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# Cross-validation of segments of credit card holders

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ABSTRACT

This work presents the segmentation of credit cards holders of a Portuguese financial institution. It is focused on the evaluation of the obtained solution via cross-validation. The proposed approach specifically handles a large data set with mixed (numerical and categorical) variables. It provides the evaluation of the internal stability of the segmentation solution and helps in characterizing the segments. Furthermore, it provides classification rules for new credit card holders. Finally, this work presents the credit card holders' segment profiles, helping to support ongoing and future strategic decisions.



## 1. Introduction

Segmentation is a key marketing tool that deals with the heterogeneity of the market—see Wedel and Kamakura (2000), and Baker and Hart (2008), for example. The definition of segments is an important step for effective marketing and to the business strategy, since it helps marketeers to better understand the particular characteristics of each type of customer and so to better design products and services according to customers' needs and preferences. A market segmentation strategy can actually lead to greater profitability for the organization.

In the financial institutions context, today's over-competitive environment is an increasing reality. Customers are switching to the bank that offers the most attractive products and services (Manrai and Manrai, 2007). In order to retain them, marketing should be able to identify the customers or customers' segments with the greatest value-creating potential and target them appropriately according to the marketing strategies defined to each one of them. Thus, the organization can reduce the risk of these high lifetime value customers defecting to competitors. Market segmentation can be used for this purpose: clustering the market, and constituting groups of customers with common characteristics relevant to the organization. Segmenting customers according to relevant attributes helps to highlight the most important subgroups of customers so that the organization can act based on this knowledge.

However, results from segmentation do not ensure that the solution achieves the expected goals. In fact, the segmentation results should be evaluated in order to meet these goals.

Firstly, segmentation results should be evaluated from a marketing point of view. At this stage, there are well known properties a segmentation solution should have; for example, a segment should be measurable and differentiated from other segments providing understanding of behavioral propensity and potential value.

Secondly, from an analytical point of view, there are also some desirable properties segments should have, namely compactness-separability (segments should differ from others and customers belonging to the same segment should be homogeneous) and stability (e.g. Gordon, 1999). In fact, the evaluation of analytical properties should precede the evaluation of the more business oriented properties, since they translate the essence of segmentation; there is no rationale in trying to target a segment which is expected to have unstable characteristics or deliver heterogeneous responses to the same marketing policies and actions.

In the present work, the evaluation of the internal stability of a segmentation solution is addressed using a cross-validation procedure. Segments refer to credit card holders of a financial institution operating in the Portuguese market and are based on behavioral characteristics.

The objectives are two-fold:

- The proposed analytical methodology should be able to deal with similar applications in diverse contexts;
- The obtained segmentation solution should provide a better insight into the market of credit card holders, thus helping to support future marketing decisions.

In this paper we begin to address the importance of customers segmentation in the financial institutions. Then, we focus on the evaluation of segments' structures and propose a methodology to deal with the specific application at hand. Next, we present the

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data analysis and, finally, we draw some conclusions and outline further research steps.

## 2. Segmentation and financial institutions

### 2.1. General concerns

Nowadays, competition in the financial services is a challenge for any bank since customers are switching to the bank that offers the most competitive products and services (Manrai and Manrai, 2007). In order to retain customers, the organizations should pay attention to customers' needs and concentrate on how to satisfy them, so their offerings should be aligned to their types of customers. However, the organization's efforts should be differentiated according to its strategy and profitability goals. Each segment has a different meaning and importance to the organization, related to its value and potential value. Therefore, marketing policies should be particularly effective when they are regarding high value customers.

The segmentation can really be the first step for the analysis of customer value management (Epstein, 2008). Ideally, segments should be correlated with customers' behaviors that conduce to the customer profitability.

There are several forms of market segmentation. However, behavioral dimensions figure with the best prospect of linkage between segments and financial purchasing behavior (Elliot and Glynn, 1998). Behavioral data, such as spending values and types, can really contribute for a better understanding of behavioral aspects – it represents new information and that different to demographic ones – helping in the direct marketing operations (Otto et al., 2009). This type of information is present on the internal databases and is typically summarized from transaction and billing histories (Berry and Linoff, 2004). To measure and manage the customer profitability, enterprises can measure customer segment margins taking into account costs from the sales, marketing and customer service areas, and then measure customer impact (Epstein, 2008). Customer impact includes the measurement of the customer influence (customer capability to influence the behavior of other customers) – thinking, for instance, in social networks – and the customer knowledge that can be acquired from internal data that maps customer behavior or through inbound contact with the customer. Finally, the customer profitability management can go far beyond the simple observation of which segments have been more or less profitable, and also includes which factors could influence segment profitability.

The segmentation process should be continually refined; thus all studies of customer profitability should be analyzed in a recursive way, in order to improve customers' profitability and, consequently, the enterprise profitability.

### 2.2. Credit card holders

In the present work, a segmentation analysis is used as a key tool to develop new knowledge of a customers' database in a Portuguese financial institution. The analysis specifically regards *premium* customers that hold at least one top (gold) card.

This application considers a dataset of 19,220 credit card holders with multiple attributes. Data originates from the organization data warehouse and other internal sources. The attributes generally regard the customers' behavior and value, including different types of information about the customers, such as general customer information, information about their relationship and interaction with the organization, information about balances, profitability, revolving credit, personal credit, directed credit, payments, defaults, card use, purchases, cash advances and some categories of expense.

According to the data at hand, the proposed methodology should be able to deal with a large data set with mixed (categorical and metric) variables, which can be commonly found in the financial institutions.

## 3. Segmentation evaluation

### 3.1. Reviewing some marketing criteria

To marketing managers, it is critical to select the target market segments on which they have to concentrate (Baker and Hart, 2008). Given a segment structure, the useful segments have to exhibit the following specific features regarding the enterprise context—e.g. Baker and Hart (2008).

- Measurability—managers have to be able to know their size and understand their characteristics and the ones that differentiate each segment from the others; so, the segments should be interpretable in the business context;
- Substantiality—segments should have a minimum profitability size;
- Accessibility—managers should be able to reach the segments in order to serve them appropriately, which depends on the capability to control the marketing mix variables;
- Actionability—managers must have conditions to serve the segments according to their needs and characteristics, being able to implement the programmes designed with the purpose of satisfying these customers.

Additionally, another property of the segmentation solution which allows segments to be targeted is the relative attractiveness of each segment, since its specific characteristics/behaviors influence and are related to its profitability.

Furthermore, responses to target campaigns should be predominantly different between different segments—the different responsiveness is associated to the idea that customers in the same segment are sharing a set of characteristics at various levels, including internal and external factors, which are correlated to their likelihood to respond to a certain marketing action. It is also critical to pay attention to competition offerings taking into account the segments' needs and to the potential different responses of the target segments to exogenous factors (such as macro-economic environment, lifestyles, etc.).

The cost to effectively reach and target each segment is also an important issue and it is a relevant variable to the managers that can establish some commitments in the customers or segments relationship management.

Finally, the possible relationships among segments are important for targeting the segments. The portfolio management should work in order to be able to effectively reach all segments, always with the best trade-off between cost and benefit. This last point may relate to the customer or segment influence, which can be mined using techniques of social network analysis already available in some technology tools in the market.

Beyond these desirable marketing and business criteria there are also some analytical ones. The next section goes further on this topic.

### 3.2. Analytical criteria

Basic analytical properties of a segment structure include within-segments homogeneity (compactness) and inter-segments heterogeneity (separability) as well as segments consistency or stability (Everitt et al., 2009). In general, a segments' structure yielded by a