, 2004-09-24)

	AT	AU	BE	CA	CH	CN	CZ	DE	DK	ES	FI	FR	GB	HU	IT	NL	NO	PL	RU	SE	SK	US
2000	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2001	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2002	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2003	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2004	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×

Table II.3 *Nbr of Stores* (Sales Database, BA10, IoS, FY2000-2004)

Appendix III

Microsoft Visual Basic Code

Sub getarticle()

' GetArticleNbr Macro

```
Dim ArticleNbr As String
Worksheets("Input Values").Select

With

        ActiveSheet.QueryTables.Add(Connection:= "ODBC;DSN=Sales
        Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=281;FIL=MS
        Access;MaxBufferSize=2048;PageTimeout=5;" , Destination:=Range("B21"))
        Sql = Array( "SELECT `?GetArticleNew`.ARTNO" & Chr(13) & "" & Chr(10) &
        "FROM `C:\PRICEOPTI\SALES_DATA`.`?GetArticleNew` `?GetArticleNew`" )
        .FieldNames = True
        .RefreshStyle = xlInsertDeleteCells
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .RefreshOnFileOpen = False
        .HasAutoFormat = True
        .BackgroundQuery = True
        .TablesOnlyFromHTML = True
        .Refresh BackgroundQuery:=False
        .SavePassword = True
        .SaveData = True

End With
```

'Perform the regression for all articles

```
While Len(ActiveSheet.Cells(21, 1).Value) <> 0

        ArticleNbr = Worksheets("Input Values").Range("A21")
```

' Get PRA, PA, ARTNO, StartDate, EndDate

```
        Worksheets("Program").Select

        With

                ActiveSheet.QueryTables.Add(Connection:= "ODBC;DSN=Sales
                Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=281;FIL=MS
                Access;MaxBufferSize=2048;PageTimeout=5;" , Destination:=Range("A1"))
                .Sql = Array( "SELECT SALES_DATA_FY00_04.PRA,
                SALES_DATA_FY00_04.PA, SALES_DATA_FY00_04.ARTNO,
```

```
                SALES_DATA_FY00_04.STA_DATE_SALE_EXP,
                SALES_DATA_FY00_04.END_DATE_SALE" & Chr(13) & "" & Chr(10)
                & "FROM `C:\PRICEOPTI\SALES_DATA`.SALES_DATA_FY00_0" _
                , "4 SALES_DATA_FY00_04" & Chr(13) & "" & Chr(10) & "WHERE
                (SALES_DATA_FY00_04.ARTNO='" & ArticleNbr & "')")
                .FieldNames = True
                .RefreshStyle = xlInsertDeleteCells
                .RowNumbers = False
                .FillAdjacentFormulas = False
                .RefreshOnFileOpen = False
                .HasAutoFormat = True
                .BackgroundQuery = True
                .TablesOnlyFromHTML = True
                .Refresh BackgroundQuery:=False
                .SavePassword = True
                .SaveData = True

        End With

' Count the number of rows in the data set

        Dim i As Long
        i = 2

        Do Until Len(ActiveSheet.Cells(i + 1, 1).Value) = 0

                i = i + 1

        Loop

' Get Data depending on StartDate

        Dim s As Long
        Dim t As Long
        Dim u As Long
        Dim v As Long
        Dim StartSaleDate As Long
        Dim Com1 As String
        Dim Com2 As String
        Dim Com3 As String
        Dim Com4 As String
        Dim ChangeInCom As String
        s = Worksheets("Input Values").Range("B5") '2000-09-01
        t = Worksheets("Input Values").Range("B6") '2001-09-01
        u = Worksheets("Input Values").Range("B7") '2002-09-01
        v = Worksheets("Input Values").Range("B8") '2003-09-01
        ChangeInCom = "Different ComClasses"
        StartSaleDate = ActiveSheet.Range("D2")
        Range("Z1").Select
        ActiveCell.FormulaR1C1 = "ComClass"
```

100

```
If StartSaleDate < s Then 'SaleStart before 2000-09-01

        With

                ActiveSheet.QueryTables.Add(Connection:= "ODBC;DSN=Sales_
                Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=281;FIL=
                MS_ Access;MaxBufferSize=2048;PageTimeout=5;" ,
                Destination:=Range("F1"))
                .Sql = Array(
                "SELECTComClass.COM_CLASS_2001,ComClass.COM_CLASS_2
                002
                ,ComClass.COM_CLASS_2003, ComClass.COM_CLASS_2004,
                ComClass.NAME, ComClass.STYLE_NAME,
                ComClass.PRICE_Q_NAME, ComClass.SumOfSALE", _
                "_QTY, ComClass.SalesEUR, ComClass.FY, ComClass.RU" &
                Chr(13) & "" & Chr(10) & "FROM
                `C:\PRICEOPTI\SALES_DATA`.ComClass ComClass" & Chr(13) &
                "" & Chr(10) & "WHERE (ComClass.ARTNO='" & ArticleNbr & "')"
                )
                .FieldNames = True
                .RefreshStyle = xlInsertDeleteCells
                .RowNumbers = False
                .FillAdjacentFormulas = False
                .RefreshOnFileOpen = False
                .HasAutoFormat = True
                .BackgroundQuery = True
                .TablesOnlyFromHTML = True
                .Refresh BackgroundQuery:=False
                .SavePassword = True
                .SaveData = True

    End With

    Com1 = ActiveSheet.Range("F2")
    Com2 = ActiveSheet.Range("G2")
    Com3 = ActiveSheet.Range("H2")
    Com4 = ActiveSheet.Range("I2")

    If Com1 = Com2 And Com1 = Com3 And Com1 = Com4 Then

            ActiveSheet.Range("Z2") = Com1

     Else

            ActiveSheet.Range("Z2") = ChangeInCom

     End If

     ElseIf s <= StartSaleDate And StartSaleDate < t Then
                        'SaleStart between 2000-09-01 & 2001-09-01
```

101

```
With

        ActiveSheet.QueryTables.Add(Connection:="ODBC;DSN=Sales
        Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=281;FI
        L=MS Access;MaxBufferSize=2048;PageTimeout=5;",
        Destination:=Range("G1"))
        .Sql = Array( "SELECT `ComClass2,3,4`.COM_CLASS_2002,
        `ComClass2,3,4`.COM_CLASS_2003,
        `ComClass2,3,4`.COM_CLASS_2004, `ComClass2,3,4`.NAME,
        `ComClass2,3,4`.STYLE_NAME, `ComClass2,3,4`.PRICE_Q_" ,
        "NAME, `ComClass2,3,4`.SumOfSALE_QTY,
        `ComClass2,3,4`.SalesEUR, `ComClass2,3,4`.FY,
        `ComClass2,3,4`.RU" & Chr(13) & "" & Chr(10) & "FROM
        `C:\PRICEOPTI\SALES_DATA`.`ComClass2,3,4`
        `ComClass2,3,4`" & Chr(13) & "" & Chr(10) & "WHERE
        (`ComClass2,3,4`.ARTNO='" & ArticleNbr & " ')")
        .FieldNames = True
        .RefreshStyle = xlInsertDeleteCells
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .RefreshOnFileOpen = False
        .HasAutoFormat = True
        .BackgroundQuery = True
        .TablesOnlyFromHTML = True
        .Refresh BackgroundQuery:=False
        .SavePassword = True
        .SaveData = True

End With

Com2 = ActiveSheet.Range("G2")
Com3 = ActiveSheet.Range("H2")
Com4 = ActiveSheet.Range("I2")

If Com2 = Com3 And Com2 = Com4 Then

        ActiveSheet.Range("Z2") = Com2
Else
         ActiveSheet.Range("Z2") = ChangeInCom
End If

ElseIf t <= StartSaleDate And StartSaleDate < u Then
                'Sale Start between 2001-09-01 & 2002-09-01

    With
        ActiveSheet.QueryTables.Add(Connection:= _
        "ODBC;DSN=Sales
        Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=281;
        FIL=MS Access;MaxBufferSize=2048;PageTimeout=5;"
        Destination:=Range("H1"))
```

```
                    Sql = Array( "SELECT `ComClass3,4`.COM_CLASS_2003,
                    `ComClass3,4`.COM_CLASS_2004, `ComClass3,4`.NAME,
                    `ComClass3,4`.STYLE_NAME, `ComClass3,4`.PRICE_Q_" , _
                    "NAME, `ComClass3,4`.SumOfSALE_QTY,
                    `ComClass3,4`.SalesEUR, `ComClass3,4`.FY,
                    `ComClass3,4`.RU" & Chr(13) & "" & Chr(10) & "FROM
                    `C:\PRICEOPTI\SALES_DATA`.`ComClass3,4`
                    `ComClass3,4`" & Chr(13) & "" & Chr(10) & "WHERE
                    (`ComClass3,4`.ARTNO='" & ArticleNbr & " ')")
                    .FieldNames = True
                    .RefreshStyle = xlInsertDeleteCells
                    .RowNumbers = False
                    .FillAdjacentFormulas = False
                    .RefreshOnFileOpen = False
                    .HasAutoFormat = True
                    .BackgroundQuery = True
                    .TablesOnlyFromHTML = True
                    .Refresh BackgroundQuery:=False
                    .SavePassword = True
                    .SaveData = True

            End With

            Com3 = ActiveSheet.Range("H2")
            Com4 = ActiveSheet.Range("I2")

            If Com3 = Com4 Then

            ActiveSheet.Range("Z2") = Com3

            Else

            ActiveSheet.Range("Z2") = ChangeInCom

            End If

            ElseIf u <= StartSaleDate And StartSaleDate < v Then
                        'Sale Start between 2002-09-01 & 2003-09-01

                With

                    ActiveSheet.QueryTables.Add(Connection:=
                    "ODBC;DSN=Sales
                    Data;DBQ=C:\PRICEOPTI\SALES_DATA.mdb;DriverId=28
                    1;FIL=MS Access;MaxBufferSize=2048;PageTimeout=5;" ,
                    Destination:=Range("I1"))
                    .Sql = Array( "SELECT `ComClass4`.COM_CLASS_2004,
                    `ComClass4`.NAME,      `ComClass4`.STYLE_NAME,
                    `ComClass4`.PRICE_Q_" , _
                    "NAME, `ComClass4`.SumOfSALE_QTY,
                    `ComClass4`.SalesEUR, `ComClass4`.FY, `ComClass4`.RU"
```

103

```
                        & Chr(13) & "" & Chr(10) & "FROM
                        `C:\PRICEOPTI\SALES_DATA`.`ComClass4` `ComClass4`"
                        & Chr(13) & "" & Chr(10) & "WHERE
                        (`ComClass4`.ARTNO='" & ArticleNbr & " ')")

                        .FieldNames = True
                        .RefreshStyle = xlInsertDeleteCells
                        .RowNumbers = False
                        .FillAdjacentFormulas = False
                        .RefreshOnFileOpen = False
                        .HasAutoFormat = True
                        .BackgroundQuery = True
                        .TablesOnlyFromHTML = True
                        .Refresh BackgroundQuery:=False
                        .SavePassword = True
                        .SaveData = True

            End With

            Com4 = ActiveSheet.Range("I2")
            ActiveSheet.Range("Z2") = Com4

            ElseIf StartSaleDate >= v Then 'Sale Start after 2003-09-01
            MsgBox "Sales started during Financial Year 2004"

            End If
```

' *Price Macro*

```
        Range("Q1").Select
        ActiveCell.FormulaR1C1 = "Price"
        Range("Q2").Select
        ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-2])=FALSE,RC[-3]/RC[-4],"""")"
        Selection.AutoFill Destination:=Range("Q2:Q" & i) ', Type:=xlFillDefault
```

' *ShareOfBA10 Macro*

```
        Range("R1").Select
        ActiveCell.FormulaR1C1 = "ShareOfBA10"
        Range("R2").Select
        ActiveCell.FormulaR1C1 = "=IF(RC[-3]=2000,LOOKUP(RC[-
        2],ShareOfBA10!R1C2:R1C24,ShareOfBA10!R2C2:R2C24),IF(RC[-
        3]=2001,LOOKUP(RC[-
        2],ShareOfBA10!R1C2:R1C24,ShareOfBA10!R3C2:R3C24),IF(RC[-
        3]=2002,LOOKUP(RC[-
        2],ShareOfBA10!R1C2:R1C24,ShareOfBA10!R4C2:R4C24),IF(RC[-
        3]=2003,LOOKUP(RC[-
        2],ShareOfBA10!R1C2:R1C24,ShareOfBA10!R5C2:R5C24),IF(RC[-
        3]=2004,LOOKUP(RC[-
        2],ShareOfBA10!R1C2:R1C24,ShareOfBA10!R6C2:R6C24),"""")))))"
        Selection.AutoFill Destination:=Range("R2:R" & i), Type:=xlFillDefault
```

' GNI Macro

```
    Range("S1").Select
    ActiveCell.FormulaR1C1 = "GNI"
    Range("S2").Select
    ActiveCell.FormulaR1C1 = _
    "=IF(RC[-4]=2000,LOOKUP(RC[-
    3],GNI!R1C2:R1C24,GNI!R2C2:R2C24),IF(RC[-4]=2001,LOOKUP(RC[-
    3],GNI!R1C2:R1C24,GNI!R3C2:R3C24),IF(RC[-4]=2002,LOOKUP(RC[-
    3],GNI!R1C2:R1C24,GNI!R4C2:R4C24),IF(RC[-4]=2003,LOOKUP(RC[-
    3],GNI!R1C2:R1C24,GNI!R5C2:R5C24),IF(RC[-4]=2004,LOOKUP(RC[-
    3],GNI!R1C2:R1C24,GNI!R6C2:R6C24),"""")))))"
    Selection.AutoFill Destination:=Range("S2:S" & i), Type:=xlFillDefault
```

' NbrOfStores Macro

```
    Range("T1").Select
    ActiveCell.FormulaR1C1 = "NbrOfWarehouses + 1"
    Range("T2").Select
    ActiveCell.FormulaR1C1 =  "=IF(RC[-5]=2000,LOOKUP(RC[-
    4],Warehouses!R1C2:R1C24,Warehouses!R2C2:R2C24),IF(RC[-
    5]=2001,LOOKUP(RC[-
    4],Warehouses!R1C2:R1C24,Warehouses!R3C2:R3C24),IF(RC[-
    5]=2002,LOOKUP(RC[-
    4],Warehouses!R1C2:R1C24,Warehouses!R4C2:R4C24),IF(RC[-
    5]=2003,LOOKUP(RC[-
    4],Warehouses!R1C2:R1C24,Warehouses!R5C2:R5C24),IF(RC[-
    5]=2004,LOOKUP(RC[-
    4],Warehouses!R1C2:R1C24,Warehouses!R6C2:R6C24),"""")))))) + 1"
    Selection.AutoFill Destination:=Range("T2:T11753"), Type:=xlFillDefault
```

' Macro for taking the log

```
    Range("U1").Select
    ActiveCell.FormulaR1C1 = "Ln(SumOfSALE_QTY)"
    Range("V1").Select
    ActiveCell.FormulaR1C1 = "Ln(Price)"
    Range("W1").Select
    ActiveCell.FormulaR1C1 = "Ln(ShareOfBA10)"
    Range("X1").Select
    ActiveCell.FormulaR1C1 = "Ln(GNI)"
    Range("Y1").Select
    ActiveCell.FormulaR1C1 = "Ln(NbrOfWarehouses)"
    Range("U2").Select
    ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-6])=FALSE,LN(RC[-8]),"""")"
    Range("V2").Select
    ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-7])=FALSE,LN(RC[-5]),"""")"
    Range("W2").Select
    ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-8])=FALSE,LN(RC[-5]),"""")"
    Range("X2").Select
```

```
ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-9])=FALSE,LN(RC[-5]),"""")"
Range("Y2").Select
ActiveCell.FormulaR1C1 = "=IF(ISBLANK(RC[-10])=FALSE,LN(RC[-5]),"""")"
Range("U2:Y2").Select
Selection.AutoFill Destination:=Range("U2:Y" & i), Type:=xlFillDefault
```

' Regression Macro

```
Application.Run "Regress", ActiveSheet.Range("$U$2:$U$" & i), _
ActiveSheet.Range("$V$2:$Y$" & i), False, False, 90, ActiveSheet.Range( _
"$AB$1"), False, False, False, False, , False
```

' MoveToReport Macro

```
Sheets("Tabell").Select
Rows("2:2").Select
Selection.Insert Shift:=xlDown
Selection.Font.Bold = False
Worksheets("Program").Range("A2:B2").Copy
Sheets("Tabell").Range("A2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("J2").Copy
Sheets("Tabell").Range("C2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("Z2").Copy
Sheets("Tabell").Range("D2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("K2").Copy
Sheets("Tabell").Range("E2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("L2").Copy
Sheets("Tabell").Range("F2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("D2").Copy
Sheets("Tabell").Range("G2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("E2").Copy
Sheets("Tabell").Range("H2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("AC17").Copy
Sheets("Tabell").Range("I2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("AC18").Copy
Sheets("Tabell").Range("J2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("AC19").Copy
Sheets("Tabell").Range("K2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
Worksheets("Program").Range("AC20").Copy
Sheets("Tabell").Range("L2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
SkipBlanks:=False, Transpose:=False
```

```
    Worksheets("Program").Range("AC5").Copy
    Sheets("Tabell").Range("M2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AC7").Copy
    Sheets("Tabell").Range("N2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AF17").Copy
    Sheets("Tabell").Range("O2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AF18").Copy
    Sheets("Tabell").Range("P2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AF19").Copy
    Sheets("Tabell").Range("Q2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AF20").Copy
    Sheets("Tabell").Range("R2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AF21").Copy
    Sheets("Tabell").Range("S2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AE17").Copy
    Sheets("Tabell").Range("T2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AE18").Copy
    Sheets("Tabell").Range("U2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AE19").Copy
    Sheets("Tabell").Range("V2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AE20").Copy
    Sheets("Tabell").Range("W2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AE21").Copy
    Sheets("Tabell").Range("X2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Range("Y2").Select
    ActiveCell.FormulaR1C1 = "0.05"
    Worksheets("Program").Range("AG18").Copy
    Sheets("Tabell").Range("Z2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False
    Worksheets("Program").Range("AH18").Copy
    Sheets("Tabell").Range("AA2").PasteSpecial Paste:=xlValues, Operation:=xlNone,
    SkipBlanks:=False, Transpose:=False


'Delete Data

    Worksheets("Program").Select
    Columns("A:BK").Select
    Selection.ClearContents
    Worksheets("Input Values").Select
```

```
        Rows("21:21").Delete Shift:=xlUp

Wend

End Sub
```

Appendix IV

PRICE NAME	SIGNIFICANCE, price			TOTAL
	LOW GNI:	HIGH GNI:	ALL:	
D	35,71%	53,57%	53,57%	28
C	32,88%	41,10%	53,42%	73
B	50,51%	66,67%	69,70%	99
A	45,16%	48,39%	61,29%	31
Total	**42,42%**	**54,55%**	**61,47%**	**231**

Table IV.1 Percentage of significant products.
GNI and Price Group classifcation

PRICE NAME	PRICE, elastic		
	LOW GNI:	HIGH GNI:	ALL:
D	80,00%	66,67%	53,33%
C	75,00%	50,00%	43,59%
B	56,00%	57,58%	56,52%
A	64,29%	73,33%	73,68%
Total	**64,29%**	**58,73%**	**54,93%**

Table IV.2 Percentage of elastic products given significance.
GNI and Price Group classification

PRA	PA	SIGNIFICANCE, *price*	TOTAL
Home Care & Maintenance	*Clothes Care*	25,00%	4
	Treatment & Organising Accessories	7,14%	14
Home Care & Maintenance Total		*11,11%*	*18*
Small Storage	*Bins & Bags*	43,75%	16
	Boxes & Drawers	42,00%	50
	Clothes Organisers	40,00%	20
	Home Communication & Clocks	48,15%	27
	Work & Media Organisers	70,00%	20
Small Storage Total		*47,37%*	*133*
Systems & Units	*Racks & Stands*	100,00%	1
	Shelf Bar	53,13%	32
	Systems	31,91%	47
Systems & Units Total		*41,25%*	*80*
Total		**42,42%**	**231**

Table IV.3 Percentage of significant products *(GNI Low)*,
PRA and PA classification

PRA	PA	PRICE, *elastic*	TOTAL, *significant*
Home Care & Maintenance	Clothes Care	100,00%	1
	Treatment & Organising Accessories	0,00%	1
Home Care & Maintenance Total		*50,00%*	*2*
Small Storage	Bins & Bags	71,43%	7
	Boxes & Drawers	66,67%	21
	Clothes Organisers	75,00%	8
	Home Communication & Clocks	61,54%	13
	Work & Media Organisers	64,29%	14
Small Storage Total		*66,67%*	*63*
Systems & Units	Racks & Stands	0,00%	1
	Shelf Bar	64,71%	17
	Systems	60,00%	15
Systems & Units Total		*60,61%*	*33*
Total		*64,29%*	*98*

Table IV.4 Percentage of elastic products given significance *(GNI Low)*,
PRA and PA classification

PRA	PA	SIGNIFICANCE, *price*	TOTAL
Home Care & Maintenance	*Clothes Care*	0,00%	4
	Treatment & Organising Accessories	21,43%	14
Home Care & Maintenance Total		*16,67%*	*18*
Small Storage	*Bins & Bags*	56,25%	16
	Boxes & Drawers	68,00%	50
	Clothes Organisers	45,00%	20
	Home Communication & Clocks	66,67%	27
	Work & Media Organisers	75,00%	20
Small Storage Total		*63,91%*	*133*
Systems & Units	*Racks & Stands*	100,00%	1
	Shelf Bar	40,63%	32
	Systems	51,06%	47
Systems & Units Total		*47,50%*	80
Total		**54,55%**	**231**

Table IV.5 Percentage of significant products *(GNI High)*,
PRA and PA classification

PRA	PA	PRICE, *elastic*	TOTAL, *significant*
Home Care & Maintenance	Clothes Care		0
	Treatment & Organising Accessories	33,33%	3
Home Care & Maintenance Total		*33,33%*	*3*
Small Storage	Bins & Bags	55,56%	9
	Boxes & Drawers	67,65%	34
	Clothes Organisers	55,56%	9
	Home Communication & Clocks	50,00%	18
	Work & Media Organisers	40,00%	15
Small Storage Total		*56,67%*	*85*
Systems & Units	Racks & Stands	0,00%	1
	Shelf Bar	30,77%	13
	Systems	87,50%	24
Systems & Units Total		*65,79%*	*38*
Total		**58,73%**	**126**

Table IV.6 Percentage of elastic products given significance *(GNI High)*, PRA and PA classification