

CRM AND DATA MINING TECHNIQUES: A LITERATURE REVIEW & CLASSIFICATION

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Abstract

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Data Mining is a continuous business process for exploring large amounts of data to discover meaningful patterns and rules, which readily fits in with other strategies for understanding markets and customers .The key is to recognize the flow of customers and the commonalities of data across the enterprise. The current paper is an attempt to conduct an in depth review of different articles pertaining to data mining technologies to customer relationship management, which consists of four dimensions like Customer Identification, Customer Attraction, Customer Retention, Customer Development.

Keywords: CRM, Data Mining, business, customer

Introduction

Information systems and technology are contributing to ever-growing volumes of user profiles of consumers. Even so, most of the profit-generating knowledge about consumers and their habits is still shrouded in mystery. Coupled with the current focus on consumer management, data mining has an excellent opportunity to help the role of marketing to determine which business strategies to follow. Data mining helps organisations to find previously unknown customers, predict future actions, and allow organisations to proactively gather knowledge. Once predictive analyses can process large amounts of new and evolving data in real time, these simulations can include information that was never before possible, such as planning for the future. Data mining tools satisfy complex questions that previously needed in-depth investigation. In any

sector, understanding the needs of the customers is of utmost importance, no matter what it is the business you have to give them. Many different models and techniques were generated from the process of segmenting clients according to statistical properties (such as total amount of money received), followed by data mining models (like classification models), then going on to include neural networks and beyond. When we talk about customers, we also include the CRM department. Most major corporations apply their own model to analyse consumers' trends, define their behaviours, and eventually discern their desires. Towards the end of the decade, numerous creative works and new technologies were created in this area. Rogiels, Wang and Yen 2002: Many data mining techniques from discovery, predictive modelling, and forensic analysis have been identified in their review in 2012. In terms of business analytics, they start from the premise that customer relationship management is achievable thanks to data mining techniques that have become actual tools in the response to

our questions. they say that the priorities of managers have changed from product to customer management. There are two ways to accomplish this goal: to focus on what customers value the most, and to identify the methods to maximize customers equity. Shaving the same idea, the focus on customers value, Verhoef, Doorn and Dorotic (2007) make a wide literature review and read to the conclusion that customer lifetime value is a research area that has too few studies. The research in data mining has gained a high attraction due to the importance of its applications and the increasing generation information (Radhakrishnan et al., 2013). Data Mining technology allows marketing organizations to better understand their customers and respond to their needs.

Objectives

1. To analyse the possibilities of data mining techniques in improving customer relations.
2. To examine the web personalization strategies adopted by major e-commerce sites

Literature review

Customers whether they are individuals, households, or business, change over time. (Sheth et al., 2000). The business relationship with a customer evolves over time. Although each business is different, the customer relationship places customers into five major phases like Prospects, Responders, New customers, Established customers and former customers. Business processes move customers from one phase of the customer life cycle to the next. These business processes are important because they lead to making customers more valuable over time. Customer Acquisition is the process of attracting prospectus and turning them into customers. Albeit this is often done by advertising and word of mouth, data mining is also play an important role. Available data limits the role that data mining can play. Response modeling is used for channels such as direct mail and telemarketing, where the cost of contact is relatively high. The goal is to limit the contacts to prospects that are more likely respond and become good customers and become good customers data available for such endeavours fall into 3 categories source of prospect appended individual household data appended demographic data at a geographic level

.Data mining can play many roles in prospecting the most important of these are identifying good prospects choosing a communication channel reaching prospects picking appropriate messages for different groups of prospects .

It should be noted that customers drive every organization's revenues. Acquiring new customers, delighting existing customers and predicting buyer behaviour will improve

the availability and profitability of products and services. Therefore the ultimate objective of any DM exercise in e-commerce is to improve processes which contribute to the value of the end customer. Consider an online store such as <http://www.amazon.com> in which the customer can select a product of their choice, order the same, track movement and pay for the product and services. Amazon has the potential to make the retail experience outstanding with the technology behind such a website. The details available in web log files will, in the most basic level, illuminate what prospective customers want from a platform. Are they shopping or just browsing intentionally? They're familiar with buying something or something they know nothing about? Are they shopping from home, work or a hotel? The information in the log files is frequently utilised for determining what profiling in the context can be dynamically

processed and indexed into the dynamic HTML generation and how the servers and network perform to help customer service and to make e-business interaction efficient. New computer systems have been designed to warn consumers of major incidents of concern. The paper by Jeng and Drissi (2000) describes a tool called PENS that not only notifies customers of things that happen, but also is able to anticipate scenarios and events. The event notification system in PENS (Planning, Engagement, Systems, Registries, and Collaboration Infrastructure) has the following components: Association rules and cluster analysis are the algorithms used for forecasting events. This e-commerce business introduces the PENS method to help itself better predict the needs of product category demand. How the data science of shopping has been used to evaluate how consumers respond to rewards offered by a credit card company (Zhang et al 2003). Fuzzy and conditional logic can be used to determine whether-or-and-and laws for personalised product strategy, Niu et al (2002) describe a method of building customer profiles using product hierarchy They sort each customer by demographic data, then by behavioural results, and lastly by association rules. Since customers are segmented according to their interests, the authors produce two kinds of recommendations, interests based recommendations. They propose a specialised search/matching data structure called a "tree"

Data Mining in web personalization

A Guide to Customizing the Personalization and on Site Use, Mobasher (2004) provides an overview of how to customise the web from the perspective of Web Mining. Preprocessing and combining data from different sources are standard practises in this process. Any visitor's navigational behaviour is represented in the log data captured by the Web and application servers.

Data mining techniques in CRM assist the organisation in identifying and selecting appropriate data. This information can then be used to create a simple picture of the consumer life cycle. Customer detection, attraction, retention, and growth are all part of the life-cycle. The more data in the database, the more detailed the models generated would be, and hence the greater the value gained. Predictive modelling, forecasting, and descriptive modelling techniques are popular techniques used in data mining. CRM allows a company to participate in a variety of useful practises in the era of data analytics. You can control customer satisfaction, select the appropriate segments, establish optimal pricing strategies, and rank suppliers according to your requirements.

According to Swift (2001), Parvatiyar and Sheth (2001, p. 5) and Kracklauer, Mills, and Seifert (2004, p. 4), CRM consists of four dimensions: (1) Customer Identification; (2) Customer Attraction; (3) Customer Retention; (4) Customer Development

Applications of Data Mining in CRM

Basket Analysis: Discover which products customers often buy together. Stocking, store layout plans, and promotions will all benefit from this experience. (Ailawadi et al., 2006) **Sales Forecasting:** Businesses can make better re-stocking decisions by looking at time-based trends. It also aids supply chain management, financial management, and provides full control over internal operations. (Hiles, 2004)

Database Marketing: Retailers can build consumer profiles based on demographics, tastes, interests, and purchasing habits. It will also help the marketing team create the best marketing plans and promotional deals possible. This would result in increased efficiency, optimum

resource utilisation, and a favourable return on investment. (Tynan & Drayton, 1987).

Market Segmentation: Find out who would be interested in buying your products. Create marketing campaigns and promotions that cater to their tastes and desires. Since you won't be approaching consumers who aren't interested in your product, this will improve productivity and yield the desired ROI.

Product Customization: Manufacturers have the ability to customise goods to suit the unique needs of consumers. They must be able to anticipate which features should be bundled to satisfy consumer demand in order to accomplish this.

Fraud Detection: You can avoid potential fraudulent transactions by reviewing previous transactions that turned out to be fraudulent. This function would greatly benefit banks and other financial institutions by lowering the amount of bad debts.

Techniques of Data Mining for CRM

Anomaly Detection: Anomaly detection is when you look for information that doesn't fit expected behaviour or a predicted trend. Since they differ from the average in the data collection, anomalies may provide useful information.

Association: The goal of association is to create relationships between things that are found together in a record. (Ahmed, 2004; Jiao, Zhang, & Helander, 2006; Mitra et al., 2002). Association modelling is widely used in market basket research and cross-selling systems, to name a few examples. Statistics and apriori algorithms are popular methods for association modelling.

Clustering: The process of segmenting a heterogeneous population into a number of more homogeneous clusters is known as clustering. In contrast to classification, clusters are uncertain at the start of the algorithm. In other words, no predefined clusters exist. Neural networks and discrimination analysis are two popular clustering methods. (Ahmed, 2004; Berry & Linoff, 2004; Carrier & Povel, 2003).

Classification: In data mining, classification is one of the most popular learning models. (Ahmed, 2004; Berry & Linoff, 2004; Carrier & Povel, 2003). Its aim is to construct a model that can predict future customer behaviour by categorising database records into a collection of predefined classes based on certain parameters. (Ahmed, 2004; Berson et al., 2000; Chen, Hsu, & Chou, 2003; Mitra et al., 2002). Neural networks, decision trees, and if then-else rules are popular classification methods.

Regression: One of the more advanced data mining techniques in CRM is regression analysis. The aim is to identify the relationships between various data items and map out which variables are influenced by others. This method is used to figure out how satisfied customers are and how it affects consumer loyalty. Each data object is mapped to a real value using regression, a statistical estimation technique that provides a value for prediction (Carrier & Povel, 2003; Mitra et al., 2002). Linear regression and logistic regression are two popular regression tools.

Sequence discovery: The discovery of connections or patterns over time is known as sequence discovery. (Berson et al., 2000; Carrier & Povel, 2003; Mitra et al., 2002). Its aim is to model the states of the process that generates the series, as well as to extract and report deviations and trends over time (Mitra et al., 2002). Tools for sequence discovery are statistics and set theory. **Visualization:** Visualization refers to the presentation of data that users can view in complex patterns (Shaw et al., 2001). It's used in combination with other data mining models to provide a deeper understanding of the trends or relationships that have been discovered (Turban et al., 2007). Visualization model are 3D graphs, "Hygraphs" and "SeeNet" (Shaw et al., 2001)

The following are some widely used algorithms in Data Mining

1. Association rule;
2. Decision tree;
3. Genetic algorithm;
4. Neural networks;
5. K-Nearest neighbour;
6. Linear/logistic regression.

Table 1: Distribution of articles according to Data mining Techniques

CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
Customer Identification	Segmentation	Classification	Decision tree	Kim, Jung, Suh, and Hwang (2006)
		Clustering	Self-organizing map, decision tree and means Markov Chain Model	Ha, Bae, and Park (2002)
			Data envelopment analysis, self organizing map and decision tree	Dennis, Marsland, and Cockett (2001), Raja et al., (2020) Lee and Park (2005)

CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
Customer Attraction	Target customer	Regression	Pattern based cluster	Yang and Padmanabhan (2005)
			Self-organizing map	Bae, Park, and Ha (2003), Verdú, García, Senabre, Marín, and Franco (2006)
			Logistic regression	Hwang, Jung, and Suh (2004)
			Decision tree	Chen et al. (2003), Wu, Kao, Su, and Wu (2005), Zhang, and Zhang (2005)
		Clustering	Self-organizing map	Lee, Suh, Kim, and Lee (2004)
			Customer map	Woo et al. (2005)
		Regression	Logistic regression	Prinzle and Poel (2005)
			Bayesian network classifier	Baesens et al. (2002)
		Classification	Decision tree	Buckinx et al. (2004)
			Genetic algorithm	Ahn et al. (2006), Chiu (2002)
Customer Attraction	Direct marketing	Regression	Pattern based cluster	Yang and Padmanabhan (2005)
			Self-organizing map	Bae, Park, and Ha (2003), Verdú, García, Senabre, Marín, and Franco (2006)
			Logistic regression	Hwang, Jung, and Suh (2004)
			Decision tree	Chen et al. (2003), Wu, Kao, Su, and Wu (2005), Zhang, and Zhang (2005)
		Clustering	Self-organizing map	Lee, Suh, Kim, and Lee (2004)
			Customer map	Woo et al. (2005)
		Regression	Logistic regression	Prinzle and Poel (2005)
			Bayesian network classifier	Baesens et al. (2002)
		Classification	Decision tree	Buckinx et al. (2004)
			Genetic algorithm	Ahn et al. (2006), Chiu (2002)

CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
Customer Retention	Complaints management	Clustering	Neural network and genetic algorithm	Kim and Street (2004)
			Outlier detection	He et al. (2004)
		Clustering	Self-organizing map	Bae et al. (2005)
	Loyalty program	Sequence discovery	Survival analysis	Larivière and Poel (2005)
		Classification	Decision tree	Cox (2002), Douglas et al. (2005), Larivière and Poel (2005), Chen et al., (2020)
				Kim et al. (2003)
			Genetic algorithm	Lejeune (2001)
			Logical analysis of data	
			Neural network, K-nearest	Datta et al. (2000)
CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
			neighbor and decision tree	

CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
Customer Development	Lifeti me value	Classification	Classification and regression tree and multi-variate	Lee et al. (2006)
			adaptive regression splines	
			Bayesian network classifier	Baesens et al. (2004)
			Neural network	Drew et al. (2001)
			Survival analysis	Rosset et al. (2003)
			Markov chain model	Etzion et al. (2005)
			Linear regression	Verhoef and Donkers (2001)
			Association rules	Aggarval and Yu (2002), Brijis et al. (2004), Jukic and Nestorov (2006)
			Markov chain model	Giudici and Passerone (2002)
			Association rules	Chen, Tang, Shen, and Hu (2005), Kubat et al. (2003)
	Market basket analysis	Association		
		Sequence discovery		

CRM Dimensions	CRM Elements	Data Mining Functions	Data Mining Techniques	References
	Up/cross selling	Association	Neural network and association rule Mixture transition distribution	Changchien et al. (2004) Prinzie and Poel (2006)

Table No: 2 Quantification of Articles by CRM and Data mining models

CRM Dimensions	CRM Elements	Data Mining Model	Number of Articles	
Customer Identification	Customer Segmentation	Classification Clustering Regression	9	2
				6
				1
			5	
	Target Customer Analysis	Classification Clustering Visualization		3
				1
				1
Customer Attraction	Direct marketing	Regression Classification Clustering	7	
				1
				5
				1
Customer Retention	Complaints Management	Clustering Sequence Discovery	2	
				1
				1
	Loyalty program	Classification	8	8
Customer Development	Customer life-time Value		5	
			9	

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CRM Dimensions	CRM Elements	Data Mining Model	Number of Articles
		Classification	1
		Clustering	2
CRM Dimensions	CRM Elements	Data Mining Model	Number of Articles
		Forecasting	1
		Regression	1
			6
	Market basket	Association	4
			2
		Sequence Discovery	
			2
	Up/cross selling		1
		Association	1
		Sequence Discovery	

> CRM elements identified with customer identification are customer segmentation and target customer analysis. The data mining models used for customer segmentation and target analysis are classification, clustering, regression and visualisation. 14 articles were reviewed u Discussion

The current study gives an in-depth review of different articles pertaining to techniques of data mining in CRM. For this study around 46 articles have been reviewed. Each article was carefully analysed and separately classified according to the four categories of CRM dimension and seven categories of data mining models, which serves as a comprehensive base for understanding different data mining techniques and functions. Even though there is no specific definition for CRM many scholars have tried to define it in their own ways. CRM as a “enterprise approach to understanding and shaping customer behaviour by meaningful interactions in order to improve customer acquisition, retention, and satisfaction customer profitability and loyalty” (Ling & Yen, 2001; Ngai, 2005). Swift (2001, p. 12). CRM is described as “the strategic use of knowledge, processes, technology, and people to manage your customer's relationship with your company (Marketing, Sales, Services, and Support) across the customer life cycle.” (Kincaid (2003, p. 41). In today's world E-commerce site are widely used, profitability of E-Commerce sites is linked with customers. So a prolific CRM is essential. The current study analyses different techniques and tools which can be used to boost the sales of E-commerce sites.

Conclusion

Application of data mining techniques in CRM is an developing trend in the industry. It has enticed the interest of practitioners and academics all round the globe. CRM which is an emerging trend which can be linked to profitability of an enterprise includes a set of processes and supporting systems to boost up marketing strategies to build long term relationships with customers who are in turn stake holders of the company. Data mining is used in organization for decision making and forecasting of prospective customers. We have studied recent literature related to use of data mining techniques for CRM. Based on review of the contemporary literature, we analyzed different data mining techniques employed in different types of business, corporate sectors and organizations. We draw a critical review table which provides the problem addressed, proposed techniques, significance, limitations and suggested possible improvements for each proposed techniques review during this study. The critical review of the data mining techniques which are being used for CRM is provided in this paper.

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