

**Analysis and comparison of target selection models for
market segmentation and development of a new approach
based on fuzzy expert systems**

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Summary

Target selection models play an important role in business practice. They are the data-mining methods that enable firms to conduct market segmentation. Marketers apply them to customer databases to identify the profiles of consumers who are most interested in a particular offer or marketing proposition. However, both the marketing and data-mining literature indicate that there is inadequate research that compares target selection models in order to help practitioners understand how to apply them. With respect to this, the focus of this study is to provide guidance on the implementation of a collection of target selection models and to assess their comparative performance with regard to their practical usefulness. This study assesses the relative performance of the methods cluster analysis alongside multiple discriminant analysis (MDA), Chi-square automatic interaction detector (CHAID) and expert systems in predicting the weekly expenditure of grocery products of 9,854 consumers in the UK and develops a new approach based on fuzzy expert systems. The comparison of these methods is conducted by using three criteria (parity test, hit rate and lift charts) and one validation method (M-fold cross-validation). The results suggest that these methods vary in performance across different criteria. Overall, CHAID and fuzzy expert systems outperformed cluster analysis alongside MDA in terms of classification accuracy (parity test and the hit rate), moreover, as far as practical applicability is concerned (lift charts), no clear conclusions could be drawn between CHAID and cluster analysis alongside MDA on which of the two is best, while expert systems performed last. Furthermore, from the findings mentioned and from the empirical application of the methods examined, conclusions are derived on the features of their processes that affect their practical usefulness and on the way they should be implemented.

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Chapter 1: Research context, problem statement, research questions and research design

1.1 Introduction

This thesis performs a study on a selection of data-mining methods¹ (target selection models²) that marketers use to conduct market segmentation. Its fundamental aim is firstly to empirically apply them and analyse their processes in order to provide guidance on the way they should be implemented to segment marketing data. Secondly, to develop and apply an approach of conducting market segmentation based on the fuzzy expert systems³ framework. Thirdly, to assess the segmentation solutions of the chosen target selection models and the fuzzy expert system in order to identify their comparative performance in terms of stability, classification accuracy, profitability and business applicability.

This chapter presents the literature of market segmentation and data-mining that highlights the need for studies that compare target selection models and reviews the existing research that has underlined the importance of fuzzy expert systems. Then, this chapter describes the research problem and states the aims, objectives and the research questions of this thesis. Moreover, it highlights the significance of this study and presents the research design that it has adopted. This chapter concludes with a description of the thesis structure and the order of presentation.

1.2 Research context

1.2.1 Market segmentation and target selection models

The theory of market segmentation is based on the fact that the behaviour of each consumer within a given market is too diverse for any organisation to study and address to an individual level (Sohi, 1996; Cui and Choudhury, 2002; Baltas, 2005; Kalchschmidt, Verganti and Zotteri, 2006 and Gonzalez-Benito, Martinez-Ruiz and

¹ Data-mining methods are models that are used to explore and analyze large volumes of data to discover meaningful patterns and rules (Berry and Linoff, 2000).

² Target selection models are the data-mining methods that marketers apply to their customer databases to identify the consumers who will be most interested in a particular product offer (Madeira, 2002).

³ A fuzzy expert system is a tool that is used to predict an output performance value from the performances of the input variables, by replicating the reasoning of human experts (Unahabhoka, Platts and Tan, 2007 and Malagoli, Magni and Mastroleo, 2007). More detail on fuzzy expert systems is presented in Section 2.10.

Molla-Descals, 2008). As a result, market segmentation, according to Goodstein, Nolan and Pfeiffer (1993), is used to divide the market into groups of individuals that are characterised by similar preferences, so as to enable the identification of those that are the most interested in a particular product offer or marketing proposition (and thus appropriate for targeting). In doing that, it allows organisations to study in-depth the factors that influence the purchase decision of the target segments, thus increasing their understanding on the behaviour of the consumers and enabling the formulation of marketing strategies that are relevant and accurate (Hassan and Craft, 2005). The benefit in exploiting a market segment rather than the market as a whole is that the individuals between the market segments have different preferences and price elasticity, hence providing the opportunity to organisations to charge different prices by differentiating the same products to the needs or wants of each segment (Dickson and Ginter, 1987; Croft, 1994; Wyner, 1995; Kara and Kaynac, 1997; Webber, 1998; Levin and Zahavi, 2001; Hassan, Craft and Kortam, 2003 and Wenstein, 2004).

However, according to Jenkins and McDonald (1997) and Dolnicar (2005), in order for market segmentation to take place, the market under study has to be grouped into segments, the tools that research whether such segments exist are the data-mining methods (Hoek, Gendall and Esslemont, 1996; Wedel and Kamakura, 2000 and Luan, 2001). More specifically, the data-mining methods that determine whether segments of consumers that can become potential customers exist are the target selection models. Target selection models aim to specify the target audience for a particular product by identifying the profiles of customers that have shown an interest in that product in the past through the analysis of customer data obtained from similar previous marketing campaigns (Kaymac, 2001).

However, as criticised by Li and Ruan (2007, p. 170):

“...real-world discovery knowledge tasks are too complex to be accessed by simply applying a single learning or data-mining algorithm...”

This results in practitioners not being able to derive meaningful feedback in all situations (Wang and Ariguzo, 2004). With respect to this problem, Hair (2007, p. 314) stated that:

“Academic and industry researchers will need to understand and apply the most rigorous scientific methods to ensure the reliability and validity of their approaches and achieve the predictive accuracy necessary to be globally competitive.”

Both these arguments (Li and Ruan, 2007 and Hair, 2007) were supported from the study conducted by Van Bruggen, Schmidts and Wierenga (2001), where it was concluded that the availability of an increasing amount of data not always leads to better decision-making. A basic factor that determines whether data will have a positive or negative impact depends on whether marketers are equipped with the right data-mining methods and whether they are in position to apply them effectively. This conclusion was reinforced by Higgs and Ringer (2007) who demonstrated that although there is great richness of data available to the organisations, the increasing complexity of the target selection models’ processes reduces the validity and usefulness of their feedback.

This argument was supported further by the review performed by Kaplan (2007) in failed enterprise customer relationship management (CRM) implementations, who concluded that the use of target selection models requires an incredible amount of expertise to be applied effectively. Furthermore, the need to teach practitioners to apply target selection models correctly was also underlined by the study Stanton (2006) performed on the requirements that organisations face, when attempting to derive knowledge from large datasets. More specifically, Stanton (2006) supported that it is critical for future practitioners to understand why data-mining is important and its direct application to business and marketing problems.

Thus, with respect to the literature presented, it can be concluded that, although numerous target selection models exist that can provide insight on consumer behaviour, the complexity of their processes and the lack of guidance on their applications undermine the validity and the effectiveness of their feedback, hence biasing the decision-making process and hindering the targeting efficiency of marketing plans. The reason behind this issue, according to Wedel and Kamakura (2000), is based on the fact that both researchers and practitioners require further insight on the comparative performance of target selection models, so as to be in a better position to decide which to choose and under what conditions. The existence of

this problem was verified by Dolnicar and Leisch (2003) from a review they performed on the way organisations' practice data-driven segmentation. Based on the results of their study, Dolnicar and Leisch (2003, p.1) concluded that:

“So far no attempt has been made to construct a framework enabling managers to systematically choose between different segmentation solutions with regard to their practical usefulness.”

This argument was further supported by Hill, McGinnis and Cromartie (2007) from a literature review they conducted on marketing intelligence and planning. They identified that the main reason that hinders practitioners to derive knowledge from marketing research data is that academics have placed more emphasis on the observation and verification of marketing theories rather than their application, or as summarised in Wu, Yu and Piatetsky-Shapiro (2000, p. 254) following an extensive analysis on data-mining development:

“Data-mining researchers should be asking themselves: Suppose I solved this problem. Now what?”

Both of these arguments were verified by the results of Danneels (1996) that were derived from an empirical study he performed on clothing retailers operating in Belgium, to identify the way they conduct market segmentation. The results of that study led Danneels (1996) to conclude that there is an inadequate literature guiding the application of segmentation and that more must be done to teach practitioners how to perform market segmentation and what tools to use. The results of Danneels (1996), were verified by the findings that Quinn, Hines and Bennison (2007) derived from the review they performed on marketing segmentation literature to evaluate the organisational practice of marketing segmentation in fashion retailing. With respect to their findings, Quinn *et al.* (2007) concluded that, despite the trend towards increasingly complex segmentation frameworks, further research needs to be performed to address the gap that exists in the literature in terms of how to implement market segmentation. Further practical guidance is required to explain which target selection models to select and how to apply them to conduct market segmentation.

This conclusion was reinforced from the results of the review that Kalafatis and Cheston (1997) performed on the literature of normative models for segmentation in

business markets. From the findings of this review, it was observed that, even though there is a substantial amount of research focused on emphasizing the importance of segmentation, there are still studies that report that there is a gap in the literature in terms of guidance on the implementation of segmentation. This argument was supported by Dibb (1998) and Dibb and Wensley (2002), from the results they derived from the empirical studies they conducted in European manufacturers of car parts to identify the way they were applying market segmentation. They concluded that there is need for research to develop and apply a more systematic approach to the evaluation of particular segmentation tools in terms of statistical evidence, performance and economic criteria to enable practitioners to decide when to apply them.

The symptoms of the issue mentioned, was studied by Dolnicar (2002, 2002b and 2003). Dolnicar (2002, 2002b and 2003) conducted a survey of 243 business administration publications to identify how they apply market segmentation using marketing data, it was found that 73% of the businesses studied used segmentation tools without taking into account factors such as features of the segmentation tools, the size of the data sample or the format of the dataset, thus collecting flawed or inconclusive feedback. With respect to this, Tiwari, Turner and Majeed (2008) performed a literature review of business process mining to provide an overview of state-of-the-art data-mining methods and point out future research directions. As a result, they concluded that there is lack of existing research that compare data-mining methods in order to help practitioners understand when and how to apply them. More specifically, since 2001, only two percent of the papers on process mining provided guidance on when and how to implement data-mining methods.

Following this line of thought, the focus of this thesis is firstly, to provide guidance on the implementation of a selection of data-mining methods (target selection models), and secondly, to assess their comparative performance.

1.2.2 Target selection models and fuzzy expert systems

“Developing reliable business forecasting models requires a successful collaboration between line management and knowledge engineers. And even where the fusion of working knowledge and abstract representation is

successful, its results are too often thwarted by the unpredictable dynamics of the real-world.” Cox (1999, p.16)

With respect to this, it can be concluded that, the efficiency of target selection models depends on two factors: firstly, on how well they can emulate the knowledge of the expert in their processes, and secondly, the extent they can accommodate the dynamics of the market under study. As far as the first factor is concerned, as identified by White (2005), from a review he performed on the way knowledge is derived from business intelligence, it was found that practitioners face problems in emulating their knowledge to their business processes and market segmentation activities. In doing that, the models used fail to capture and apply the knowledge and experience that organisations have on the structure of the markets, thus providing feedback that may be irrelevant and invalid. As far as statistical models are concerned, this is because firstly, they are complex to implement and thus to reflect the expert’s knowledge over the consumers’ behaviour in the market (Dahal, Hussain and Hossain, 2005 and Thomas, Adam, Leyking and Loos, 2006) and secondly, the basic parameter that they rely on to draw conclusion from large customer databases, the statistical significance testing (F, t, and χ^2 tests), faces problems that hinder its ability to derive practically meaningful results. More specifically, when the data sample under study is larger than 500 data objects (cases), then even the most trivial effects can obtain statistical significance (Banasiewicz, 2005). As stated by Banasiewicz (2005, p. 526):

“Statistical significance testing is not the rock of analytic objectivity many believe it to be. Its heavy dependence on sample size casts doubt on the objectivity of its conclusions and the inherent conflict between its applicability limits and business objectives calls into question the methodology’s appropriateness as an applied business tool.”

As far as the second factor is concerned, which requires business models to accommodate the dynamics of the market under study, in the case of market segmentation, as explained by Sicilia and Garcia (2003), these dynamics is the heterogeneity of customer needs for a specific need category. Therefore, the heterogeneity of customer needs has to be included in the process of the business model, in order for its feedback to be relevant and applicable. However, as stated by Thomas, Adam and Seel (2005), the complexity of this aspect is not supported by

business process management, because of the difficulties that existing business models face in expressing the imprecision and the dynamics of the real-world.

This is performed, as explained by Metaxiotis, Psarras and Samouilidis (2003), because they rely on a standard conditional (Boolean) logic, where all notions are expressed in terms of true or false, and cannot handle the concept of partial truth. In doing that, they face a major drawback, because in the real-world consumers' may have partial membership to more than one segment according to their consumption behaviour. Thus the inability of the standard conditional (Boolean) logic to express this notion automatically creates the threat of misrepresenting the structure of the market and distorting the view of the marketers about the heterogeneity of consumer wants.

With respect to this, a type of logic is required that can describe the type of reasoning mentioned in order to be in position to capture the dynamics and imprecision of the way consumers behave within a market. A means to address this, is fuzzy logic, according to Zadeh (1988, p. 83):

“...unlike classical logical systems, [fuzzy logic] aims at modelling the imprecise modes of reasoning that play an essential role in the remarkable human ability to make rational decisions in an environment of uncertainty and imprecision. This ability depends, in turn, on the ability to infer an approximate answer to a question based on a store of knowledge that is inexact, incomplete, or not totally reliable.”

In other words, as explained by Malagoli *et al.* (2007), fuzzy logic is a framework that aims to formalize the way human beings conceive the world, solve their problems, and interpret qualitative and vague concepts. Following this argument, as described by Malagoli *et al.* (2007), the formal approach that is used to implement the human activities mentioned to solve data-mining problems⁴ are the fuzzy expert systems. Fuzzy expert systems, according to Bozdog, Kahraman and Ruan (2003) and Kouatli (2008), operate by approximating the reasoning of human logic and by simulating the dynamic behaviour of the physical system under study in a form of a series of rules that constitute its knowledge base, which then use to infer an answer for any given question that the practitioner asks.

⁴ Identification of data patterns and rules within databases (Berry and Linoff, 2004).

This function is performed by using the basic element of fuzzy logic, the fuzzy sets (Andriantiatsaholiniaina, Kouikoglou and Phillis, 2004; Sun and Collins, 2007 and Behesti and Lollar, 2008). The fuzzy sets are used to divide the variables that describe a phenomenon such as the consumption behaviour of consumers within a market (i.e. weekly expenditure and cost of service) into states (i.e. low, medium, or high) and display to what extent a consumer can be categorised to each of these states with numerical values that describe their degree of membership. By using the fuzzy sets, an expert, based on his/her past experience and knowledge can create if-then statements called fuzzy rules. In the if-part he/she places the combination of fuzzy sets that best describe the condition that he/she would take action (i.e. ‘if’ a consumer has high weekly expenditure and low cost of service). In the then-part he/she places the corresponding actions that he/she would want to take place (i.e. ‘then’ classify as good customer) (more information on fuzzy expert systems is provided in Section 2.10). If a consumer achieves adequate degrees of membership to the combination of fuzzy sets that the expert specified in the if-part of a fuzzy rule, then, the action he/she determined in the then-part will take place.

Fuzzy expert systems have two advantages over existing business models. Firstly, by using fuzzy rules they can emulate human logic in the market segmentation process, and secondly, by using the ability of fuzzy logic to categorize data objects (consumers) under more than one fuzzy set (state) and display the degree of membership that each data object can be designated to each, they can capture the dynamics of a market (Kwong, Ip and Chan, 2002).

With respect to the advantages mentioned, it can be concluded that the fuzzy expert systems are equipped with the means to address both the factors that were identified at the beginning of this section as important for the efficiency of target selection models. They can emulate the knowledge and past experience of the experts in their processes when used to conduct market segmentation, and through the use of fuzzy logic, they can express and include the dynamics of the real-world (heterogeneity of consumers’ wants) when producing a segmentation solution. Following this line of thought, the focus of this thesis is to develop a target selection model for market segmentation by using the fuzzy expert systems’ framework.

With respect to the gaps identified in the literature in Section 1.2.1 and Section 1.2.2, this thesis formulated the research problem stated in the next section.

1.3 Central research question

With respect to the issues mentioned it is clear that use of standard conventional approaches can be inaccurate and misleading. Therefore, this thesis adopted the central research question:

What is the comparative performance of a collection of target selection models including a fuzzy expert system with regard to their practical usefulness?

The reason why this central research question was formed is because firstly it requires the implementation of a collection of target selection models including a fuzzy expert system, thus allowing the identification of the features on which their processes rely on to segment marketing data. Secondly, the comparison of their performances will indicate how the features of each model studied affect its performance relative to the other models, hence enabling this study to make recommendations on what actions to be taken to remedy the deficiencies of these features that cause these differences in performance. Thus providing guidance on the way they should be implemented. Furthermore, the comparison between the models studied is performed with regard to their practical usefulness so that the guidance that will be provided on their implementation (which will be based on the results of this comparison) will be relevant to both research and business practitioners.

1.4 Aims and objectives

Based on the research problem stated, the aims of this thesis are firstly to examine the way a selection of data-mining methods is applied by existing research and analyze their processes, in order to determine those that can be used as target selection models. Secondly, to develop a fuzzy expert systems approach of conducting market segmentation. Thirdly, to assess the performance of the models implemented by this thesis by comparing the segmentation solutions they produce.

With regard to the aims stated, this study formulated research objectives to ensure that all of them are addressed effectively. These research objectives are as follows:

1. Determine the target selection models that this thesis will research by examining the data-mining literature to determine those that are widely used, can operate as target selection models and have not yet been researched by the existing literature focused on the assessment of data-mining methods.
2. Identify how fuzzy expert systems are applied to conduct market segmentation.
3. Identify the methodology that is used to compare target selection models by examining the literature that is focused on data-mining method assessment.
4. Apply all chosen target selection models to marketing data.
5. Assess the performance of the chosen target selection models by comparing the segmentation solutions they produce.

1.5 Research questions

With respect to the analysis performed in Chapter 2, which determines the target selection models that this thesis will examine and Chapter 5 which presents their application to the marketing data of this thesis, the following research questions were developed to ensure that the central research question stated is addressed effectively.

1. How is cluster analysis alongside multiple discriminant analysis (MDA) and the Chi-square Automatic Interaction Detector (CHAID) applied to segment marketing data?
2. How is the expert system constructed by this thesis applied to segment marketing data?
3. What are the comparative performances of cluster analysis alongside MDA, CHAID and the constructed expert system?

1.6 Research design

The research design of this thesis takes the form of a controlled experiment that has as an objective to assess the performance of the target selection models under study. More specifically, the controlled experiment consists of two stages. The first stage applies all the chosen target selection models to a marketing database by using the

Knowledge Discovery in Databases (KDD) process. The second stage assesses the comparative performance of the target selection models by implementing selected model assessment methods (parity test, hit rate test and lift charts) to the segmentation solutions they will produce.

As far as the first stage of the research design is concerned, due to the fact that this thesis examines target selection models, in order for their assessment to be practically valid (to avoid the criticism that artificial data were used that favoured particular target selection models), they have to be applied to a 'real-world' database, which is a database that was collected by an organisation for direct marketing purposes (Asparoukhov and Krzanowski, 2001). With respect to this, all target selection models were implemented on a real-world database that contained information on consumer demographics and purchase behaviour in the UK grocery retail market. The reason that led this thesis to acquire this database was the importance of the grocery sector to UK's retail industry. As stated by Eastham, Sharples and Ball (2001, p.10):

“The grocery retail sector is a significant area of economic activity in the UK. It employs 950,000 people and it has a current value of £9.6 billion. The UK grocery sector is the third largest in the European Union.”

With respect to this, according to Akehurst (2002, p.162):

“It is an important part of retailing, and developments within it are likely to have repercussions for retailing as a whole.”

Based on these arguments, this thesis selected to use as a means of comparison of the target selection models examined data that describe consumer behaviour on grocery products. Because, in doing that, it will allow the results of this thesis to be applicable to businesses of one of the most important areas of economic activity in the UK.

Moreover, the reason for the use of the KDD process to implement all the chosen target selection models (the first and the second research question) is to confirm the validity and reliability of the data used (and as a consequence to confirm the validity and reliability of the segmentation solutions that the target selection models produce). More specifically, this process aims to increase data validity and reliability by performing two actions. Firstly to ensure data validity it requires that the practitioner collects/selects a database that addresses the goal to be achieved by using the KDD

process. Secondly, to ensure data reliability it requires that the practitioner examines whether the database is sufficiently complete and error free to support the goal to be achieved by using the KDD process (Maimon, Kandel and Last, 2001).

To address the first condition the data variables that this thesis selected were determined as a result of a literature review. This was performed in order to identify the variables that according to existing research can help it achieve its goal, which is to conduct a fair and unbiased assessment of the comparative performance of the chosen target selection models. To address the second condition this thesis performed all the required tests and transformations to ensure that the selected database supports the goal mentioned earlier. More specifically, it processed the data of the selected database so that it complies with all the data conditions of the chosen target selection models and the assessment methods involved.

As far as the second stage of the research design is concerned, to assess the comparative performance of the chosen target selection models (the third research question) this study applied a selection of model assessment methods: the hit rate, lift charts and the parity test. The hit rate assesses the performance of data-mining methods in terms of the number of successful predictions they made, the lift charts assess their performance in terms of the number of successful predictions they made by targeting a given percentage of respondents in the dataset and the parity test assesses their performance in terms of the number of wrong predictions they made. More detail on the research design of this study is presented in Chapter 4.

1.7 The significance of the study

As stated by Hair (2007, p.303):

“...data analysts will increasingly rely on mixed data-models that examine both structured (numbers) and unstructured (text and images) data, ...”

The fact that data-mining methods are important in providing greater insight on data increases the need for better understanding of their features, strengths and weaknesses (Higgs and Ringer, 2007).

With respect to this issue, this study will firstly, empirically apply a selection of target selection models to provide guidance on the way they should be implemented. Secondly, it will assess their comparative performance across different criteria (model assessment methods) in order to form conclusions that will help practitioners to choose between the target selection models examined with regard to their practical usefulness. Thirdly, this thesis will develop an approach of conducting market segmentation by using the fuzzy expert systems' framework that will empower marketers to use their knowledge and past experience on consumer behaviour⁵ as segmentation criteria to identify consumption patterns within a customer database.

1.8 Structure of the thesis and order of presentation

Chapter 1 is the introduction and includes the aims, the objectives and the research questions of this thesis. Chapter 2 reviews the literature of market segmentation theory and target selection models in order to identify the significance and the role of the target selection models to market segmentation. Moreover, it performs a literature review on data-mining methods to present the way they are implemented and to determine those that this thesis will study. Then, an in-depth analysis is performed on the applications and the processes of the data-mining methods selected to determine those that can be implemented as target selection models. After this takes place, it introduces the theory of fuzzy logic and fuzzy expert systems and examines the way they are practiced to conduct market segmentation. Then, it provides a literature review on the studies assessing the performance of target selection models, to identify the combination of target selection models that has not been assessed yet by the existing research and that this thesis will examine. Chapter 2 concludes by presenting the combination of target selection models that according to the literature performed earlier has not been assessed yet and that this thesis is going to assess.

Chapter 3 identifies the methodology that is used to assess the performance of target selection models and determines the elements that the research design of this thesis should include. Furthermore, it surveys the literature on model assessment methods to specify those that this thesis will use to assess the comparative performance of the

⁵ More detail on this topic is presented in Chapter 5 (Section 5.4).

target selection models under study and determines the data variables that will employ to perform its analysis.

Chapter 4 is the methodology chapter of this thesis. It describes the application of the research design presented in Chapter 3. Firstly, it explains how the data selected was used to achieve the goal of this thesis, which is to assess the comparative performance of the chosen target selection models. Secondly, it presents the tests and transformations that took place to ensure that the database of this thesis complies with the conditions of the target selection models and the assessment methods used to achieve the goal mentioned earlier. Thirdly, Chapter 4 describes how the model assessment methods specified in the previous chapter were implemented to evaluate the performance of the target selection models examined.

Chapter 5 displays the implementation of the target selection models to the database of this thesis and shows how their feedback was interpreted to segment the database. Chapter 6 is the findings and discussion chapter of this study. Firstly, it displays the results that this research derived by applying the assessment methods to the segmentation solutions that the target selection models produced. Secondly, it discusses the findings of the assessment methods and presents the observations made while empirically applying the target selection models in Chapter 5. Chapter 7 highlights the conclusions that are drawn from the findings and observations shown in Chapter 6 and states the limitations and issues for further research that are derived from the conduct of this study.

1.9 Conclusion

This chapter presented in detail the research context that surrounds the phenomena under study and based on the analysis of this research context, it stated this thesis' research problem, aims and objectives. Moreover, this chapter presented how this thesis responds to its objectives and described how its research questions were formulated. Furthermore, it explained the research design adopted to epistemologically address the research questions stated and highlighted the significance of this study. This chapter concluded with a description of this thesis' structure and order of presentation.

The next chapter presents the theory of market segmentation and identifies the role of target selection models and data-mining. Furthermore, it explains how data-mining methods are applied in the segmentation process and determines those that this thesis will study. Then, it performs a literature review for each chosen data-mining method to identify the way it is applied by existing research and analyses the methods and processes they use to operate, in order to specify whether they can be used as target selection models. After this is performed, it introduces the theory of fuzzy logic and fuzzy expert systems and studies the way they are applied to segment data.

THE CENTRAL CHAPTERS OF THIS THESIS ARE NOT AVAILABLE.

THE STUDENT HAS REQUESTED THAT ONLY THE BARE MINIMUM BE AVAILABLE ELECTRONICALLY.

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