A DYNAMIC PRICING SERVICE FOR THE MULTI-CHANNEL RETAIL BANK WITH APPLICATIONS IN GENERAL E-COMMERCE

by

M. Michael Serbinis

A thesis submitted in conformity with the requirements for the degree of Master of Applied Science
Graduate Department of Industrial Engineering
University of Toronto

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M. Michael Serbinis  
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Abstract

This research is an investigation of new tools for use in the banking industry, specifically for pricing retail products at the E-Commerce point of sale. The dynamic pricing problem is investigated considering the stated goals of a customer-centric bank: to maximize customer profitability across all sales channels. A dynamic pricing model is proposed and compared against traditional pricing models. It was hypothesized that a dynamic pricing model based on channel costs, customer profitability and the value of a new sale opportunity should result in a more profitable customer base.

It was found that dynamic prices perform better from a profitability perspective than all other pricing models. It was also found that pricing strategies based on future profitability perform better than those based on past profitability.

With further development, the mathematical model developed in this research can be used to determine the effect of dynamic prices on different businesses.
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Chapter 1  Introduction

1.1  Background

1.1.1  The Information Age

During the last decade, the United States has experienced the longest economic expansion in its history while forming a new economy and the beginning of the Information Age. This transformation is not limited to the United States, but in fact, is occurring around the world. The increasingly powerful personal computer, connected to the Internet and wireless networks have already begun to change how we work and communicate. These technologies, combined with the advent of broadband networks are poised to change commerce, education, government services and entertainment as we know them.

The development of this new economy began with a vision of putting a computer on every desktop and making information available at the click of a mouse. Companies like Microsoft, Intel and Compaq thrived through this period, with sales of computers and software experiencing tremendous growths beginning in the mid 1980s. It was only until the year 2000 that personal computer sales began to slow somewhat. Today, it is the Internet that is driving the growth of the Information Age.

The Internet began as a Defense Advanced Research Projects Agency (DARPA) project in the early 1970s. It was mainly the domain of academic and government institutions until the advent of the world wide web (WWW) developed by Tim Berners Lee in 1992. The development of the first WWW browser called Mosaic spawned a startup called Netscape, founded by Marc Andreesen and Jim Clark. Netscape went on to create and distribute its Netscape browser and web servers, and the Internet revolution was truly born.
The Internet allows us to connect not only personal computers but also any device; together through open standards using global networks both wireless and wireline. It allows us to communicate anytime, anywhere and anyplace, using any device. Pioneering companies like Cisco, America Online (AOL) and Yahoo! have emerged as global Internet leaders with their infrastructure hardware, content and services.

Cisco pioneered packet-switching using TCP/IP, an open protocol for data transmission. Cisco's routers are the traffic control "cops" that route data to their intended destinations on the Internet. America Online is the largest Internet service provider in the world, providing dial-up Internet access to millions of people worldwide. In addition, through its acquisition of Netscape Communications, AOL provides the Internet browser that many people use to access the web.

The very first Internet sites were search engines. Yahoo! was the first search engine on the web, and it was followed by Excite, AltaVista, Lycos, MSN and others. These companies were startups funded by venture capitalists in Silicon Valley. Search engines competed for page-views, page-views that could be monetized using a paid advertising based business model, thus resulting in the first Internet business model.

At the time Yahoo was developing, traditional businesses were creating their very first websites. They were largely online brochures that provided browsers a view of the company and some product information. Banks were among the first businesses to have an online presence; their web sites also began with company and product information. Later, banks began offering their first web-site services, effectively extending their PC banking platforms to the web to allow customers the ability to check account balances and pay bills.

The advertising business model that Yahoo pioneered was marginalized by competition and the limited demand for Internet advertising. Yahoo continued to add services in order to drive page-views, and extended its offerings with co-marketing agreements and fee based services. Yahoo was beginning to enter the realm of e-Commerce. Banks too, realized that e-Commerce was the way to their future.
The pioneer of business-to-consumer (B2C) E-Commerce was Amazon.com, a startup that began as an online book retailer. Amazon's customers could browse an online storefront and buy books, paying by credit card and accepting delivery by mail or courier. Many companies, not only Internet startups, copied this E-Commerce model.

Banks were among the first traditional enterprises to realize that they had to go beyond simple "brochure-ware", and even beyond Internet banking - servicing their products online, to E-Commerce - that facilitated selling their products online.

1.1.2 Retail Banking

Banks have always been leaders in adopting new technology from the earliest mainframes, to minicomputers and PCs. One of the first promises of the PC revolution was the ability to bank from the comfort of your own home. This service was delivered by many banks using custom made PC banking software and a modem.

With the advent of the Internet, banks created their first websites and offered product information such as interest rates on mortgages and loans, mortgage calculators and currency converters. Internet banking was initially an alternative service channel but eventually developed to be a replacement for PC banking. It promised all the functionality of PC banking without the added cost of private communications networks and creating and distributing custom software to end user customers.

In 1998, Internet banking was the number one Internet application, giving customers the ability to view account balances and pay bills. However, the Internet, like PC and telephone banking before it was largely a service channel, a cost-centre, and not a sales channel or profit centre.

Moreover, banks were undergoing their own transformation from being branch-centric to being customer-centric. So called "alternative" channels like telephone banking, PC banking and Internet banking proved to be viable sales channels, and not merely service channels.
Multi-channel sales models boasted higher returns and motivated banks to sell products over several channels, as opposed to limiting sales to the branch. Banks realized that their most valuable asset was their customer and their personal relationship with him/her not any one product or mode of delivery. Banks focused on a business strategy that involved cross-selling products to existing customers in an effort to maximize customer value.

Some retail banks reorganized into customer, product and channel groups. Customer groups were responsible for maximizing the value of the customer base, and attracting new customers. They organized according to customer profitability segments and heavily invested in data warehousing technologies to analyze market segments and target customers for their product offerings. Product groups were responsible for creating, marketing and maintaining products to offer customers across all sales channels. Sales channels were responsible for selling into the customer base.

The transition from being branch-centric to customer-centric began in the retail banking industry and the Internet was transformed into a significant sales channel. This marked the birth of the Internet based E-Commerce in the banking industry, and served as the harbinger of the customer revolution that was going to take traditional enterprises by storm.

1.1.3 E-Commerce

Banks were one of the first traditional enterprises to face the challenges of the Internet as a new sales channel. Customer retention became the primary goal due to the ease with which customers could do price comparisons with both existing and new competitors - comparisons that could not as easily be done in the past.

With the Internet, customers can easily get product information and compare product features and prices with competitors. Product comparisons became easier with the Internet, especially with the advent of e-mail and bank intermediaries like iMoney.com. Because of this, it was easy to lose a new sales opportunity to another bank, or worse, lose the entire business of a customer to a competitor. This problem was exacerbated by changes in
banking rules resulting in increased competition from international banks, out-of-state banks and new online competitors. New competitors used Trojan horses like low interest rate loans to individuals, higher interest savings accounts and credit cards to break into the market. Others targeted the commercial customer and "suitcase bankers" attacked the business loan market with vigour.

Selling on the Internet, a new and not at all understood sales channel, was a challenge to begin with. This challenge was augmented by the fact that banks were facing some channel conflict, even competing with themselves in some cases when making a sale to a customer. It was not uncommon for the Internet sales channel to offer products and discounts, which then inadvertently resulted in pulling customers away from their own branch. After all, the Internet channel did not have the benefit of years of face-to-face interaction that their counterparts in the branch had with customers, and negotiation was not possible online.

Each channel was trying to market and sell all products - there was no channel specialization, only competition in a drive to achieve channel revenue goals. There was also no regard to the overall value of the customer to the bank. Banks began selling through many channels but were definitely not customer-centric. The need for coordination was obvious.

The telephone channel adopted price discount heuristics based on customer relationship. At best, marginal discounts are given by sales agents using manual heuristics based on customer history like the number of years as customer or number of products bought.

The problem with this pricing mechanism is that the information used to approve the discounts is not directly tied to customer value or is consistent across the organizational level, but is left in the hands of typically inadequately trained sales agents without full access to customer information held by the branch.

Price comparison shopping, price pressure from competitors and channel conflict affecting both top line and bottom line results, including price strategy development meant there was an obvious problem with developing pricing strategies for products for sales on the Internet.
1.2 Motivation for this Research

During the late 1990's banks were subject to many forces of change due to globalization and deregulation and the latest challenge, the Information age. Evolving their Internet strategies to include E-Commerce was natural and coincided with their drive to become customer-centric as opposed to being branch-centric. Progressive banks like the Toronto Dominion Bank faced many challenges, ones that foreshadowed what was to come in the new millennium. Today, the large majority of traditional enterprises are evolving their businesses to include E-Commerce. One of the most visible examples is General Electric Corporation which is in the midst of remaking its business into an Internet centric enterprise.

This research was sponsored by the Toronto Dominion bank to investigate the sale of bank products on the Internet, and the pricing models that would be successful in E-Commerce. The Bank was in the midst of transforming itself into a customer-centric bank by employing a business model based on cross selling products into their existing customer base. They expected to maximize customer value on the premise that it was far more expensive to get a new customer than it was to keep an existing one.

The bank realized that to continue its history as a leader in the Canadian banking industry, they would have to be exceptionally successful on the Internet.

1.3 Problem Definition

This research is an investigation of E-Commerce in the banking industry, specifically focusing on the pricing strategies of bank products at the channel. This investigation is done in the context of the bank as a multi-channel, customer-centric bank.

The pricing problem is investigated in line with the goals of a customer-centric bank: to maximize customer profitability across all sales channels. A dynamic pricing model is proposed and compared against traditional pricing models.
It is the goal of this research to show that a dynamic pricing model may be applied to a multi-channel retail bank, and to E-Commerce in general, in order to sell products online successfully.

1.4 Contribution

The contribution of this research is to recommend a methodology, a dynamic pricing service, for use by banks to price their products for successful sale across multiple channels, including the Internet.

This is done through an investigation of the Banks’ sales operations and the analysis of various pricing models. The goal of this methodology, is in line with the goals of the customer-centric bank; and its desire to maximize customer profitability.

It will also be shown how this methodology can be applied in other industries where constituent companies are evolving their businesses to include e-Commerce.

1.5 Thesis Organization

This research comprises the following sections, organized in the order listed below:

The Literature Review is presented in Chapter 2. The topic of Customer Profitability is presented in Chapter 3 while Pricing is discussed in Chapter 4. The Proposed Solution is presented in Chapter 5 and the actual results from a series of simulations, together with an analysis included in Chapter 6. Chapter 7 offers Conclusions and Recommendations for Future Work.
Chapter 2  Literature Review

2.1 The Banking Industry

Banking has traditionally been one of most heavily-regulated industries in most nations of the world. This has been due mainly to the important role that banks have played in the development of modern economies. They continue to play an important role today, but they are facing increased competition. As globalization occurs and barriers to trade fall, major banks are able to increase their presence in foreign markets. Another important development has been the phenomenon of disintermediation, where traditional financial intermediaries, i.e. banks, are being replaced by capital market intermediaries that are able to provide banking services to the same customers at much lower costs.

In the past ten years, there has been a significant trend of deregulation in the financial services industry worldwide. Major governments are relaxing the regulations on financial institutions headquartered within their borders, and also opening access to foreign institutions. Globalization and disintermediation have contributed to deregulation as the global market has been evolving rapidly and regulators are no longer able to control their own market in relative isolation. Market integration and trade treaties have forced regulators to eventually allow full participation by foreign firms, and regulators have responded by moving closer to allowing competition to decide the shape of the market.

Waves of mergers have been sweeping through many markets. Although some of these have been necessary to save one of the two merging institutions, e.g. ING and Barings, and the purchase of Daiwa's U.S. assets by Sumitomo, the majority have been driven by business considerations. Bank mergers are not a new phenomenon; they have been occurring in the U.S. and elsewhere for a very long time. However, the pace at which they are occurring has accelerated dramatically, as has the size of the merging institutions.
The United States has always had a highly fractured banking system due to the McFadden Act (1927) and the Glass-Steagall Act (1933) which severely limited inter-state branch banking. [ROSE97] There were no truly nationwide banks; most were small regional banks. In fact, the majority of U.S. banks have only one or two branches. Thus the U.S. banking sector was in desperate need of consolidation when Congress and the Federal Reserve Board proceeded with deregulation through the effective removal of interstate branching prohibitions and the lessening of the barriers between commercial and investment banking.

Multi-billion dollars deals have become commonplace in the U.S. in past few years, spurring a 10-year old bull market, as high equity prices provide banks with abundant (market) capital to put towards acquisitions. Not only have the number of deals been increasing, but so has their values. In 1990, there were 216 bank mergers worth $4.6 billion, whereas in 1994 the figures increased to 564 mergers worth $22.5 billion. In 1998, up until early May, there were 145 mergers worth $207.2 billion[BLAN98].

Some of the biggest mergers in recent memory include: Chase Manhattan Corp. and Chemical Banking Corp. (at the time $10 billion, 1995), Travelers Group and Citicorp ($74.5 billion US, 1998), BankAmerica and Nations Bank ($60 billion US, 1998), First Chicago NBD and Banc One of Ohio (1998), Bank of New York’s purchase of Mellon Bank Corp. ($23 billion US, 1998), and the merger between Wells Fargo and Norwest (1998). Even after the “merger-mania” of recent years, there are still over 8,000 banks in the US, and further even-larger mergers seem imminent [BLAN98].

Unlike the US, Canada has had national branch banking for some time. It has a concentrated banking sector where five nationwide banks dominate the business. In 1998, two pairings, the Royal Bank and Bank of Montreal, and CIBC and Toronto Dominion announced intentions to merge. The stated reasons for these mergers was to defend against increased foreign competition, notably the threat of the newly merged super-banks in the US, and to be able to compete globally. However, neither of these two mergers received government approval to go ahead.
**Competition**

The wide availability of banking services from both banks and non-banks has placed significant pressure on price levels at which they sell their services. To provide competitive services, banks are forced to make continuing investments in technology and automation. As a result, banks are seeing profit margins shrink, and there is a feeling that economies of scale specific to technology can be achieved.

There has been an increased level of competition from non-bank financial service providers such as mutual funds, mortgage banks and mortgage brokers, finance companies, investment banks and new Internet-only banks. Banks are not only competing with other banks, but are also competing with money market funds for deposit taking. In addition, banks are losing many high quality corporate borrowers to the commercial paper market.

A competitive threat is also posed by the specialized or 'monoline' international firms, each offering a single line product such as credit cards, residential mortgages or business loans. These 'monolines' are using their economies of scale and expertise developed in their home market to expand into new markets.

Foreign bank penetration into domestic markets varies. For example, in Canada, foreign banks control less than 10% of the total banking sector [MCKA98], which is one of the lowest totals in the world. In the United States this figure is 14%.

**One-stop Shopping**

Many consumers find it convenient to have one financial institution handle all their financial service needs. Since deregulation of the banking industry in Canada, this has been made possible and banks offer many financial services including insurance. Banks can offer customers a comprehensive set of financial products, allowing consumers one “stop” for all their financial services shopping. Consumer banking is a retail business, and the predominant trend in retail has been declining market share to specialty retailers.
However, to remain competitive as a full service provider, banks' products must be competitive and this has proved to be a challenge. For example, banks have not had much success with mutual funds because their in-house funds are typically neither stellar performers nor recognized brand names. Similarly, banks are increasingly competing with narrowly focused firms with low selling costs. Many banks have not faced the issue of managing channel conflicts and may be reluctant to match the price of the cheapest provider.

2.2 Changing Retail Banking Models

In the early part of the 1990's, the goals of retail banking could be summarized as: cut unit transaction costs, off-load volume from branches and expand delivery channels. In the latter part of the decade, the industry began transforming business models from a traditional branch centric model, in favour of a multi-channel delivery model. Institutions pioneering new models were achieving ROE (return on equity) of 15-25%, unlike traditional branch-centric returns of 10%. [PARE98]

The initial cost advantage of alternative service channels was being realized and as volumes grew, so did an appreciation for their usefulness. Operating expenses of direct banking alternatives are at least 30-40% lower than those of traditional branches. [ADOL97]

Banks reorganized themselves into product specialists, channel specialists, and segment specialists [ADOL97]. The new business model of banking required coordinating multi-product, cross channel service and sales capability, efficiently tailored to individual customer needs. In 1997, Mentis reported in that 70% of large banks (deposits exceeding $4 billion) have multi-channel integration strategies in place in order to present a common face to the customer, whatever channel the customer chooses to use. [MARL97]
Banks began focusing on prioritizing customer relationships and using information technology (IT) to cross-sell products into their customer base. [MARL97] Using case-based reasoning, and data warehouse technology, banks focused on providing new information and decision support at the point of sale. For example, based on customer profile, sales agents can suggest the next best product to buy. Middleware technologies were also being used to integrate point of sale systems with other legacy banking systems.

Banks effectively were making the transition to being customer-centric, and invested in technology that would make them more customer facing, and ready to serve their customers. This was especially true in self-service or alternative delivery channels such as telephone banking and soon, Internet Banking where all the technology was extremely customer driven and responsive to customer needs. [BARR97]

2.3 Internet Banking

Internet banking was first introduced in 1996, primarily as a way to cut service transaction costs. By 1998, the Internet was just another distribution channel, and starting to look like a full-fledged business of its own. The Internet had become a major component of most financial institutions’ business strategies. [LEUC99]

Some of the largest institutions in the world, such as Chase Manhattan, Wells Fargo and Citigroup reorganized to create substantial Internet divisions. Growing internally and through acquisition, leading institutions invested heavily and explored many different strategies. Banks such as the Royal Bank of Canada and TD used the Internet to enter foreign markets with their respective acquisitions of Security First and Waterhouse. Like others taking the Internet seriously, these institutions invested heavily in technology to make their Internet businesses a success. [LEUC99]

Internet banking channel managers were faced with many questions:
What market segments should we focus on? How well does the organization and its processes support Internet strategy? Should we operate under our own brand? What are our differentiators? Should Internet banking aim to replicate the branch experience? How do you price products and services online? Should pricing vary by distribution channel or by customer segment?

These questions and more had to be answered for successful online sales.

Citigroup’s eCiti division offered a range of products through several media – set-top boxes, cell phones, the Internet, as well as ATMs in Blockbuster and Kinko’s. eCiti invested 170 million in their first year, a fraction of their $3.3 Billion annual technology budget. [LEUC99]

Under the direction of vice chairman Joseph D. Sponholz, Chase Manhattan Bank created a new division, chase.com. Chase took a different tact initially, focusing on its business clients. Business to business electronic procurement, online brokerage and electronic bill presentment and payment were among the many services it offered. [LEUC99]

Another US giant, Wells Fargo, began its Internet drive late, but it quickly gained traction with 300,000 customers in 1998, exceeding 1 million in 1999. The number of households served by Wells Fargo is expected to increase by 4% in 2001 due to Internet banking. In fact, it is expected that 2-3% of earnings are to come from new customers added from Internet banking. [LEUC99]

The Internet proved to be a powerful distribution channel, but still among many that the customer wants to interact with. Even Internet only banks discovered that they needed branches, with Security First opening an Atlanta branch in 1997. [SCOT98]

To attract new customers, Internet banks used several different tactics. For example, it was not uncommon to offer higher interest rates on deposit accounts or free ATM transactions. For Internet only banks, these tactics were possible because expenses were much lower. The
Internet divisions of existing banks resorted to strategies such as constant or flat discounts on bank products such as loans or credit cards.

Although it was evident that the Internet channel was here to stay, many banks still faced the challenge of profitability on the Internet. [KLINCO] This challenge was made more complicated by competition from Internet-only banks, and the pricing pressure that resulted. eCiti, among others, invested heavily in its Internet technology and posted a loss of $179 Million in 1999. Although online services are seen as strategic, an important means of customer retention and competitive differentiation, banks were feeling the pressure of profitability. The opportunity to use customer profitability information to understand the outcome of a new sale was being explored and invested in by many banks.

2.4 Customer Centric Strategies

As online sales grew in volume, complexity and economic importance, it was more important to ensure that sales and service online coincided with other channels to provide a seamless face to the customer. [KLIN99] With the demise of the traditional branch centric model, new enabling technologies made the customer-centric bank possible.

With a business model transformation and the need for profitable Internet banking, gathering and deploying customer information is considered the most important issue in banking. [CLIN99] It is not a product-centric strategy, [OREN97], but a customer-centric strategy that must be applied so that banks can proactively focus on the customer.

To this end, information technology should be used to [SALV99]:

a) Modernize the historically oriented data warehouse efforts into a more accessible data mart/mall

b) Incorporate analytic tools such as data mining software that help explain customer behaviour
c) Establish a layer of interactive software that facilitates electronic sales management (e.g. Customer Relationship Management or CRM software)

Banks spent millions of dollars on data warehouses and data marts/malls to gather detailed customer information. Data marts, application specific stores of customer information have been deployed to capture such information as customer decision-making behaviour. Over 70% of the large banks in the US plan to utilize data warehouses by the end of 2000. The top priority of First Union Bank is to use IT to increase sales and capture more customer information. In effect, this sentiment is transforming the data warehouse into an E-commerce warehouse [HALL99], which integrates the traditional warehouse with E-commerce data banks. Archiving all this information demands a great deal of storage and processing power for analytics. To this end, hardware and software technology costs have increased. [HALL99]. Optical storage, more CPU power, high-speed tape storage and high-speed CD-ROMs are all a part of the picture.

Valuable customer data can be mined to glean valuable insights using sophisticated data mining techniques, which have proven to be indispensable tools of the financial trade [HALL99]. There is an endless list of questions that can be asked of a data warehouse.

How can we measure a customer's affinity for certain products? What percentage of a given customer data sample is required for a promotion to be profitable? What are the odds a given group of customers will default on their loans? Why is a branch under performing? What is the percentage of customers that are likely to buy at this price?

Data mining uses defined mathematical models and complex algorithms to search large amounts of data in order to find trends. Software and the accompanying consulting services offered by vendors are typically very expensive in this regard.

Because of the complexity and costs involved, most IT heads of large institutions expressed that their marketing organizations are still unable to use the their customer data effectively. However, the more advanced financial institutions are using data mining to launch new
products and also integrating results in real-time with customer relationship management software (CRM) at the point of sale. [SALV99]

Banks like First Union (Charlotte N.C, 157 billion) have built a customer centric database holding 15 million customers including products and services used by each customer, all interactions, promotions. [OBRI98] In 1998, they had accumulated 13 months of transaction history in a terabyte scale database. They are now building a data mart, and have the ability to conduct multiple complex direct marketing campaigns simultaneously to track and monitor performance very quickly learn and adapt campaigns based on this learning.

This system will help support customer service with intelligence about customer requirements, to cross sell appropriate products, deepen their relationships with customers, and increase loyalty. This is where CRM’s are becoming more and more useful.

CRM is being used across the banking industry to maintain a unified, seamless relationship with the customer across multiple channels of delivery. CRM systems merge sales, marketing, service and support functions to present a constant face to the customer. The primary objectives for implementing CRM’s are to gain customer fidelity, to provide a personalized service to customers and to gain better knowledge about a customer.

Major US banks are spending an average of 3.1 million on CRM projects, and they expect annual revenues to grow at 8% annually because of it. [CERN99] Banks need to implement CRM one channel at a time, even though they are all related. According to the same study, 98% of banks have CRM tools for field sales forces, 85% have call centers and 71% have web sites. However, the major challenge for seeing a return on investment from CRM’s is that most banks are still organizationally structured around products and departments, and not customer segments.

CRM software is also used at the point of sale to capture customer behaviour data and store it into data marts. A data mart captures all sorts of information that can shed light on why a customer did what they did- their decision making, transaction volumes, purchase propensity and how they relate to other variables like time or day. [SALV99]
Although software integration with existing customer information systems and data warehouses is expensive, training is a primary issue. With 40,000 people in 2,500 branches, it is evident that training is a substantial part of the cost equation.

Information technology like CRM is transforming the activities at the point of sale, helping sales agents understand the customer opportunity, helping them targeting specific products to specific customers. With CRM, the transaction driven environment that is E-Commerce can be made into a richer sales environment. [OREN97]

2.5  Sales Strategies

"There is no advantage of dealing with just one bank" – Customer

The number of products sold per customer has changed little over the years, and banks have not been able to recapture market share lost to new competitors. According to an American Bankers Association Retail Banking Survey, in 1996, banks averaged 218 product/service relationships per 100 customers down from 230 in 1993. [STON97].

The vast majority of banks talk about cross selling, but cannot implement it” said James Moore, president of Mentis. [STON97]. It is only through accessing and manipulating detailed customer information particularly that banks can be successful in cross-selling. [JOHN97]

Intelligent cross-selling can only be done with CRM software at the point of sale, gleaning valuable information from a data mart to make decision recommendations to a sales agent, enabling reps to offer the right product to the right customer. Sales reps make 25 to 40 decisions per day: whether to waive a fee, suggest a product, recommend a delivery channel, or start a conversation to get more information. Deciding on the value (profitability) of a particular sales strategy is difficult to do without operational decision support.
What is absolutely vital in cross selling is to ensure that it is actually profitable. Over 60% of cross selling that takes place destroys shareholder value. A most promising area of study is to use sophisticated customer information to make operational decisions about sales, crafted to handle individual customer situations.

In fact, the typical retail portfolio consists of 20% of accounts contributing profits equaling 200% of the overall return while up to ½ of the accounts generate losses. [CARR97] This further emphasizes the need for an individual customer sales approach.

It may be useful to examine customer profitability in making a sales decision, although there are differing views on this. Some view that historical customer profitability reports offer powerful guidance for day-to-day interactions with individual clients. However, others believe that information is of limited usefulness in supporting sales and service decisions. [JOHN97]

A number of banks have gone ahead with marketing solicitations based on customer value data, selectively offering fee waivers and rate breaks to retain high value clients, and varying service responses based on customer profitability profiles. [CARR97] Such data can be used to lift unprofitable relationships, ushering people into service packages containing price incentives for using automated tellers and other low cost channels.

However, historical profitability profiles may not signal how customer will behave in the future even with currently held products, never mind for new ones being offered. In fact, historical customer profitability statistics are of limited use in decision support. [JOHN97]

It is far better to use account level data to forecast customer behaviour such as purchase propensity, service needs and repayment patterns. These projections are then coupled with bank specific cost data to calculate the net present value of the lifetime cash flow consequences of a particular decision, such as attempting to cross sell a party. [CARR98]

The ideal decision support that can be provided to a sales agent is: *if I do this, what happens, and does it add value?* In other words, the capital budgeting logic of a major structural decision is
applied to a customer level action e.g. an effective decision support tool for cross-sell
solicitation includes estimates of all cash flows associated with the decision, including expenses
of up front booking outlays, on-going account maintenance and servicing, and potential credit
losses. Clearly a decision tool is only as powerful as its estimates of customer cash flows based
on 1) customer level behavioural predictions, and 2) bank specific financial inputs.

Info from credit bureaus and other external databases can be used to predict behaviour e.g.
external credit scores, total number of credit products held, home and car ownership,
internal data about account balances, transactions and payment patterns can also be used.

In § 5, customer profitability both past and future, along with account level data (cost to
serve) are used in making dynamic pricing decisions.

2.6 Price Elasticity

Elasticity is a concept that relates the responsiveness (or sensitivity) of one variable to a
change in another variable. The elasticity of A with respect to B is equal to the percentage
change in A divided by the percentage change in B. This is shown in Equation 2.6-1.

Equation 2.6-1 Elasticity

\[ \text{Elasticity of } A / B = \frac{\text{percentage change in } A}{\text{percentage change in } B} \]

Elasticity answers the question of how much one variable will change when another one
changes. With elasticity we will be able to answer the question: If the price of a good
increases by a certain amount, then how much will the quantity demanded decrease by,
resulting from this price change. The price elasticity of demand is the measure of
responsiveness of a quantity of a commodity demanded to a change in market price. This is
shown in Equation 2.6-2. [LIPS91]
Equation 2.6-2 Price Elasticity of Demand

\[ \eta = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}} \]

**Types of Elasticity**

There are five types of elasticity:

- \( \eta < 1; \text{inelastic demand} \)
- \( \eta > 1; \text{elastic demand} \)
- \( \eta = 1; \text{unity} \)
- \( \eta = \infty; \text{perfectly elastic} \)
- \( \eta = 0; \text{perfectly inelastic} \)

When the change in price is greater than the change in quantity demanded, elasticity is said to be inelastic. Elasticity is zero, or perfectly inelastic when a change in price results in no change in the quantity demanded. When the change in quantity demanded is greater than the change in price, elasticity is said to be elastic. Elasticity is said to be perfectly elastic, when a change in quantity demanded is not accompanied by a change in price. [LIPS91]

**Determinants of Price Elasticity**

Price elasticity is largely determined by the availability of close substitutes. A commodity with close substitutes tends to have an elastic demand. A commodity with no close substitutes tends to have an inelastic demand.

The product's cost to the consumer relative to his/her income or wealth also affects elasticity: the higher the cost, the greater the elasticity. Lastly, the period of time under consideration affects elasticity: the longer the time period, the greater the elasticity.

**Elasticity and Sales Revenue (price \times quantity)**

The relationship between elasticity and sales revenue can be summarized as follows:
a) If demand is elastic, price and total revenue are negatively related. A fall in price increases total revenue and a rise in price reduces it.

b) If demand is inelastic, price and total revenue are positively related. A fall in price reduces total revenue and a rise in price increases it.

c) If elasticity of demand is unity, total revenue is constant and therefore unrelated to price. A rise or a fall in price leaves total revenue unaffected.

With this in mind, the concept of price elasticity is utilized in §5 where $\eta$ is elastic and price and total revenue are negatively related; a fall in price increases total revenue due to increased sales. This assumption is used independent of the value of the customer's relationship with the institution, which would affect the customer's purchasing decision independent of price.

2.7 Monte Carlo Simulation

Simulation can be defined as a technique that imitates the operation of a real system as it evolves over time [WINS94]. Simulations are done by first developing a simulation model that incorporates assumptions made about the real system. The resulting model can be executed on a computer to generate representative samples and their resulting performance can be measured. This can be repeated so that an average performance can be calculated, where the more samples that are used, the better the average.

The end result depends on many factors including the model, the assumptions made, the starting conditions of the simulation, and the length of time or population size being simulated.

Simulations can be static or dynamic where static simulations simulate a system at a particular point in time and dynamic simulations represent a system as it evolves over time. A simulation can be further classified as deterministic or stochastic [DUB100]. A deterministic simulation model is one that contains no random variables whereas a stochastic system does.
In a stochastic simulation, random variables need to be sampled from a selected probability distribution. This sampling from a probability distribution or random variate sampling is known as Monte Carlo sampling. It is vital that a probability distribution that best approximates the real world system is chosen for application in Monte Carlo sampling, otherwise results will have little meaning.

In § 5, a mathematical model is developed and simulated using random variables, according to a normal distribution.

2.8 Dynamic Pricing

Dynamic pricing is defined as the process where the price of a good can be adjusted dynamically in time, according to some other contextual information e.g. competitors’ prices. Dynamic pricing can be used in many different applications, although the most common is in the pricing of options or other derivative securities.

New applications of dynamic pricing have emerged in Internet businesses. An example of this is the application of bartering models to the aggregation of supply and demand. For instance, a group of small businesses can subscribe to a service like Onvia.com that aggregates their demand for office supplies, such that the group as a whole has greater buying power and through bartering can buy goods at lower unit prices. Such online bartering and access to information about goods and services was previously impossible. New efficiencies are possible by embracing dynamic pricing systems.

The financial services industry has been quick to adopt a form of dynamic pricing where prices on products and services are adjusted based on the relationship with a customer. For example, the greater the number of products or services the customer has bought, the greater the discount that they can achieve on the next product they purchase. Typically, this model is favourable if a large catalogue of products/services is offered. Active cross-selling (the act of selling an unrelated good to an existing customer) and cross-promotion (the act of promoting the sale of an unrelated good to an existing customer) enhance the success of relationship pricing models. An example of this can be found at the Washington County US Government Employees Credit Union where the credit union reduces the base rate of an
installment loan by 0.10% for each additional service utilized by the member, up to a full 1% for using all 10 available services [ANON98].

Relationship pricing tools can take many forms (e.g., premiums on deposits, discounted loan rates, waived service fees) and can be applied to many different market segments [COWL89]. Customer segmentation [BANK98] and incentives for using low cost channels [DRAK95] were shown to increase the effectiveness and profitability of different relationship pricing schemes used by US Banks and Credit Unions.

[COWL89] stresses that the almost identical nature of products offered by banks and their 'non bank' competitors is making it necessary for financial institutions to provide superior service and added value to those clients who contribute the most to the bottom line (i.e. focusing on High Value Clients (HVC's)). However, research conducted in 1998 by Datamonitor indicates that the right customer relationship pricing strategy can enable a bank to recoup as much as 85 percent of the profits it previously lost on low-profit customers [JOEL98]. While the opinions differ, one point is definitely clear, whether high value or low value, all segments can demonstrate higher profitability by incorporating new intelligence and information in the pricing decision.

Dynamic pricing does have its pitfalls however as was found out in September 2000 by Amazon.com. The online retailer performed a test on its customers, offering different prices on DVDs based on historical spending patterns. Customers quickly discovered this and Amazon was faced with a PR scandal that forced the company to refund discounts to over 7000 customers [WOLV00].
Chapter 3  Customer Profitability

3.1 The Customer Centric Bank

The goal of the customer-centric bank as described in §2 is to maximize the profitability of the customer base by cross selling bank products through several sales channels. Sales channels such as the traditional branch and alternative channels such as telephone banking and Internet banking can be used to deliver the same set of bank products to the end customer.

In order to maximize the profitability of the customer base, it is first important to examine a typical case in §3.2.

3.2 Typical Customer Bases

It is common that the ‘80-20 rule’ applies to the profitability of a bank’s customer base i.e. 20% of the customers contribute the majority of the profits. In fact, a typical retail banking customer base will have 20% of accounts contributing 200% of the overall return while up to half of the accounts generate losses [CARR97]. Therefore, customer bases are not uniform in profitability, but in fact are quite widely distributed with most customers not contributing positively to the profitability of the bank. Figure 3.2-1 is an example of a customer base at a southern U.S. bank that illustrates this. [SCOT98]
Figure 3.2-1 Customer Base Profitability Example, Colleton Bank

Figure 3.2-1 shows that Colleton Bank's customer base can be split up into three tiers, Tier I being the most profitable, and Tier III being the least profitable. Over one third of Colleton Bank's customers are Tier III customers, on whom they lose $193 thereby reducing their annual profits. Another 40% of customers are Tier II customers, and contribute only $8 per customer to annual profits. It is only 22% of the customer base that contributes to profitability in a significant manner, on average, each customer contributing $829 annually. In this example, it is in fact the case that most customers do not provide any significant contribution to the profitability of the customer base.

The Average Customer

It is useful to categorize customers in tiers of profitability for analytical purposes. This is especially true because customer bases are typically widely distributed in a non-uniform way around some mean. As a result, the concept of an average customer is not a representative one and thus not useful for analytic or direct marketing purposes. It is far more useful to create categories or tiers of profitability and model a customer within each tier in order to perform any analysis e.g. perform simulations to help design a direct marketing campaign. The number of tiers and the method of categorizing customers may differ between banks, but ultimately the creation of profitability tiers is an effective analytical approach.
The Individual Customer

Although effective compared to a non-tiered approach, creating tiers and treating all customers within a tier equally can be improved upon still by treating customers individually. This is because customers do behave differently. This is in line with the trend to one-to-one marketing over traditional product-driven marketing [MILL99].

One element of customer behaviour is the cost to serve them. It is evident that the cost to serve plays a significant role in profitability as Tiers II and III contribute nearly the same revenue ±10%, although Tier III customers, on average, cost over twice as much to serve. This disparity in the cost to serve can result from a number of different factors including the customer's choice of service channels and the customer's individual behaviour. Channel differentiated, activity based costing is integral to calculating service expenses. This is especially true for deposit accounts where channel choice, transaction type and intensity can make the difference between a profitable and unprofitable customer [MILL99]. For example, customers unfamiliar with ATM machines may still require the assistance of a bank teller to withdraw cash from a deposit account. The cost of serving a customer in the branch is much greater than the cost to serve the same customer at an ATM machine. Highly transactive customers also cost the bank more to service, especially when there are no service fees involved.

Customer Value

Individual customer profitability is clearly a variable by which a customer's value is measured. By examining historical profitability, it is obvious that only a small fraction of the customer base add to bank profitability. Losing one of these customers to another bank is a costly event since they may provide 100 times the profitability of a Tier II or III customer. It is very important to keep these customers.

Although Tier I customers are the most valuable to the bank, it is also possible (and common) for Tier II (and even Tier III) customers to migrate to Tier I over time – this is especially true for highly educated, young people. For example, a customer that is a young doctor serving his/her residency for many years completes their residency, starts practicing
and starts a family. During their residency, their salary was low and they likely incurred student loans. Upon completion of their residency, their earnings would likely substantially increase, their need for bank products such as a mortgage would increase, their cost to serve would go down as there are economies of scale in serving a customer as their number of products increases – and ultimately this customer would be more profitable than in the past.

Therefore it is important to analyze a customer’s historical profitability as well as their future potential profitability, although each has its advantages and disadvantages.

3.3 Calculating Customer Profitability

Customer profitability can be calculated by adding revenues and subtracting corresponding costs for each product a customer uses. This can then be discounted by a factor according to the time period in question to calculate the net present value of the customer’s relationship.

**Equation 3.3-1 Customer Value, Net Present Value**

\[
NPV = -CF_0 + \sum_{i=1}^{m} \left( \frac{\text{revenue}_i - \text{cost}_i}{(1 + r)^m} \right)
\]

In Equation 3.3-1, \(CF_0\) is the acquisition cost (if the customer was acquired in the period specified), revenue, and cost, correspond to a product \(i\), \((1+r)^m\) is the discount factor, \(r\) is the interest rate and \(m\) is the number discount periods. [SCOT98]

An example of calculating customer profitability is given in Table 3.3-1. McGee Bank, a North American bank with over 5 billion in assets, developed a sophisticated customer profitability system by integrating aggregate customer product holdings, activity based cost-to-serve, and assigning customers to one of five profitability tiers. [SCOT98]
### Table 3.3-1 Sales Officer A's Customer Portfolio Value, October 1 – December 31

<table>
<thead>
<tr>
<th>Customer</th>
<th>Account</th>
<th>Net Interest Income</th>
<th>Cost to Serve</th>
<th>Fee Income</th>
<th>Cost of Capital</th>
<th>Contribution Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson</td>
<td>DDA</td>
<td>$45</td>
<td>($60)</td>
<td>$10</td>
<td>($5)</td>
<td>($10)</td>
</tr>
<tr>
<td></td>
<td>MMI</td>
<td>$60</td>
<td>($15)</td>
<td>$0</td>
<td>($9)</td>
<td>$36</td>
</tr>
<tr>
<td></td>
<td>HELOC</td>
<td>$55</td>
<td>($20)</td>
<td>$0</td>
<td>($8)</td>
<td>$27</td>
</tr>
<tr>
<td></td>
<td>CC</td>
<td>$80</td>
<td>($25)</td>
<td>$10</td>
<td>($4)</td>
<td>$61</td>
</tr>
<tr>
<td>Profitability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$114</td>
</tr>
<tr>
<td>Thompson</td>
<td>DDA</td>
<td>$35</td>
<td>($35)</td>
<td>$10</td>
<td>($5)</td>
<td>$5</td>
</tr>
<tr>
<td></td>
<td>CC</td>
<td>$50</td>
<td>($15)</td>
<td>$0</td>
<td>($4)</td>
<td>$31</td>
</tr>
<tr>
<td></td>
<td>MDDA</td>
<td>$25</td>
<td>($30)</td>
<td>$0</td>
<td>($5)</td>
<td>($10)</td>
</tr>
<tr>
<td></td>
<td>CD</td>
<td>$20</td>
<td>($5)</td>
<td>$0</td>
<td>($3)</td>
<td>$12</td>
</tr>
<tr>
<td>Profitability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$38</td>
</tr>
</tbody>
</table>

McGee bank uses net interest credit/net interest income, cost to serve, fee income and the cost of capital to calculate each customer's profitability contribution on a per product basis. This is one example of how profitability can be calculated, but it is certainly not the only one.

**Implementation**

In order to practically calculate customer profitability, banks are spending vast sums on data warehouse projects that contain detailed customer information [CLIN99]. This is especially important as banks are transforming from branch-centric banks to customer-centric banks. Banks hope that data warehouse technology, and the successful use of it will help them retain their customers, while protecting them from rival banks. [CLIN99]
3.4 Strategies to Increase Profitability of the Customer Base

The primary objective of a customer-centric bank is to increase the profitability of their customer base. Three common strategies for doing this are presented below.

Sell New Products to Existing Customers

It is commonly thought that it costs more to acquire a new customer than it does to sell to an existing customer. According to a Wharton Financial Institutions Research Center study [SCOT98], it can cost $116 to sell a new product to a new customer, compared to $63 for the same transaction sold an existing customer. This difference comes from an assumed reduction in direct marketing expense of $39, and a reduction in allocated account setup costs of $14. Therefore it costs 46% less to sell a new product to an existing customer than it does to a new customer.

Inflexible Pricing for Unprofitable Customers

The retention of unprofitable customers reduces the overall profitability of the base. Giving discounts to these customers and encouraging them to buy new products which also may be unprofitable further reduces the overall profitability of the base. By selectively pricing products on a per customer basis, losses can decrease. Take for example a specific product category, the CD (cash deposit). In 1996, the overall CD profitability for McGee Bank was $36 million. The annualized savings from unprofitable customer defection through selective pricing would be $3.5 million making the projected CD profitability $39.5 million in 1997. [SCOT98]. The bank could refuse to give flexible pricing for unprofitable or marginally profitable customers to limit losses. However, there is the case of the customer that migrates to a higher profitability tier over time. Providing inflexible pricing to such a customer could result in their defection to another bank, where, in time, they may become a profitable customer, a lost opportunity due to shortsightedness.

Flexible Pricing for Profitable Customers
It is cost-effective to sell new products to existing customers because of reduced costs of direct marketing and account creation. Providing flexible pricing to these same customers can increase retention, and as a result reduce overall price sensitivity and reduce the cost of service per service transaction [SCOT98]. It therefore makes sense to provide selective pricing to customers according to their profitability level. However, a customer that is profitable historically may not continue to be profitable in the future and so such discretionary discounts can be wasted.

3.5 Using Customer Profitability Data

The three strategies presented in §3.4 point to the requirement of a better understanding of each individual customer, and their profitability. Although historical profitability data is available in data warehouses, and can be useful for direct marketing and product pricing, there are problems with using historical profitability alone:

a) Descriptive not Predictive - Historical profitability data may not suggest how a customer will behave in the future
b) Myopic - Historical profitability recorded in a given performance period may incompletely describe the value of the part relationship.
c) Retrospective - Historical profitability is a lagging metric; it incorporates specific past market conditions such as the interest rate environment, and competitive intensity.

It is a far better approach to support operational decisions with tools to handle individual customers and situations, than to use historical profitability alone. [CARR98] Account level data can be used to forecast customer behaviour such as purchase propensity, service needs and repayment patterns. These projections can be coupled with bank specific cost data to
calculate the NPV of the lifetime cash flow consequences of a particular decision such as attempting to cross-sell a product.

Consider the example in a decision on whether to cross-sell a home equity line of credit to two checking account customers Miss Smith and Mr. Jones. On a rolling 12 month basis each may have generated $55 in profits for the bank. Using historical profitability alone suggests that Mr. Jones and Miss Smith should be treated the same. However, it can be found that these customers behave entirely differently from each other. Miss Smith has a high account balance and checks written generate $55. Mr. Jones has a low account balance and a high incidence of returned checks, resulting in $55 of fees. From this example it can be seen that identical profit figures obscure important behavioural differences that may have a substantial impact on the relative attractiveness of these customers for a loan solicitation. [CARR98]

It is clear that historical profitability alone is insufficient in making decisions to increase the overall profitability of the base. In fact, a truly powerful tool would incorporate both historical profitability and other variables such as service costs to be able to project future profitability in order to make intelligent decisions such as pricing decisions at the channel point of sale.

Channel pricing and pricing strategy is explored in §4.
Chapter 4 Pricing

4.1 Price Pressure

Several factors including new products, new technology, and new competitors have increased competition significantly in the last decade, resulting in increased price sensitivity and increased downward pressure on prices of financial services products.

New Products

The Unidex Report [SCOT98] cited that from 1993 to 1996, the percentage of consumers holding relationships with four or more financial institutions doubled from 10.5% to 21.1%. During the same period, the percentage of consumers holding relationships with only one institution decreased from 35.1% to 30.2%; with two institutions from 34.0% to 30.7%; with three from 17.5% to 14.1%. According to the U.S. Federal Reserve, this was in part due to the increasingly complex needs of the consumer to purchase products such as mutual funds and retirement accounts. [SCOT98]

New Technology

Because of new technology, the time required for a consumer to find the best price for a product fell substantially. This is illustrated in Figure 4.1-1, based on research by McKinsey & Company. [SCOT98] The advent of call-centre and Internet technology effectively reduced the time to find a price by 12-30 times from 300 minutes to 25 and 10 respectively. The use of the Internet with agent technology reduced this further to 1 minute compared to 300 minutes using in-person visits.
New Competition

The financial service industry, especially in US and Canada, has seen an increased level of competition from non-bank financial service providers such as mutual funds, mortgage banks and mortgage brokers, finance companies and investment banks. Banks are not only competing with other banks, but are also competing with money market funds for deposit taking. Furthermore, banks are losing many high quality corporate borrowers to the commercial paper market.

In addition to non-bank financial service providers, banks have also faced the competitive threat posed by the specialized or 'monoline' international firms, each offering a single line product such as credit cards, residential mortgages or business loans. These 'monolines' are using their economies of scale and expertise developed in their principal market segment to expand into new geographical markets. Foreign bank penetration into domestic markets varies. For example, in Canada, foreign banks control less than 10% of the total banking sector, which is one of the lowest totals in the world. In the United States this figure is 14%.
New products, new technology and new competition are among the reasons for increased pressure on banks to price their products competitively. Consumer price sensitivity rose throughout the 1990's. In a report by the Raddon Financial Group, the percentage of CD owners that reported switching institutions for better rates increased from 33% in 1991 to 44% in 1995. [SCOT98]

4.2 Price Composition

In most retail banks, a product marketing organization typically sets product price. However, the end price that a customer pays is often a result of direct or indirect customer interaction with a sales channel.

The end price that a customer pays for a product is composed of several factors, including the cost of capital, overhead cost (product development/management), risk, sales cost, service cost and margin requirements. From a channel perspective, this can be reduced to two components: the minimum price and the maximum price.

a) Minimum Price \( (P_{\text{min}}) \): The minimum price takes into account the cost of goods: capital, overhead, and risk associated with the product.

b) Maximum Price \( (P_{\text{max}}) \): The maximum price is equivalent to the suggested retail price and must cover delivery costs (sales & service) and margin requirements. The difference between the maximum price and the minimum price is effectively the key contributor to channel net revenue.
Equation 4.2-1 Product Price Components

\[ P = P_{\text{min}} + m \]

where P is the price, \( P_{\text{min}} \) is the minimum price described above, and m is the channel margin. For any product i and channel j, Equation 4.2-1 can be generalized in the form,

Equation 4.2-2 Product Price Components, per product per channel

\[ P^{ij} = P^{ij}_{\text{min}} + m^{ij} \]

where the sales channel has control of the variable \( m^{ij} \), the channel margin. A range for channel margin can be defined so that sales agents can price products in line with channel revenue goals.

Equation 4.2-3 Channel Margin Range

\[ m^{ij}_{\text{min}} \leq m^{ij} \leq m^{ij}_{\text{max}} \]

where \( m^{ij}_{\text{max}} \) makes the product priced at the maximum suggested retail price.

4.3 Channel Pricing

As described in § 4.1, many factors have increased competition resulting in increased price sensitivity and an increased downward pressure on prices. In practice, all channels discount products in order to make sales and achieve revenue targets. How channels discount differs because of their differing capabilities and goals (resulting in inconsistent pricing) but ultimately, all of these methods do not consider customer profitability and hence do not aid the bank in maximizing the profitability of the customer base [MARL98].
Discount Model

Channels are by default price opportunistic, seeking to sell the product at the maximum possible price. This is especially true when sales agents’ commissions are tied to the value of the sale.

Regardless of the price discounting method, consider a discretionary discount $d$, 
\[ d^u \geq 0 \text{ and } d^u \leq \left( m^u_{\text{max}} - m^u_{\text{min}} \right) \]

Equation 4.3-1 Channel Pricing with Discounts

\[ m^u = m^u_{\text{max}} - d^u \]

and Equation 4.2-2 becomes

\[ P^u = P^u_{\text{min}} + m^u_{\text{max}} - d^u \]

Types of Discounts

a) Flat Discount - Flat discounts are usually given as a part of a marketing promotion to drive revenues and new customer acquisition. With a flat discount $d^u$ is constant and applies equally to all customers without regard to their profitability.

b) Heuristic Discount - Heuristic discounts are based on rudimentary rules that can be applied by a sales agent to give a customer a discount

b) Negotiated Discount - Discounts can also be negotiated face to face in a branch or over a phone, and are typically based on an existing relationship between customer and sales agent.

An example of discounting in action is given in Table 4.3-1. A loan of $50,000 is priced across three channels, a branch, in-store branch and the call-centre. In each case there is a minimum
price based on costs and minimum margin requirements. Based on the price customers are willing to pay, the average competitive price (for comparison), a final price is reached using heuristics and negotiation.

Table 4.3-1 Pricing Analysis for Fixed Rate Loan Product, by Delivery Channel

<table>
<thead>
<tr>
<th>Loan Basis</th>
<th>Pricing Analysis of Product Originated in Branch</th>
<th>Pricing Analysis of Product Originated in In-Store Branch</th>
<th>Pricing Analysis of Product Originated in Call Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost to Originate Loan</td>
<td>$200</td>
<td>$100</td>
<td>$50</td>
</tr>
<tr>
<td>Minimum Price Based on Cost</td>
<td>5.58%</td>
<td>5.54%</td>
<td>5.52%</td>
</tr>
<tr>
<td>Maximum Price Customers Willing to Pay</td>
<td>6.52%</td>
<td>6.52%</td>
<td>6.52%</td>
</tr>
<tr>
<td>Average Price of Competitors in Market</td>
<td>6.33%</td>
<td>6.33%</td>
<td>6.21%</td>
</tr>
<tr>
<td>Final Price</td>
<td>6.20%</td>
<td>6.20%</td>
<td>6.10%</td>
</tr>
</tbody>
</table>

In this example, profitability analysis can be used to reveal the minimum price needed to achieve product profitability, competitor research and analysis reveals the average competitor price in market and customer research and analysis reveals the maximum price customers are willing to pay.

The following table is a summary of the type of price discounting practiced in a retail bank such as the TD.
Table 4.3-2 Discounting Methods used in a retail Bank

<table>
<thead>
<tr>
<th>Pricing</th>
<th>Branch</th>
<th>Telephone</th>
<th>Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>List Price</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Flat Discount</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Heuristic Discount</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Negotiated Discount</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3.1 Branch Channel

The branch channel is a 'high touch, low tech' channel that has a number of advantages over other bank sales channels, but also it also suffers from certain disadvantages.

a) Scale

Branches do not have the scale in their ability to serve customers as an Internet Channel or Telephone Channel.

b) Cost of Delivery

Given the physical overhead and lack of scale, branches have the highest cost of delivery.

c) Sales capability

The branch can sell the most complex products due to the face to face interaction with customers. It is also easy for the branch to close a sale requiring a signature, or a complex set of steps like those involved in closing a mortgage. Conversely, a branch is not as efficient at closing simpler transactions like those involved with applying for a credit card.

d) Price Discounting
With respect to price discounting, branches have the greatest capability. Branches are able to provide flat discounts, heuristic discounts as well as negotiated discounts to their customers because their use of technology, physical presence and high touch nature. Other channels simply do not have this range of services. Furthermore, price negotiation based on long-term, face to face relationships can occur where the sales agent typically has a long personal history with the customer and understands their value to the bank.

4.3.2 Telephone Banking Channel

In the telephone banking channel, two discounting methods are generally used to calculate the final price; flat discounts and heuristic discounts. Negotiated discounts are used less frequently.

a) Scale

On a per call-centre basis, the telephone channel has greater scale than the Branch but not nearly the scale of the Internet channel.

b) Cost of Delivery

Telephone banking has a lower cost of delivery than branch delivery, but higher than the Internet channel.

c) Sales capability

It is easy to apply for many products over the telephone channel, but certain products such as mortgages are still difficult to sell over the telephone.

d) Price discounting capability
With respect to price discounting, the telephone channel provides flat discounts and heuristic based discounts, negotiation is infrequently used as it is based on factors like the skill-level of call-center agents which can be quite inconsistent. More common are heuristics based discounting, where for a certain product line and customer, rules can be applied by the sales agent to determine the discount that can be given. Table 4.4-3 illustrates this for a mortgage renewal. In this example, it can be seen that the number of products that a customer has with the bank is the discount-determining factor.

Table 4.3-3 Telephone Banking; Mortgage Renewal Discretionary Pricing, March 16 1998

<table>
<thead>
<tr>
<th>Term</th>
<th>First Offer if 3 Products</th>
<th>Final Offer if 5 Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>0.25% Discount</td>
<td>0.35% Discount</td>
</tr>
<tr>
<td>1 year</td>
<td>0.25% Discount</td>
<td>0.35% Discount</td>
</tr>
<tr>
<td>2 years</td>
<td>0.25% Discount</td>
<td>0.50% Discount</td>
</tr>
<tr>
<td>3 years</td>
<td>0.25% Discount</td>
<td>0.50% Discount</td>
</tr>
<tr>
<td>4 years</td>
<td>0.25% Discount</td>
<td>0.50% Discount</td>
</tr>
<tr>
<td>5 years</td>
<td>0.25% Discount</td>
<td>0.50% Discount</td>
</tr>
</tbody>
</table>

Approach

1. Offer ALL renewals/purchases at the posted rate. Our present experience suggests that most of our customers will accept the posted rate.
2. If the customer requests a preferred rate, offer ALL customers up to a 0.25% discount, if they have 3 additional TD products (including cross-sells).
3. If the customer still requests a better rate, offer all customers up to a 0.35% discount on 6 month and 1 year terms and up to a 0.50% discount on all other terms, if they have 5 additional TD products (including cross sells).
4. If the caller still requests a better rate than you have offered, speak to your Team Leader for advice on how to proceed.
5. We WILL NOT be escalating any rate requests back to the branch. Any unique customer situations/requests can be referred to a Team Lead for ...

4.3.3 Internet Channel

In the Internet channel, the flat discount model is typically used.

a) Scale

The Internet channel has the highest scale of any bank delivery channel.

b) Cost of Delivery

The cost of delivery on a per transaction basis is the lowest of all the bank delivery channels.

c) Sales capability

The sales capability of the Internet channel is the lowest of all bank delivery channels. In part this is due to the fact that it is the newest sales channel, and as a sales medium that is still maturing. Although a great number of bank customers service their accounts online, few actually buy products online. Those that do typically cannot have their sale closed online and need to go into the branch since transactions such as loans require signatures. Complex products are also hard to sell online, and typically require multi-channel involvement to close a sale. All said, the Internet channel is maturing rapidly because of its unique and expanding set of capabilities with better user interfaces, and the advent of digital signature technology.

d) Price discounting capability

With respect to price discounting, the Internet channel has the lowest capability today as flat discounts are mainly used. The lack of human to human interaction, as well as specialized
software make heuristic and negotiation based discounts difficult to implement. Flat discounts are used both for their ease of implementation and as a promotion to attract customers to a new (and lower cost) channel.

Figure 4.3-1 Flat discounts for buying online; excerpt from www.tdbank.ca

<table>
<thead>
<tr>
<th>Personal Credit Rates and Discounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click Here to launch the Loan Calculator</td>
</tr>
<tr>
<td>TD will knock 1/2% off the rate just for applying on the web!</td>
</tr>
<tr>
<td>Get saving now!</td>
</tr>
<tr>
<td>Applies to TD Unsecured Select Line, Car Loan and TD Personal Term Loans.</td>
</tr>
<tr>
<td>Excludes TD Home Equity Select Line, TD RRSP Loan at Prime and TD RRSP Carry Forward Loan</td>
</tr>
</tbody>
</table>

4.4 The Pricing Challenge

Factors noted in § 4.1 have increased the need to price competitively. Flat discounts, heuristic discounts and negotiated discounts are used in today's retail bank in order to make sales and achieve revenue targets. The type of discount largely depends on the sales channel as does the implementation of that discount. The amount of the discount is traditionally dependent on the channel and product for the most part, and not on customer profitability.

Offering a discount without considering customer profitability both historical, and future potential ignores the value of the customer to the bank. This practice can result in missed sales and customer defection which goes against the goal of the customer centric bank: to maximize the profitability of the customer base. A solution to this problem is proposed, modeled and simulated in §5.

4.5 Hypothesis
A pricing model that calculates a price based on channel costs, customer profitability and value of a new sale opportunity should always result in a more profitable customer base.

Specifically, the change in annual profitability of a customer base treated with this pricing model should always surpass the change in profitability due to the use of a flat discount or random discount based pricing model.
Chapter 5  Proposed Solution

5.1  A Dynamic Pricing Service

5.1.1  Background

Like many banks, TD aimed to convert service channels (telephone and Internet) into sales channels. At the same time, the bank was in the midst of transforming itself into a customer-centric bank from a traditional branch-centric bank. The mission of a customer-centric bank is to maximize the value of the customer base by cross selling new products. This requires that the value of the customer base be maximized across all sales channels.

5.1.2  Problem

The introduction of telephone banking made it easier for customers to carry out extensive price comparisons. Internet banking enhanced this further, resulting in greater price sensitivity and customer churn. Augmenting this problem was the pricing pressure from new competitors. To address the problems caused by increased price sensitivity, channels created their own price discounting schemes to compete necessarily cutting into their margins. As a result, channel pricing was not only inconsistent, but potentially damaging to the very goal of being customer-centric by not taking into account customer value. Varying channel delivery costs added to the problems. Furthermore, channel conflict occurred and most importantly, the profitability of the customer base was not optimal.

5.1.3  Solution Goal

The primary goal of a customer-centric bank is to maximize the profitability of the customer base, and any solution considered should aim to achieve this same goal.
5.1.4 Solution Requirements

The requirements for any solution are defined to:

1) Provide a pricing model that can be used across sales channels to address increased price sensitivity.
2) Determine the price offered to the customer by:
   a. Considering customer profitability
   b. Considering channel sales and service costs
   c. Considering product costs

5.1.5 Proposed Solution

The solution proposed involves the incorporation of a pricing service into the bank's information technology infrastructure. This service would be made available to all channels - whether the sales agent is a sales person in the branch, an agent in a call centre or a web site in Internet banking. This pricing service would utilize a mathematical model to calculate a price discount for a given customer, channel and new sale opportunity.

5.2 General

It is clear that the price is not only based on the product's cost/value, but also on the channel sales and service costs and most importantly, customer profitability. This channel pricing mechanism is designed to operate so that each pricing decision aims to maximize the value of the customer base.

Figure 5.2-1 outlines the basic components to this model: an existing customer, a new sale opportunity, a channel, a pricing service, and several databases containing customer, product and channel data.
At the core of the pricing service is an application running as a process on some platform e.g. Microsoft Windows NT, Unix, Linux or in the case of large Banks, on IBM Mainframe technology. This can be implemented in many ways, and would likely depend on the bank’s existing infrastructure and use of programming languages e.g. Java, C++, Cobol. For this reason, the application and its architecture are described only in general terms.

**Application**

The primary function of the software is to accept input from a calling application (customer service application, Internet site, branch green-screen, Internet phone), and return output that includes a price. To do this the application must include an interface for input/output, a data access layer to access stored information in bank databases, and price calculation logic.

**Interface**

This process should have an open (protocol) interface for easy integration into existing applications e.g. a customer service application, Internet site, branch green-screen, Internet phone site. The interface should also be extensible to include additional information in the future. An HTTP interface accepting XML data, and responding using XML would be ideal. This interface would accept customer information and new sales opportunity information,
and then access customer profitability information, product cost and margin information, channel sales and service cost information in order to calculate a price. The application would return a pricing recommendation to the calling application.

**Architecture**

Two architectures most easily satisfy these requirements: a two-tier and a three-tier architecture. A two-tier architecture involves both interface logic and business logic running together on a server like an HTTP server, and data being served by some database or file server, preferably an RDMS type system. This architecture would involve the lowest cost and complexity, but may encounter scalability or manageability problems if the complexity of the pricing service is enhanced over time. A three-tier architecture separates interface logic from business logic into two different layers: a web server and an application server. While this option would involve the greatest cost and complexity at first, it might not run into scalability and manageability problems in the long term. Ultimately, a two-tier architecture can be migrated to a three-tier architecture as needed.

**5.3 Mathematical Model**

A mathematical model is developed to describe the customer, customer base, product, price, pricing model, and sales transaction so that simulations can be performed to test the hypothesis in §5.1. Simulations (described in §5.4) use the mathematical model to depict a series of customer new sales opportunities, in order to test various pricing models.

**5.3.1 The Customer**

In modeling a customer of the bank, it is important to consider the goals of the pricing service— to maximize the profitability of the customer base. Therefore customer value is the primary aspect of the customer that should be modeled.
5.3.1.1 Customer Value

Customer value can be described subjectively using variables like customer age, relationship lifetime, or number of products. However, in each of these cases the correlation to customer profitability is highly dependent on local factors such as demographics, that define the bank’s customer base.

Age

A customer’s age can be used to determine their value. It can be shown that typically, middle-aged customers are worth, on a current basis, more to the bank than 20-somethings since they are likely to have more wealth after a lifetime of earnings. However, it also can be shown that middle-aged customers are more costly to service compared to 20-somethings which use high-tech low cost service channels. Who is more profitable? The middle-aged higher wealth, higher cost customers or the 20-something lower wealth, lower cost customers? In most cases, age cannot be a conclusive measure of customer profitability. However, it is much less expensive to look up a customer’s age than it is to calculate customer profitability.

Relationship Lifetime

A customer’s lifetime relationship with the bank can also be used to determine their value. It stands to reason that longtime customers are likely more valuable customers than brand new customers. This is because longtime customers probably use more bank products than new customers. However, a new customer defecting from another bank may buy several products at the outset of their relationship. Also, an existing customer with a longtime relationship may only have a few products with the bank. For these reasons, relationship lifetime is not a conclusive measure of a customer’s profitability to the bank although it too, is less expensive information to access.

Number of Products
The number of products a customer purchases can be used to determine their value. It can be shown that a customer with more products will be more profitable than a customer with fewer products. However, a customer may have several products and in fact, cost the bank so much in service that they are not profitable at all. The number of products a customer uses is not a conclusive measure of a customer’s value to the bank, although it is less expensive information to access albeit more expensive than age and relationship lifetime.

5.3.1.2 Customer Profitability

At the end of a fiscal quarter or fiscal year a bank is measured on its profitability. A customer centric bank aims to maximize the profitability of its customer base to increase the overall profits of the entire bank.

The profitability of an individual customer can be calculated (as shown in Equation 5.3-2) using historical transaction data. This data can be used over differing time periods to determine how valuable an individual customer actually is, considering both the revenues and costs associated with the customer and their products. Customer profitability is used as a measure of a customer’s value to the bank.

Several time periods can be examined:

a) Profitability in the Entire Relationship Lifetime – A long term view of past profitability of a customer, dependent on their relationship lifetime may prove to be an ineffective view of customer profitability because of the relevance of the oldest data. For a new customer, this data would be relevant, but its relevance for a customer of 20 years is questionable. It is also highly unlikely that a bank would have all customer transactions in detail available in a data warehouse because of the costs of storage and the effects of rapid technological change which results in serious incompatibilities between old and new databases.

b) Profitability in the Last Year (or two or three years) – A medium term view of a customer can be used to determine how valuable the customer has been in the recent past, avoiding seasonal affects of a short term view but retaining some part of the
relevance of a long term view. However, it is not sufficient to determine future profitability itself, although one component to the cost element, the service cost, can be examined and used to make future projections.

c) Profitability in the Last Month - A short-term view can be used to determine how valuable the customer is in the present, compared to other customers. However, this gives no indication of how profitable a customer has been in the longer or medium term past, and will likely include the effects of seasonality which can badly distort the results.

d) Profitability in the Next Month - A short-term view of future profitability can be projected based on the last month and any new sales and their associated profitability considering all costs. This projection can be considered with a low degree of uncertainty given that profitability is dependent on customer behaviour, and that can only be estimated based on historical performance.

e) Profitability in the Next Year - Can be projected based on the last month and any new sales and their associated profitability. This projection should be considered with a degree of uncertainty given that profitability is dependent on customer behaviour, and that can only be assumed to remain constant.

A component of profitability within a given product is the cost of servicing the product. This cost is dependent on the number of times a customer requires service and the cost of that service which will vary on a channel-by-channel basis. Not surprisingly, this is not constant throughout a customer base. Some customers are extremely costly, meaning they use the most costly service channels, and they require a great deal of service and support. Other customers cost very little to service since they require service infrequently and/or they use inexpensive service channels like the Internet. The service transactive nature of a customer is a behavioural trait, and it directly affects that customer’s profitability, both past and future.

**Modeling Profitability**
For the purpose of this model, customer value will be modeled directly using past (annual) profitability, and the service transaction nature. The profitability of an individual customer is defined generally in equation 5.3-1.

**Equation 5.3-1 Customer Profitability**

$$V^t = \sum_{i=1}^{s} R_i - \sum_{i=1}^{s} C_i$$

$V^t$ is the customer profitability, $R_i$ represents the revenue from a product $i$, over all products, and $C_i$ represents the costs associated with selling and servicing product $i$. $R_i$ and $C_i$ can take many functional forms, according to the type of product being sold and how that sale or cost is accounted for. It is expected that every organization will have a slightly different calculation of customer profitability depending on information availability, and local factors.

It is useful to think of profitability at some time period $\Delta t = t_f - t_i$, e.g. 1 year.

**Equation 5.3-2 Time-based Customer Profitability**

$$\overline{V^t}(\Delta t) = \sum_{i=1}^{s} \overline{R}_i(\Delta t) - \sum_{i=1}^{s} \overline{C}_i(\Delta t)$$

where $\overline{V^t}$ is the rate of profitability with units of $\$/time.

**Modeling Customer Base Profitability**

Equation 5.3-2 can be extended to calculate the profitability of the customer base by adding $\overline{V^t}$ over all N customers, as shown in Equation 5.3-3 below.

**Equation 5.3-3 Customer Base Profitability**

$$\sum_{n=1}^{N} \overline{V^t}(\Delta t) = \sum_{n=1}^{N} \left( \sum_{i=1}^{s} \overline{R}_i(\Delta t) - \sum_{i=1}^{s} \overline{C}_i(\Delta t) \right)$$
Implementation

Through the use of data warehousing systems, many banks have the transaction data that can be used to calculate profitability on a monthly basis. Therefore, it is reasonable to assume that the monthly customer profitability data is available for use in any calculations. It is also reasonable to expect that year-old data is warehoused. However, it is unreasonable to assume that data exists for the entire relationship lifetime of the customer, unless s/he is a relatively new customer—within the data range. For the purpose of this model, it is assumed that one year of profitability data does exist for each customer.

Modeling Service Transactive Nature

Service transactive nature can be modeled as a constant, by taking the average number of transactions per month from historical data, which is available in a data warehouse.

Therefore, each customer will have a characteristic service transactive nature $T^x$, that can be used to calculate the cost of servicing a product. It is assumed that the transactive nature stays, on average, constant into the future. The cost of servicing a customer on a monthly basis can be determined according to Equation 5.3-1.

Equation 5.3-4 Monthly cost of servicing a customer

$$C_{service} = \bar{T} \cdot c^x_{\text{service}}$$

Where $c^x_{\text{service}}$, the cost of a service transaction for a given channel, and product is a constant and $\bar{T}^x$ is the average monthly service transactive nature for a given customer, expressed in transactions/month.
5.3.1.3 Customer Base Distribution

Any given customer base will have a profitability distribution in a range of profitabilities between \( \min V^k \) and \( \max V^k \). In theory, there may be several distributions. Four distributions are discussed below.

Flat Profitability Distribution

In a flat distribution all customers have the same profitability. This type of distribution is extremely unlikely and not practical in the banking industry.

Figure 5.3-1 Flat Profitability Distribution

<table>
<thead>
<tr>
<th>Number of Customers</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Uniform Profitability Distribution

In a uniform distribution, there are an equal number of customers for every measure of profitability. This type of distribution is also extremely unlikely and not practical in the banking industry.
Normal Distribution

In a normal distribution, the customer base is normally distributed around a mean $\mu_v$ with a standard deviation of $\sigma_v$. Most customers have mean profitability. This type of distribution is more likely in a retail bank where the customer base is diverse.

In a retail bank with a customer base that consists of mass market consumers, the distribution is likely centred above $0$, as described in § 3, since retail banks often have a base where most customers are largely unprofitable. In a private bank or an affluent segment of a retail bank's customer base, most customers are profitable, and therefore the distribution is centred about a high positive mean.
Figure 5.3-3 Normal Profitability Distribution

Modeling the Customer Base

The types of customers that a bank has will likely depend on many factors including the type of bank, its location(s), product lines, and types of channels. Ultimately, these factors will affect the mean profitability, and the standard deviation of the mean in a normally distributed base. For the purpose of this research, 2 distributions will be simulated using the normal distribution: a low profitability customer base and a high profitability customer base. In addition, the service transactive nature will also be modeled according to a normal distribution.

5.3.2 The Product

For the purposes of calculating profitability, a product can be modeled using two functions, a revenue function and a cost function. Most products will have dissimilar sets of functions, although certain classes of products will have similar sets of functions. For example a credit card would have a different set of functions from a personal term loan. For the purpose of this research, only one product is modeled: the personal term loan. The term loan can be modeled with a principal quantity q, a term N, and an interest rate r, which is effectively the price of the product.
The revenue function from a term loan is the interest income earned from the customer's loan payments. It is assumed that an equal monthly loan payment model is used. In this model the component of the payment that is interest portion of the payment varies on a monthly basis.

**Equation 5.3-5 Product Revenue**

\[
A = q \frac{r(1+r)^N}{(1+r)^N - 1} \\
A = A_i + A_q \\
R(q, N, r) = \sum_{n=1}^{N} \frac{(A - A^*_q)}{(1+r)^n}
\]

where \(A\) is the monthly payment on a loan \(q\) with interest rate \(r\) (annual rate divided by 12 here) over a term \(N\) (in months here), \(A_i\) is the interest portion of the payment, and \(A_q\) is the principal portion of the payment. \(R\) is the total revenue from the loan and it is calculated by summing, over all payments, the net present value of each interest portion of a loan payment. Additionally, the product revenue could include service fee revenue, although that is not modeled in this study.

The cost function of a personal term loan consists of three components: the cost of sale (which is accounted for in the first month), the monthly cost of service, and the cost of capital. The cost of sale is assumed to be constant on a per channel, per product basis. The cost of service is assumed to be based on the average cost on a per channel, per product basis multiplied by the service transaction nature of the customer which is an average, expressed in transactions/month. The actual cost of service will depend on the number of service transactions, which is dependent on the service transaction nature of the customer. The cost of capital is based on an internally-set, bank interest rate \(r^*\) on the principal outstanding.

**Equation 5.3-6 Product Costs**

\[
C(q, N, r^*, T^i) = c_{sale}^i + \sum_{n=1}^{N} \frac{T^i c^{i_{service}}}{(1+r^*)^n} + c_{capital}(q, N, r^*)
\]
where \( i \) is the product, \( j \) is the channel, \( k \) is the customer, \( N \) is the term of the loan, expressed in months.

### 5.3.3 The Price

The price \( P^i_{ij} \) of a product \( i \), can be determined at the sales channel \( j \) using Equation 4.3-1. This equation assumes that channels are opportunistic, starting at a maximum price and giving discretionary discounts according to some pricing model.

**Types of Discounts**

a) **Flat Discount** \((d^i = a)\). This is the case where the discount is based on some constant \( a \), and is the same for all customers. The trivial case (no discount; \( a = 0 \)) is also considered.

b) **Random Discount** \((d^i = u; u \) is a uniform random variable\). This case is not used in practice but is useful to represent other pricing methods that incorporate information with little correlation to customer profitability. This method is also useful to compare with a calculated discount.

c) **Calculated Discount** \((d^i = f)\). This is the case where the discount is calculated in real-time according to a mathematical function.

**Pricing Model: Calculated Discount**

It is hypothesized that a pricing model that calculates a price (or discount) based on channel costs, customer profitability and new sale opportunity should always result in a more profitable customer base.
Equation 4.3-1 can be rewritten with the customer index, k, to reflect this.

**Equation 5.3-7 Channel Pricing with Customer Based Discounts**

\[ P_{ij}^k = P_{\min}^k + P_{\max}^k - d_{ij}^k \]

The pricing model can incorporate several variables. It is the focus of this research to show that a calculated discount using customer profitability should always result in a more profitable customer base – it is not an exhaustive search for the optimal function, although this could be the topic of future work. In this light, the following variables are used to calculate \( d_{ij}^k \): past customer profitability, customer service transactive nature, and projected customer profitability.

**Equation 5.3-8 Calculated Discount**

\[ d_{ij}^k = \Theta \left( \nu_{ij}^k, \nu_{ij}^*, \bar{T}^k \right) \]

It stands to reason that the greatest discount should go to the most profitable customers. However, there is no guarantee that customers who were profitable in the past will continue to be profitable in the future, and so it is reasonable to explore that the greatest discount should go to the most potentially profitable customers in the future, based on the immediate sale opportunity. We must not forget to deal with presently very profitable clients to ensure that they stay with the bank.

**Equation 5.3-9 Calculated Discount based on Past Profitability**

\[ d_{ij}^k = \Theta \left( \nu_{ij}^k, \bar{T}^k \right) \]
Equation 5.3-10 Calculated Discount based on Future Profitability

\[ d_{ijk} = \mathfrak{D}\left(V^{*}_{ijk}, T^e \right) \]

The functions represented in 5.3-9 and 5.3-10 can take different functional forms. The function investigated uses the logarithmic form. According to the Advisory Council on Financial Competition study, "Principled Price Concessions", the logarithmic form is a sensible form since the discount increases with customer profitability, and levels off at an accepted maximum discount for the best customers. [SCOT98]

Figure 5.3-4 Logarithmic Customer Discount Function; \( y = \log x \cdot c \)

5.3.4 The Transaction

The sales transaction is one outcome of a sales workflow that is outlined in Figure 5.3-7. This is assumed to be the workflow for the purposes of this research.
1. The workflow begins with an existing customer contacting a sales agent via a sales channel, with the desire to purchase a quantity of an available product. This sales agent can be a human or an automated information system such as a Website.

2. The sales agent presents the customer with a price calculated by the pricing service.

3. The customer makes a purchasing decision.

4. If the customer decides not to purchase at the given price, they may choose to defect, not buy anything or even leave the bank.

5. The customer stays and does not affect the value of the customer base.

6. The customer defects and may subtract (if they are profitable) or add (if they are unprofitable) value to the customer base.
7. The customer buys the product at the given price and adds value to the customer base.

This workflow is not exhaustive, but an example of a simple way to model customer behavior in a new sales opportunity.

Assumption: Buyer Readiness

For the purposes of this model, and the simulation that follows, it is assumed that all customers coming into the channel are qualified (i.e. credit worthy), can make a decision to buy and have a genuine need for the product in question, a personal term loan.

Potential Value of a New Sale

Assuming a constant term of the term loan, a quantity \( q \), and a price \( P \), the value of the sale can be determined for the first year using Equation 5.3-11.

**Equation 5.3-11 Value of a New Sale**

\[
V^\mu(q, N, P, r^* , T^k) = R(q, N, P) - C(q, N, r^* , T^k)
\]

**Actual Value of a New Sale**

If the customer decides to buy, then the value of the new sale is denoted by \( +V^\mu \). If the customer decides not to buy, then the value of the new sale is zero.

**Purchasing Decision**

To model the purchasing decision, it is assumed that each customer new sale opportunity has a probability \( \rho_{sale} \), of converting into a sale.
Equation 5.3-12 Purchasing Decision Probabilities

\[ \rho_{sale} + \rho_{no sale} = 1 \]

It is also assumed that customers are price opportunistic, and have perfect information on the competition, and therefore have an average expected price \( P_{ave} \) in mind. It is assumed that most customers would buy the product at the average expected price. This can be modeled by a normal distribution centred on the average expected price, assuming that price elasticity of demand is less than zero, or elastic, meaning that a fall in price will result in a rise in demand, sales and revenue.

Figure 5.3-6 Purchasing Distribution centred on \( P_{ave} \)

![Purchasing Distribution](image)

Defection Decision

If a customer chooses not to buy, they may also choose to defect. The probability of a customer defection can also be examined and factored into the simulation, since a defection could have a negative effect on the overall profitability of the customer base.

Equation 5.3-13 Defection Decision Probabilities

\[ \rho_{defect} + \rho_{nodeflect} = 1 \]
Assuming the customer defects, the change in the customer base is \( -V^t \), or their annual profitability in the last year, projected into the future. This assumption is a difficult one to make based on limited information. For example, a term loan in a customer's existing product portfolio may come to an end in a very short period of time if s/he is currently shopping to replace an existing loan facility, thus reducing the overall effect of a customer defection.

Because of the limited data available on defection (due to its sensitivity) and the limited information about the projected future value of the existing product set, customer defection is not strongly examined in this model and the simulation that follows.

### 5.4 Simulation

The purpose of the simulation is to examine the mathematical model, and specifically, the proposed pricing model, comparing it to other pricing models. The change in annual customer base profitability is used for comparison in each case.

**Channel**

One channel is modeled in the simulation, with a $50/sale and $10/service transaction.

**Product**

The product modeled is a personal term loan with a cost of capital of 6%, a channel minimum price of 7% and a channel list (maximum) price of 9%. The average expected price is 8% ± 0.5%.

**Customer Bases**

To begin with, two customer bases are simulated using the normal distribution: a low profitability customer base and a high profitability customer base. Each customer has a past (annual) profitability level modeled using the normal distribution, a service transactive nature.
modeled using the normal distribution and a desired term loan amount, modeled with a uniform distribution between $5,000 and $50,000.

In the low profitability customer base, the mean profitability is $0 and the standard deviation is $600. The transactive nature is 3±1 transactions/month. In the high profitability customer base, the mean profitability is $600 and the standard deviation is $600. The transactive nature is 2 ± 1 transactions/month.

Pricing Models

Three pricing models are simulated: flat discount (including the trivial case), random discount, and calculated discount including both past profitability and future profitability. Each model is examined in both a low profitability customer base, and a high profitability customer base.

Flat discounts from 0% to 2% (the maximum discount) with increments of 0.25% are modeled. Random discounts are generated between 0% and 2% using a uniform distribution. Two calculated discounts are generated, one based on past profitability and the second based on future profitability.

Purchasing

The purchasing decision is modeled using the concept of an average expected price, which is set to 8% ± 0.5%, using a normal distribution.

Defection

The defection decision is modeled in a simplistic manner, for those customers who choose not to buy using a constant probability of defection, set to 0.5%.

Simulation Tool
The simulations are done using Microsoft Excel 2000 with Monte Carlo simulation and the mathematical model depicted in §5.3.

Results are reported and analyzed in §6 and specifically the sensitivity of the results to certain aspects of the mathematical model is explored.
Chapter 6  Results and Discussion

6.1  Results

The mathematical model developed in §5 was executed using Microsoft Excel in order to produce the following results shown in §6.1. These results are discussed in §6.2

6.1.1  Customer Bases

Two customer bases were simulated, one low profitability base representative of mass market consumers and the other, a high profitability base representative of affluent (High Net Worth - HNW) customers.

Low Profitability

The low profitability customer base results are shown in Figure 6.1-1 the simulation run had 1,000 customers, a mean annual profitability of $0 and a standard deviation of $600. Of these customers, just over half (503) were profitable, and the total annual profitability of the base was $6,595.94. The base can be segmented into 3 tiers, Tier I being the most profitable and Tier III the least profitable. It was found that 22% of the customers were contained in Tier 1 and contributed the majority of the net income, on average, $817 per customer per annum. Tier II customers (49% of the base) each contributed $79 per annum and the remaining 29% of the base were in Tier III, and highly unprofitable. Low profitability customers had a service transactive nature normally distributed about a mean of 3 transactions per month, with a standard deviation of 1 transaction. They typically sought out loans between $5,000 and $50,000 according to a uniform distribution.
High Profitability

The high profitability customer base, shown in Figure 6.1-2, was simulated with 1,000 customers, a mean annual profitability of $600 and a standard deviation of $600 using the normal distribution. Most of these customers, 818, were profitable, and the total annual profitability of the base was $587,672.27. The base can be segmented even though most of the customers are profitable. It was found that 31% of the customer base was in Tier 1 and contributed the 68% of the wealth, on average, $1,299 per annum. Tier II customers (37% of the base) contributed $598 per annum and the remaining 32% of the base were in Tier III, and marginally unprofitable contributing ($86) to profitability. High profitability customers had a service transactive nature normally distributed about a mean of 2 transactions per month, with a standard deviation of 1 transaction. They typically sought out loans between $5,000 and $50,000 according to a uniform distribution.
6.1.2 The Product and Price

The product modeled in this simulation was a personal term loan, with a term of 36 months, a minimum price of 7% and a maximum suggested retail price of 9%. The average expected interest rate used in the simulations was 8 ± 0.5%.

6.1.3 The Channel

The simulation tested one channel, unspecified by name, with a cost of sale of $50 and a cost of service of $10.

6.1.4 Pricing Models

Three pricing models were tested, a flat discount, a random discount and a calculated discount.
6.1.4.1 Flat Discount

Flat discounts of 0 to 2% were tested and the change in annual customer profitability was measured.

Low Profitability

As expected, as the discount increased, more customers chose to buy. Initially, the increase in discount resulted in increased change in annual profitability; however, profitability reached a maximum at a discount of 0.86% and proceeded to decrease at higher discounts, becoming negative at ~1.25%. This effect is primarily due to more loans being sold at a loss because of high service costs outbalancing interest income.

Figure 6.1-3 Effect of Flat Discounting on Low Profitability Customer Base

An optimal price discount of 0.86% resulted in a change in annual profitability of 653.3% to $43,088.36. This is compared to a zero discount in Table 6.1-1. A zero discount resulted in a change in annual profitability of (+125.7%) or $8,288.78.
Table 6.1-1 Flat Discount Comparison in Low Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base Profitability ($)</th>
<th>Flat Discount=0</th>
<th>Flat Discount=0.86%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$313,223.33</td>
<td>$105,876.01</td>
</tr>
<tr>
<td></td>
<td>(+4748.7%)</td>
<td>(+1605.2%)</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$8,288.78</td>
<td>$43,088.36</td>
</tr>
<tr>
<td></td>
<td>(+125.7%)</td>
<td>(+653.3%)</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.6%</td>
<td>40.7%</td>
</tr>
<tr>
<td>Number of Sales</td>
<td>26</td>
<td>391</td>
</tr>
</tbody>
</table>

High Profitability Customer Base

The application of a flat discount in a high profitability customer base resulted in a similar discount-profitability curve as the low profitability base. The optimum discount was 1.20% at which point profitability started to decrease the greater the discounts, becoming negative between 1.75% and 2%.
An optimal price discount of 1.20% resulted in a change in annual profitability of 14.97% to $87,987.27. This is compared to a zero discount in Table 6.1-2. A zero discount resulted in a change in annual profitability of (+1.8%) or $10,474.99.

Table 6.1-2 Flat Discount Comparison in High Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base Profitability ($)</th>
<th>Flat Discount=0</th>
<th>Flat Discount=1.20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$432,428.03</td>
<td>$142,284.55</td>
</tr>
<tr>
<td></td>
<td>(+73.6%)</td>
<td>(+24.2%)</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$10,474.99</td>
<td>$87,987.27</td>
</tr>
<tr>
<td></td>
<td>(+1.8%)</td>
<td>(+14.97%)</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.4%</td>
<td>61.8%</td>
</tr>
<tr>
<td>Number of Sales</td>
<td>26</td>
<td>655</td>
</tr>
</tbody>
</table>
Summary

If the average expected price is less than the maximum suggested retail price, and the standard deviation is small, it is generally true that a zero-discount pricing model will result in minimum volumes and sub-optimal customer profitability. This effect is amplified in an affluent customer base where every sale is significant compared to a mass-market customer base where sales are typically less significant.

Flat discounts can boost profitability in either type of customer base, and do so optimally at an optimal discount that is characteristic of the customer base. A customer base can be more accurately modeled with better information than was simulated in this research to predict an optimal flat discount. Of course, this would be based on a number of assumptions like the ones made in §5, about the service transaction nature of a customer remaining constant into the future, and relatively constant across product lines.

It is important to find the optimal flat discount in a low profitability customer base since choosing a discount that is too high can severely undermine profitability. At the very least, a negative outcome can be avoided by modeling and simulation. Therefore, in offering a flat discount to customers over the Internet channel, as is common practice, it is important to choose an optimal flat discount. In a high profitability customer base, most discounts (less than the maximum discount) can result in a positive change in profitability because of the low service cost nature of the customers. However, choosing an optimal flat discount can result in significant returns for the bank.

6.1.5 Random Discount

A random discount, generated using a uniform distribution with a range of 0 to 2% was tested as a baseline comparison for calculated discounts, and also to simulate the effect of using information with little correlation to customer profitability to select discounts, such as in heuristic discount models.
6.1.5.1 Low Profitability

The results of applying a random discount for a low profitability customer base are shown in Table 6.1-3.

Table 6.1-3 Random Discount Comparison in a Low Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base</th>
<th>Flat Discount = 0</th>
<th>Flat Discount = 0.86%</th>
<th>Random Discount (average discount = 0.99%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability ($)</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
</tr>
<tr>
<td>Last Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$313,223.33 (+4748.7%)</td>
<td>$105,876.01 (+1605.2%)</td>
<td>$73,270.25 (+1110.8 %)</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$8,288.78 (+125.7%)</td>
<td>$43,088.36 (+653.3%)</td>
<td>($7,849.09 (-119%)</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.6%</td>
<td>40.7%</td>
<td>-10.7%</td>
</tr>
<tr>
<td>Number of Sales</td>
<td>26</td>
<td>391</td>
<td>487</td>
</tr>
</tbody>
</table>

In this low profitability case, a random discount results in a comparably worse result than offering no discount at all. Offering a zero discount results in a change in profitability of 125.7%, whereas a random discount results in a change of -10.7%. It follows that a random discount is also worse than an optimal flat discount.

6.1.5.2 High Profitability Customer Base

The results of applying a random discount for a high profitability customer base are shown in Table 6.1-4.
Table 6.1-4 Random Discount Comparison in High Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base Profitability ($)</th>
<th>Flat Discount -0</th>
<th>Flat Discount -1.20%</th>
<th>Random Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$432,428.03</td>
<td>$142,284.55</td>
<td>$189,945.06</td>
</tr>
<tr>
<td></td>
<td>(+73.6%)</td>
<td>(+24.2%)</td>
<td>(+32.3%)</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$10,474.99</td>
<td>$87,987.27</td>
<td>$47,209.18</td>
</tr>
<tr>
<td></td>
<td>(+1.8%)</td>
<td>(+14.97%)</td>
<td>(+8%)</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.4%</td>
<td>61.8%</td>
<td>24.9%</td>
</tr>
<tr>
<td>Number of Sales</td>
<td>26</td>
<td>655</td>
<td>492</td>
</tr>
</tbody>
</table>

In this high profitability case, a random discount results in a comparably worse result than offering a flat discount but it improves on a zero discount. Offering a zero discount results in a change in profitability of 1.8%, a flat discount results in 14.97% and a random discount results in a change of 8%.

**Summary**

A flat discount showed better results than a random discount. This is not surprising since a random discount model is likely to provide a high discount to a costly, unprofitable customer, resulting in a costly sale, and also a low discount to a low cost, profitable customer resulting in no sale. On the other hand, a flat discount offered appropriately, can result in a balance between high cost, unprofitable customers, and low cost, profitable customers.
Pricing decisions based on information uncorrelated to customer profitability (e.g. certain heuristics) can be dangerous in low profitability customer bases. In high profitability customer bases random discounts may yield positive results because of the nature of the customer base itself; hence heuristics using information uncorrelated to customer profitability may still provide positive results, although due to random effects.

6.1.6 Calculated Discount

Two types of calculated discounts were generated and tested, one based on past profitability and another based on future profitability. The change in annual customer profitability was measured and results were compared to flat discounts and random discounts.

Low Profitability

Results for a calculated discount in a low profitability customer base are shown in Table 6.1-5. A calculated price based on past profitability results in a 612.4% increase in annual profitability whereas a calculated price based on future profitability results in a 1,224% increase in annual profitability. In this case, a calculated price based on future profitability outperforms the one based on past profitability by as much as 100%.

A calculated price based on past profitability is comparable to results from offering an optimal flat discount. However, a calculated price based on future profitability significantly improves on an optimal flat discount and a calculated discount based on past profitability.
### Table 6.1-5 Comparison of Calculated Discounts in Low Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base Profitability ($)</th>
<th>Flat Discount=0</th>
<th>Flat Discount=0.86%</th>
<th>Random Discount</th>
<th>Calculated Based on Past Profitability</th>
<th>Calculated Based on Future Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
<td>$6,595.94</td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$313,223.33</td>
<td>$105,876.01</td>
<td>$73,270.25</td>
<td>$146,531.12</td>
<td>$98,743.48</td>
</tr>
<tr>
<td>Delta</td>
<td>(+4748.7%)</td>
<td>(+1605.2%)</td>
<td>(+1110.8%)</td>
<td>+2222%</td>
<td>+1497%</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$8,288.78</td>
<td>$43,088.36</td>
<td>($7,849.09)</td>
<td>$40,393.80</td>
<td>$80,749.40</td>
</tr>
<tr>
<td>Delta</td>
<td>(+125.7%)</td>
<td>(+653.2%)</td>
<td>(+119%)</td>
<td>(+612.4%)</td>
<td>(+1224%)</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.6%</td>
<td>40.7%</td>
<td>-10.7%</td>
<td>27.5%</td>
<td>81.8%</td>
</tr>
<tr>
<td>Number of Sales Sales</td>
<td>26</td>
<td>391</td>
<td>487</td>
<td>297</td>
<td>341</td>
</tr>
</tbody>
</table>

**High Profitability**

Results for a calculated discount in a high profitability customer base are shown in Table 6.1-6. A calculated price based on past profitability results in a 15.8% change in annual profitability, compared to a calculated price based on future profitability, which results in a 20.5% change in annual profitability. Again, the calculated price based on future profitability tends to provide better results than one based on past profitability, by nearly 30%.

Just as in the low profitability case, a calculated price based on past profitability is comparable to results from offering an optimal flat discount.
Table 6.1-6 Comparison of Calculated Discounts in High Profitability Customer Base

<table>
<thead>
<tr>
<th>Customer Base Profitability ($)</th>
<th>Flat Discount=0</th>
<th>Flat Discount=1.20%</th>
<th>Random Discount</th>
<th>Calculated Based on Past Profitability</th>
<th>Calculated Based on Future Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
<td>$587,672.27</td>
</tr>
<tr>
<td>Maximum Delta</td>
<td>$432,428.03</td>
<td>$142,284.55</td>
<td>$189,945.06</td>
<td>$195,708.45</td>
<td>$160,109.10</td>
</tr>
<tr>
<td>Actual Delta</td>
<td>$10,474.99</td>
<td>$87,987.27</td>
<td>$47,209.18</td>
<td>$93,031.68</td>
<td>$120,677.48</td>
</tr>
<tr>
<td>% Realized</td>
<td>2.4%</td>
<td>61.8%</td>
<td>24.9%</td>
<td>47.5%</td>
<td>75.4%</td>
</tr>
<tr>
<td>Number of Sales</td>
<td>26</td>
<td>655</td>
<td>492</td>
<td>470</td>
<td>472</td>
</tr>
<tr>
<td>Average Profitability of Buyers</td>
<td>$426.57</td>
<td>$582.92</td>
<td>$661.53</td>
<td>$713.35</td>
<td>$586.42</td>
</tr>
</tbody>
</table>

Summary

Calculated discounts proved to be better than flat discounts and random discounts, effectively optimizing the channel pricing problem.

Calculated discounts based on future profitability consistently proved to show better results than calculated discounts based on past profitability and optimal discounts. A likely explanation for this is that looking at the past alone will benefit profitable customers, but not the majority of the bank's customers, leading to low volumes. Specifically, a lower than
expected discount based on poor to average past performance can cost the loss of an otherwise profitable future sale. However, by looking at the value of the new sale including projected service costs, more sales opportunities can prove worthy of a discount, resulting in more actual sales.

This explanation is evidenced in the two customer bases tested. In the low profitability base where most customers have a poor to average profitability history, a calculated discount based on future profitability proved to be 100% better than one based on past profitability. This is compared to the high profitability case where the calculated discount based on future profitability proved to be only 30% better than one based on past profitability.

_A transition strategy_

Calculated discounts based on future profitability can be used as a strategy to transition customers from lower profitability segments to higher profitability segments. Those that are not profitable but are effectively low cost customers because of their behaviour can be encouraged to buy new products from the bank and not be “encouraged” to defect to another bank. This strategy is less useful in a high profitability base where most customers are already profitable, than it would be in a low profitability base.

_A filtering/retention strategy_

A calculated discount based on past profitability can be used as a strategy to filter out the less affluent minority, resulting in defections that can only improve profitability. It would also result in the retention of profitable customers who are in effect, rewarded for their relationship with the bank. This would be more effective in a high profitability base, since the less affluent are a minority, and the resulting decrease in number of sales would have negligible impact. This strategy wouldn't do well in a low profitability base where the majority are less affluent, the result being fewer sales compared to offering a calculated discount based on future profitability.
6.2 Discussion

After completing the simulations described in §5.4, according to the mathematical model described in §5.3, it was found that calculated discounts according to customer profitability and cost to service the account, provided better results in annual profitability. Specifically, the use of future profitability in calculating discounts provided better results, by as much as 100% in a low profitability customer base. A number of assumptions were made in producing these results, and these are discussed in the paragraphs that follow.

Customer Base

Based on the literature, it was assumed that the customer base had a profitability profile that was normally distributed, meaning that most customers had mean profitability with a given standard deviation. The actual values that were modeled were derived from referenced customer bases like the one in §3.1 where 22% of the base had an annual profitability of $829, 40% had an annual profitability of $8 and the remainder had a negative profitability of ($193).

The low profitability base modeled in this research attempted to approximate this and had very similar values; 22% of the customers had an annual profitability of $817, 49% contributed $79 per annum and the remaining 29% of the base were in Tier III, and highly unprofitable. A high profitability base was modeled for comparison, and indicated definite trends in the results. It is important to note that the models generated were only an approximation of a realistic, albeit hypothetical customer base, and should be treated with caution. That said, with available profitability information for a given customer base, an appropriate model could be constructed for any customer base.

Cost to serve

It was assumed that a customer's historical service transactive nature, the behaviour that indicated their cost to serve, would stay constant in the future, for at least the duration of the term loan. This assumption was the basis for projecting future customer profitability, considering only the purchase of a new term loan, and hence was important to the results presented. In practice, more investigation into the cost to serve a customer across product
lines should be done to test this assumption. Furthermore, other inputs such as customer segment averages on cost to serve could be used to project future behaviour.

Product

In this research, a term loan was modeled and simulated. The service transactive nature was modeled accordingly, resulting in low monthly service transactions. However, different products such as a checking account would typically have smaller margins, a wider range in customer behaviour, and therefore a wider range in service costs. In such a case, the effect of the cost to serve on ultimate future profitability would be wider, and the use of a calculated discount would be even more important. Conversely, on products such as NSF protection, there would be fewer monthly transactions on average, and higher margins. In such a case, the effect of the cost to serve on ultimate future profitability would be narrower, and the use of a calculated discount would be less important. It should be stated, however, that many of these products are not stand-alone and can not be separated, for example: overdraft protection is closely coupled with a checking account, so it is not realistic to de-emphasise low margin checking accounts while heavily selling overdraft protection.

It can be generally stated that calculated discounts based on future profitability are more effective when, on average, the cost to service a product has a high likelihood of negating product revenue and resulting in negative profitability.

In addition, different products such as card products or mortgages normally have monthly service fees. The mathematical model could be extended to consider service fees, and the effect of the revenue generated from them.

Purchasing Decision

It was assumed that every customer buys purely based on price, and therefore every customer is a discount seeker. In practice, it is true that price sensitivity has risen significantly in the past decade and competitive forces have put downward pressure on prices. However, price is not the only factor customers consider when buying products from banks. Quality of service, brand equity, and inertia are among others. Inertia is key in retail banking, where it can be a significant effort for a customer of many years to buy elsewhere, or even move their accounts...
to another institution. In fact, the number of products, and duration of a customer's relationship could be incorporated into the purchasing decision. This could likely have an effect on the results of using a calculated discount since more customers would tend to buy at a price higher than the average expected price, and potentially even at a price higher than the calculated price.

Furthermore, all customers may not, in fact, be discount seekers and would be willing to buy at the retail price. This would, in effect, alter the mean of the expected price distribution, and also call for a narrower distribution – but it could still be modeled.

**Average Expected Price**

Of course, the smaller the difference between the average expected price and the maximum suggested retail price, the more customers would buy by default. The utility of the calculated price when compared to the flat discount would ultimately depend on the margins at stake and the value of the new sale opportunity. For a small margin and small value, it would not likely be worthwhile using a calculated price since the ultimate benefits would be relatively small. For a larger value, it would likely still be worthwhile using a calculated discount.

**Transaction Cost**

The cost of service, and its relative impact will be based on its actual amount, and the range of service transactions that can be performed by a customer. Of course, if the cost of service was zero, all customers would be profitable (not including risk and default of risk). Furthermore, if the range of transactions was small, and the cost of service (per transaction) was small, on average, most customers would cost the same to service. In practice, this is not the case based on products like checking accounts and NSF protection as previously discussed, and for customer distributions from the literature where the majority of unprofitable customers can be attributed to high service costs.

**The Calculated Price**
Two calculated prices (discounts) were tested in this research. One used past profitability and the second used future profitability according to a logarithmic model. Although they showed positive results in simulation, it is certainly possible to do better. It is possible to combine the two profitability parameters, and even to use other information in order to come up with a new formula to calculate price. The need to do so is questionable since, the more data required and the more complex the formula, the higher the cost to calculate the price. However, it is certainly possible to do better using a new formula, and this could certainly be investigated.

Defection

The cost associated with customer defection can certainly be a factor in this model, although it wasn't explored thoroughly. This is especially true in a low profitability customer base where losing one good customer can be the equivalent of losing 100 average customers as seen in § 3.2. Defection motivated by price could be examined further, although it is subject to the same assumptions made in the purchasing decision – that customers only act on price. If this were done, a customer's existing profitability and its future recurring revenue, in the context of defection could be incorporated into the price calculation as well.

Actual value of a Future Sale

In this simulation, it was assumed that all macroeconomic variables like rates remained constant into the future. For term loans where rates are fixed, this is not an issue. However, in extending this model to other products, this would be a challenge and would make price calculation more involved.

6.3 Sensitivity Analysis and Simulation

The most critical factor in modeling the calculated discount is the service transactive nature.

This was assumed to be a constant, and was generated as a uniform random variable. In practice this assumption could be made, and the service transactive nature could be
calculated by taking the average number of customer transactions per month from historical data in a data warehouse. Fluctuations in this constant could prove to be significant. For example, a customer with a low cost to serve (low service transaction nature) is awarded a great discount on a new loan. In time, that customer’s behaviour changes for some external reason. Meanwhile, the cost to serve that customer increases, reducing the bank’s profits. In practice, the customer’s cost to serve may change significantly in response to factors including economic climate and marital status.

The service transactive nature is used in the calculation of the calculated discount, in both the historical and future profitability cases, as well as the profit generated by the customer in the first year. In order to test the effect of this important assumption, two additional analyses were performed: 1) a sensitivity analysis of the service transactive nature in the high profitability base, and 2) a simulation where the cost to serve changes over time.

6.3.1 Sensitivity

A disturbance was applied to the service transactive nature for each customer in the high profitability customer base. The effect of this disturbance was carried through to the calculation of discount, in both the historical and future profitability case, to calculate the disturbance in the total profit generated in the first year.

Table 6.3-1 Sensitivity Analysis of Service Transactive Nature - High Profitability, Calculated Discount, Historical Profitability

<table>
<thead>
<tr>
<th>Disturbance in Service Transactive Nature</th>
<th>Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>$21,672.87 (-46%)</td>
</tr>
<tr>
<td>10%</td>
<td>$31,033.34 (-23%)</td>
</tr>
<tr>
<td>0%</td>
<td>$40,393.80 (0%)</td>
</tr>
<tr>
<td>-10%</td>
<td>$49,754.27 (+23%)</td>
</tr>
<tr>
<td>-20%</td>
<td>$59,114.73 (+46%)</td>
</tr>
</tbody>
</table>
Table 6.3-2 Sensitivity Analysis of Service Transactive Nature - High Profitability, Calculated Discount - Future Profitability

<table>
<thead>
<tr>
<th>Disturbance in Service Transactive Nature</th>
<th>Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>$57,791.54 (-28%)</td>
</tr>
<tr>
<td>10%</td>
<td>$69,270.47 (-14%)</td>
</tr>
<tr>
<td>0%</td>
<td>$80,749.40 (0%)</td>
</tr>
<tr>
<td>-10%</td>
<td>$92,228.33 (+14%)</td>
</tr>
<tr>
<td>-20%</td>
<td>$103,707.25 (+28%)</td>
</tr>
</tbody>
</table>

In both cases, applying a disturbance to the service transactive nature produced a significant disturbance in customer profitability.

As expected, there is a inverse linear relationship between service transactive nature and profitability – the greater the transactive nature, the more costly it is to service the customer and hence, the lower the profitability.

In the calculated discount – historical profitability case, a 20% increase in the transactive nature resulted in a 46% decrease in customer profitability – a highly sensitive result. In the calculated discount – future profitability case, the result was less pronounced. A 20% increase in the transactive nature resulted in a 28% decrease in customer profitability.

While both approaches to calculating a discount proved sensitive to disturbances in service transactive nature, the calculated discount based on future profitability was more stable.

6.3.2 Simulation

As discussed in §5.3.1.2 and § 6.3.1, service transactive nature was assumed to be a constant in model tested. It was used a) to calculate discounts based on both historical profitability and future profitability, and b) to calculate customer profitability. In § 6.3.1, the service transactive nature was disturbed, but was still held constant, and the affect of the disturbance was calculated.
In order to test the effect of a change in customer behaviour over time, a simulation could be performed where the number of service transactions per month is a random variable. In this case, the historical service transaction nature (an average of the number of transactions per month) is used to calculate a discount, but a simulated random variable is used to calculate the projected customer profitability.

While the extent of this simulation across all discount models and customer bases is beyond the scope of this research, it is useful to examine the effect. A simulation was performed in the high profitability customer base, with a calculated discount based on future profitability. In this simulation, the number of transactions per month was simulated using a random variable to determine the effect on the overall profitability of the customer base. Two cases were tested in this simulation.

The first case assumed that although behaviour was not constant, it was not out of line with historical behaviour. The number of transactions per month was random, centred on 3 transactions per month with a standard deviation of 1 transaction per month. In this case, the average profitability of the customer base was found to be $72,268 - $2,692, or an 11% decrease in profitability with service transaction nature held constant.

The second case assumed that behaviour was random with a tendency to be out of line with historical behaviour, biased to a greater number of transactions and therefore a greater cost to serve. The number of transactions per month was random, centred on 4 transactions per month with a standard deviation of 2 transactions per month. In this case, the average profitability of the customer base was found to be $32,444 - $4,322, or a 60% decrease in profitability with service transaction nature held constant.

With the limited scope of the simulation conducted, it is evident that a significant or material change in behaviour leading to a much greater cost to serve could in fact, significantly reduce the overall profitability of the customer base.

Offering a calculated discount in variable rate instruments, where the rate is calculated on a periodic basis, could mitigate this effect.
6.4 Implementation

In determining the feasibility of implementing a dynamic pricing service incorporating calculated discounts, it is important to consider all the costs involved. Overall, the primary costs are in software development, integration, and training, considering that a data warehouse and the data warehouse team already exist. In an Internet sales channel, training costs and integration would be significantly less making it more attractive.

Software Development and Integration

The cost to develop the software is marginal compared to all other costs. Developing an application-specific module would be the simplest and least expensive approach, likely costing under $1 million. However, developing a general dynamic pricing module would be more expensive yet could be applied to many other businesses, and thus deliver a greater return. Integrating this technology with each sales channel across several businesses would be extremely costly and time consuming. However, integration could be done once with CRM or Billing/Pricing software that is already in commercial use. A company could be formed to create a general dynamic pricing service as an enabling technology, reselling it to banks and other industries for integration with their CRMs.

Data Warehouse

It is fundamental that a data warehouse infrastructure be present and integrated with bank transaction mainframes, in order to store and calculate customer profitability information. The cost of a data warehouse is significant, in the millions of dollars in setup costs and ongoing operations. Many banks are already engaged in the integration and use of a data warehouses. The top-line and bottom line benefits of a dynamic pricing would definitely improve the ROI on a data warehouse.

Hardware
The hardware needed to run a dynamic pricing software module is largely based on the scale of the application i.e. the rate of pricing events. Given that the software would run alongside an existing CRM or Billing/Pricing infrastructure, and the existence of spare capacity the cost to run the software could easily be absorbed.

Training

The cost to train sales personnel in human-resource intensive channels may be the greatest cost. This can be mitigated by integration with a CRM and existing training programs. Of course, channels like the Internet do not require sales agent training, making it an ideal candidate for a dynamic pricing service.

Modeling

Most banks with data warehouse projects underway also have a data warehouse team responsible for analyzing the customer base, and running simulations. This group would be required to model the customer base, simulate it using a model similar to that in §5, and initially configure the pricing service. Given that a bank's customer base would evolve over time, this group would be responsible for the evolution of the dynamic pricing service.
Chapter 7  Conclusions and Future Work

7.1  Conclusions

It was hypothesized that a dynamic pricing model based on channel costs, customer profitability and value of a new sale opportunity should always result in a more profitable customer base. Specifically, the change in annual profitability of a customer base serviced with this pricing model should always surpass the change in profitability due to the use of a flat discount or random discount based pricing model.

It was found that dynamic prices performed better than all other pricing models. It was also found dynamic prices based on future profitability performed better than dynamic prices based on past profitability. This is especially true in a low profitability customer bases. This is illustrated in Figure 7.1-1.
Figure 7.1-1 Discount Methods Compared

In the low profitability customer base the gains realized by using a dynamic price are significant (+1.224%) outperforming the optimal flat discount by nearly 100%. In §6 this application was characterized as an implementation of a transition strategy, effectively allowing low profitability, low cost-to-serve customers an opportunity to transition into high profitability customer segment.

In the high profitability customer base (+21%), the effect was similar, only to a lesser degree, outperforming an optimal flat discount by 40%. In §6 this application was characterized as an implementation of a filtering/retention strategy where low profitability customers are allowed to defect and high profitability customers are rewarded for their relationships.

It can be postulated that the more profitable the customer base, the less effective a dynamic pricing service is in improving the increase in annual profitability, and the more effective it is in improving customer retention and preventing costly defections.

Hence, the hypothesis was proven and, in fact, much opportunity exists in exploiting this approach in a number of businesses. Moreover, the following findings show the benefits of such technology when applied in a rigorous manner.
1. Higher profitability

2. Customer base transition strategies: movement of a portion of the customer base from barely profitable (even losing) status to highly profitable status.

3. Ability to compete more effectively in channels with limited pricing capability like the Internet.

4. By further researching the variable sets utilized in each application, much finer distinctions may be possible between what is and is not a profitable client.

5. There are opportunities to model "what if service offerings" by first simulating the potential market and the profit opportunity – before much money is spent in developing software, introducing and then marketing such services.

Furthermore, the mathematical model and simulation technique used in this research can be applied, although more development is desirable, to determine the effect of dynamic prices on specific businesses using actual business data and also to develop production ready dynamic pricing services.

While dynamic prices performed better than all other pricing models, it was shown that improvements in customer profitability were highly sensitive to historical transaction data used to calculate discounts. It was also shown that while moderate fluctuations in behaviour could minor effects on profitability, material or significant changes in behaviour could dramatically reduce profits. This suggests careful application of dynamic prices, and perhaps limited use in instruments with dynamic or variable rates which can allow calculation to occur on a periodic basis.

In any potential application it is necessary to model the specific customer base and weigh projected results against the cost of implementation of a dynamic pricing service. With existing investments in CRM and Data Warehousing, the added investment for a dynamic pricing service is marginally small, especially when compared to the benefits available from it, although potentially restrictive, based on variable training costs in human resource intensive channels. This makes a dynamic pricing service ideally suited to the Internet. Specifically, it is
applicable to services offered to the mass-market where the profitability of the customer base will be highly non-uniform.

This research was focused on retail banking, but its results could easily be applied to retail brokerage services. Online brokerages like TD Waterhouse™ could apply a dynamic pricing service in pricing online trades based on customer profitability and cost to serve. This could help a brokerage’s bottom line in volatile markets where customers are actively trading and have a highly variable cost-to-serve.

Dynamic pricing could be applied in offering traditional telephone services, Internet data services and new mobile telephone and data services. This is a great application domain because of the range of products, and likely distribution in product margins, not to mention its scale and mass market nature. In this case, dynamic pricing could also be extended to the small business market and would likely be a competitive differentiator.

Companies like Amazon.com have continually invested in customer relationship management strategies, in order to increase revenues. One service that Amazon.com provides attempts to recommend books to customers via email, according to their preferences and buying history. This kind of one-to-one marketing goes hand in hand with dynamic pricing. Customers can be given discounts on books based on their profitability and cost to serve. This application of dynamic pricing is especially attractive today because of Amazon’s drive for corporate profitability.

There are many applications of dynamic pricing in large-scale service businesses, serving mass-market customer bases, especially on the Internet where pricing options are limited. It is likely a good business strategy to create dynamic pricing technology, implemented in software, for integration with CRM applications, and resale to financial services, telecom and E-commerce companies.

7.2 Future Work

There are a number of avenues that can be explored in the future research. Some of those are discussed in the following paragraphs.
Customer Bases

At the time this research began, many financial institutions were in the process of implementing data marts, data warehouses and customer relationship management technology – much of which is now in place. This infrastructure will allow them to collect and store profitability, analyse it, and make the decisions arising from the results available at the point of sale. Because these systems were new and developmental, real data containing the inputs investigated in this research was not readily available. Given recent progress, it would be possible to get access to real customer data from a cooperating institution. It would be useful to analyze this information and in particular, further analyze the distribution characteristics of the customer base. In particular, it would be a worthwhile study comparing the specific distributions of various lines of businesses the bank offers and the types and wealth of customers in relation to such lines of business.

Inputs

In this research, service transactive nature, customer profitability and future potential profitability were used as inputs to a pricing function in order to determine price. It would be useful to analyze other inputs specifically, examine correlation between inputs, and the effects of this correlation on calculated prices. The use of DEA (Data Envelopment Analysis) would be useful in comparing these inputs.

Pricing Algorithm

A logarithmic function was used to calculate price in this research. Given a specific customer base, other functional forms could be explored. In addition, with a greater set of inputs, more complex functional forms could be developed. Another avenue that could be worth exploring is a self-developing functional form. This could be accomplished using techniques like genetic algorithms or neural networks.

Simulation

With a greater number of inputs, and several years of historical data, it would be a useful study to do larger scale simulations involving multiple channels and products in order to test the
validity of dynamic pricing recommendations. Of course, it will be sometime before such data is readily available in organizations, many of which have just recently implemented data warehouses.
Chapter 8 References


