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Effects of Free Riders and Incentive Discrimination on Customer Acquisition and Retention Resource Allocation

Geng Wang

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EFFECTS OF FREE RIDERS AND INCENTIVE DISCRIMINATION ON CUSTOMER ACQUISITION AND RETENTION RESOURCE ALLOCATION

BY

Geng Wang

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

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ACCEPTANCE

This dissertation was prepared under the direction of the Geng Wang Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctoral of Philosophy in Business Administration in the Robinson College of Business of Georgia State University.

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ABSTRACT

EFFECTS OF FREE RIDERS AND INCENTIVE DISCRIMINATION ON

CUSTOMER ACQUISITION AND RETENTION RESOURCE ALLOCATION

BY

Geng Wang

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How should a company best allocate its spending between acquisition and retention? Under what condition should a company devote resources and money to analytics? The above questions are just examples of more general issues concerning many companies when managing their customer acquisition and retention programs. To answer the above questions, I will conduct a study on the allocation of financial resources between incentives that target different types of customers, and the allocation of resources between incentives and analytics spending. This research first distinguishes between customers and acquisition, between incentive and price discount, and between acquisition and retention. It then proposes a new concept, "free rider", in a customer acquisition and retention context. Building on the free-rider concept, two mathematical models are formulated to examine the optimal allocation between acquisition incentive, retention incentive, and analytics spending. Closed-form solutions are reached for both models and the results are interpreted in the context of marketing practice. The conditions leading to different patterns of optimal solutions of analytics spending, acquisition incentives, and retention incentives are discussed. Specifically, the detailed conditions under which the optimal acquisition incentives is zero or non-zero, the optimal retention incentives is zero or non-zero, and the optimal analytics spending is zero or non-zero, are provided. Factors determining the ceiling for acceptable level of cost of analytics are also examined.

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Abstract

How should a company best allocate its spending between acquisition and retention? Under what condition should a company devote resources and money to analytics? The above questions are just examples of more general issues concerning many companies when managing their customer acquisition and retention programs. To answer the above questions, I will conduct a study on the allocation of financial resources between incentives that target different types of customers, and the allocation of resources between incentives and analytics spending. This research first distinguishes between customers and acquisition, between incentive and price discount, and between acquisition and retention. It then proposes a new concept, "free rider", in a customer acquisition and retention context. Building on the free-rider concept, two mathematical models are formulated to examine the optimal allocation between acquisition incentive, retention incentive, and analytics spending. Closed-form solutions are reached for both models and the results are interpreted in the context of marketing practice. The conditions leading to different patterns of optimal solutions of analytics spending, acquisition incentives, and retention incentives are discussed. Specifically, the detailed conditions under which the optimal acquisition incentives is zero or non-zero, the optimal retention incentives is zero or non-zero, and the optimal analytics spending is zero or non-zero, are provided. Factors determining the ceiling for acceptable level of cost of analytics are also examined.

Chapter 1: Introduction

1.1 Background and Introduction

In today's economy, the service sector accounts for two-thirds of the GDP of the United States and the European Union alike. Customer base is becoming increasingly important to service-oriented businesses. Customers are recognized not only as the buyers of the company's products and services, but also as assets of the companies' (Gupta & Lehmann, 2003). As a result, companies pay more and more attention to attracting and retaining customers in addition to selling products and services. One of the important measures that companies take to accomplish the mission of attracting and retaining customers is to offer their prospects and customers acquisition incentives or retention incentives. The ability to spend the incentive money effectively in order to minimize the cost or maximize the return will directly contribute to the companies' bottom lines and their competitiveness.

What is the "best" amount of incentives a company should offer to its prospect customers or existing customers in order to attract or retain them? What factors will affect the level of incentive?

Although many studies (Blattberg & Deighton, 1996. Berger & Nasr, 1998. Reinartz et al, 2005.) have been conducted in attempt of answering the above questions, none has examined the effects of analytics and incentive-discrimination. Since price-

discrimination is widely discussed in studies about consumer purchasing behavior, the lack of study or even the mentioning of effect of incentive-discrimination on incentive allocations, in this author's view, represents a gap in the knowledge base. At the conclusion of this research, I will demonstrate that this study contributes to the theory and managerial practice in many ways such as defining the ceiling of acceptable level of cost of analytics, and providing managerial directions when company's customer base or competitive situation changes. In addition, the study will also provide answer to the question of "Why on the one hand, retention is considered a more cost-effective means than acquisition; but on the other hand, companies are often criticized for spending less than they should on retention?" By answering this question, a gap between the existing marketing theory and common marketing practice will also be bridged.

Specifically, this research formulates mathematical models and examines how customer characteristics and the company's ability to incentive-discriminate its customer base affects its optimal decision regarding the amount of acquisition incentives, retention incentives, and analytics spending.

In the remainder of Chapter 1, to distinguish incentives from simple price discounts, a compare-and-contrast between incentives and price discounts, as well as between incentives and volume discounts, will be conducted. In Chapter 2, a review of literature will be presented to provide the foundation for the model. In Chapter 3, I will present the specific research questions and establish the framework for the models. In Chapter 4, justification for using a mathematical model is provided. In Chapter 5 and 6, a "base

model" and an "extended model" will be formulated and the optimal solutions will be solved. Chapter 7 will discuss the contributions of the study and propose future research directions.

1.2 Incentive-Discrimination

In this research, the effects of "*incentive-discrimination*" on the decisions regarding acquisition incentive, retention incentive, and analytics spending is examined. In economics as well as in marketing, price discrimination, which refers to charging different customers different prices, has been broadly studied and practiced. This research, however, positions itself in the context of customer acquisition and retention process, where customers are attracted and retained through incentives offerings. Similar to price discrimination, but in a customer acquisition and retention setting, the concept of *incentive-discrimination* is proposed and its effect is studied. In this study, *incentive-discrimination* is defined as "offering acquisition and retention incentives only to prospects or customers who satisfy certain criteria".

1.3 The Nature and Functions of "Incentive"

What constitutes an incentive? How does an incentive differ from a price discount or a quantity (volume) discount?

Although "incentive" and "discount" are often used interchangeably, it is important in the context of this study to clearly distinguish one from the other. A price discount is usually a reduction in price that aims at increasing present or short-term demand only. For example, in order to sell quickly some of its groceries, a grocer cuts the prices on those items. A volume discount (or quantity discount) is a type of price discount that is

given in the form of a reduction in unit price for high volume purchases. For example, a company constructs its price schedule as such that when the higher volume is ordered, the unit price will decrease. An incentive (for acquisition or retention) is a discount (including cash, free products, or free services) aimed at attracting or retaining customers and increasing long term demand. For example, a cell phone company offers discount if the customer agrees to sign a one-year service contract.

As I will demonstrate below, sometimes a price reduction/concession is compounded, meaning that it can function both as a simple price discount and as an incentive. Therefore, when the actual incentive amount has to be measured or the optimal incentive amount has to be implemented, it is important that we identify the true amount of incentive embedded in a price reduction/concession. Because one of the major objectives of this study is to understand the determinants of optimal incentive decisions, without a clear distinction between an incentive and a discount, the magnitude of incentive will be distorted and the results will be sub-optimal.

I will first compare and contrast between incentive and discount, incentive and volume discount, then I will summarize their differences from the following perspectives:

- Strategic
- Specific Objectives
- Operational
- Time Effect

1.3.1 Incentive vs. Price Discount

Existence of Switching Cost as a Necessary Condition for Incentives

In retail business, some stores have "moving sale" or "out of business sale" before they move or close businesses. Also, in many markets, companies cut prices in order to reduce excess supplies or inventories. The purpose of these price discounts is to increase the demand for the time being only. They are simple price discounts. The purpose of incentives, in contrast, is to increase the demand not only for the time being but also for the future periods as well.

Under what conditions will a discount offered in the current period also increase the demand in the future periods? Customers come back in the future because they might find it convenient to buy in the same store, feel more certain about the product they have already tried, find it troublesome to learn a new store layout, or feel unwilling to learn a different type of machine or operation procedure. For example, time and effort is required for making phone calls and completing paperwork if a customer wants to switch from one wireless phone services to another. Time and effort is also required for learning a different store layout if a consumer switches to a new super-market. In addition to the time and effort spent, the consumer might also face the uncertainty in the quality of the new services or products.

The time, effort, uncertainty and so on that are part of the switching process can be characterized as "switching costs." *Switching costs* are defined as costs incurred to a customer when he switches in or out from one company's products or services to a competitor's. (More broadly, we can also regard a fresh new customer's costs of joining as switching costs.) Switching costs usually include monetary cost such as new

equipment, search cost such as time spent to learn about the new product or service, and a mental cost for people who are dislike uncertainties and risks. Also, "Customer loyalty," although not necessarily rational, can also be regarded as a type of switching cost. Besides the "natural" switching costs that are inherent in the process, artificial switching costs can be created or imposed by the companies to deter switching-out. For example, early termination penalty is a type of artificial switching costs that cell phone companies impose.

These switching costs make it more likely for customers to stay with their current product or service providers. Without switching costs (monetary, or mental), a customer can churn freely and his future purchases will not be related to his current purchases. Therefore, a simple price discount without the switching cost, although increases the demand for the current purchase, will not affect future demand. Once the simple price discount is withdrawn, its effect on demand will disappear immediately. Therefore, the necessary condition for a simple price discount to become an incentive is the presence of switching cost. In other words, the presence of switching cost is what distinguishes an incentive from a discount.

Examples of Switching Cost and Incentives: Contract vs. No-contract

In this section, I will demonstrate the connection between switching cost and incentives by examining examples of incentives with contract and incentives without contract. The purpose of a contract is to create an artificial switching cost. Therefore, contract is often

used to compensate for the low natural switching cost. As the following examples will show, to bring repeat businesses, a contract usually accompanies the acquisition incentives where the natural switching cost is low.

Example 1: Cell Phone - Contract

A typical case for incentives with a contract is that of the cell phone services. A cell phone service usually requires a customer to sign a one-year contract in order to receive a phone at discounted price or for free. The one-year contract with early termination penalty is an artificially created switching-out cost. This switching cost would deter people from switching carriers before the term is due.

Example 2: Bank Account – No Contract

An example for no-contract incentive is bank accounts or trading accounts. In these cases, what lacks of in terms of using contracts to deter the churning of the customers is made up by the high "natural" switching costs. Because of the high security and privacy requirements, banking functions such as account opening/account closing/transfer of funds/paycheck direct deposit etc. represent significant switching costs that are inherent in the process. The inherent high switching cost is also enhanced by the free add-on services such as "Online Bill Pay," which enables a customer to pay bills on-line and pay recurring bills month after month automatically. By offering these services, an "artificial" switching cost is also created without using a contract.

Example 3: Credit Card – No Contract

Another example for no-contract case is credit card. Different from bank account, which has high natural switching costs, credit card has low natural switching costs. Because customers can churn easily (by filling up the application form that is received in the mail), the switching cost is usually artificially by providing airline mileages or cash back on purchases.

To summarize, an incentive program must be accompanied either by natural switching costs or by creating artificial ones.

The connection between switching cost, contract, and incentive is as follows:

- Switching cost is a necessary condition for incentives.
- The magnitude of the natural switching cost primarily determines whether a contract is necessary or not. The higher the natural switching cost, the lower the need for contract.
- Contract is a means of increasing switching cost artificially. When an incentive is offered with a contract, an artificial incentive is created and attached.
- There are other means of artificially increasing switching cost without using contracts, for example, free on-line bill pay services.
- When an incentive is offered without a contract, there must be either natural switching cost, or other forms of artificial switching cost, or both.

Summary of examples

The Table 1 summarizes the four commonly seen services examples of various types of switching costs and incentives.

1.3.2 Incentive vs. Volume Discount

There are similarities between incentives and volume discounts. For example, in both cases, the overall larger total purchases will lower the unit price for the buyer. However, volume discount differs from incentive in their functions.

Functions and Reasons for Volume Discount

A review of literature has found four reasons for volume discount/quantity discount:

1. Economics: Price discrimination. Buchanen (1953) argues that the demand schedule of large buyers is more elastic than the small buyers. Therefore, discount must be given to these larger buyers to attract their purchases. However, quantity discount is not a universal means for price discrimination – sometimes quantity surcharge is used instead. For example, Cude & Walker (1984) conduct over 2,000 price comparisons and find that about 10% of them have quantity surcharges. Canned tuna fish, laundry detergent are among the most often seen. In these instances, the unit price per pound or per ounce of a larger package is actually higher than a smaller package. Agrawal (1993) conduct an empirical study and infer that quantity surcharges is a price discrimination tool aimed at large households, who have high demands, high storage capacities, and high searching costs. Therefore, the price discrimination function of volume discount is but one specific reaction to certain customer's preferences.

2. Economics: Economy of scale. Some production function will result in reduced per unit fixed cost or reduce variable cost when the volume is higher. Therefore, the economy of scale function of volume discount is a consequence of certain production functions.
3. Supply Chain: Collaborative procurement, inventory coordination, lot-sizing, revenue sharing, vender-buyer collaboration and game, etc. From an operations management/supply chain perspective, Munson et al. (1998) classifies this function of volume discount as "joint buyer-seller perspective." Therefore, this function is the result of an increased efficiency between the buyer's and seller's organizations.
4. Marketing: Attracting buyers, etc. Munson & Rosenblatt (1998) conduct a survey asking marketing managers why they offer volume/quantity discounts. In addition to the common reasons of economy of scale in manufacturing and purchasing, survey participants replied that a volume discount is used to attract new customers. The authors state that "in situations where switching suppliers is difficult or costly, some suppliers offer large quantity discounts to new customers. Despite the mediocre profits on the initial sale, more profitable subsequent sales usually follow." This function is actually customer acquisition and retention incentive. However, this also indicates that the volume discount actually functions as a simple price discount except that some switching cost is present. The essence of this type of volume discount is not the "volume" but the "discount."

Decomposition of Volume Discount

From the above section's discussion, apparently, a volume discount can function as an incentive just as other simple price discounts. However, since a volume discount can be offered for many reasons, it is important in this study to decompose any particular volume discount. In other words, since the amount of incentive is of the primary interest to this study, it is important to know whether the volume discount is given because of price discrimination, economy of scale, supply chain efficiency, or an acquisition/retention incentive. It is also important to realize that not all quantity discounts function as incentives unless they are accompanied by switching costs.

If a volume discount is serving multiple functions, it can be decomposed of the following four components: discrimination, economy of scale, supply-chain effectiveness, and incentive as shown below:

Total Volume Discount

=Amount for discrimination + Amount for economy of scale + Amount for Supply Chain efficiency + Amount for incentives

Although in reality, it is difficult to separate the four components and allocate precisely the correct proportions to each function, one can at least qualitatively understand that only a proportion of the amount of volume discount offered should be regarded as incentive. To illustrate, I categorize volume discount into the following three scenarios:

- <u>When a volume discount is not an incentive.</u> If a volume discount is largely due to the reasons of, for example, economy of scale, then treating it entirely as an incentive will make the incentives larger than it actually is. Since the necessary

condition for a discount to become an incentive is the existence of switching cost, when there is no switching cost, a volume discount will just be a discount, not an incentive.

- When a volume discount is a mixture of many functions. This is the most common case. It is when there are both switching cost and other reasons such as economy of scale. As discussed above, there are four main reasons for providing volume discount. And sometimes these various reasons can be present in a single offer of volume discount. For example, a quantity discount can be offered because of the firm's economy-of-scale, its intent to price-discriminate, and the switching costs. In this case, the true magnitude of incentive is less than the total discount.

- When a volume discount is entirely an incentive. When there is no economy of scale, or discrimination, or supply chain efficiency, a volume discount offered to a customer is entirely an acquisition/retention incentive. In this case, a volume discount is a "pure" acquisition/retention incentive.

Volume Discount vs. Incentive: A multiple-time-period perspective

From the time perspective, volume discount often aims at increased order quantity while retention aims at increased length of relationship. For example, if the annual demand of a particular customer is a fixed amount, then volume discount would increase demand per

order and decrease the number of orders, while the retention incentives will increase the number of years the customer stays with the company.

For example, a volume discount will increase the demand from p to p+q (q>0) in the current period; an incentive will maintain the current period demand at p, but increase the number of period that the customer is with the company from n to n+m (m>0). In a multi-period framework, this will result in an increase in the demand of the future periods.

1.3.3 Strategic Differences between Incentives and Discounts

In addition to switching cost, there are other differences between incentives and price discounts. These differences can be attributed to different corporate strategies, i.e., Customer-centric vs. Product-centric.

Different from a traditional product-centric business, which focuses on product sales, a customer-centric business emphasizes on the following key characteristics of customer relations:

- A customer usually makes a stream of purchases instead of one. The product-centric approach does not take this into account.
- The probability that a customer makes his next purchase is dependent on his past purchases. The product-centric approach does not capture this aspect.
- The product-centric approach does not consider the issue of switching cost.

- For a customer-centric business, the corporate structure is often formed around customers instead of products. For example, Fidelity Personal Investments structured the corporation around customer segments such as "accounts with more than $500,000," "active traders," and "retirees," etc. Product managers report to the segment CEOs. (Selden, L. & Colvin, G. 2003)

Therefore, the differences between offering a customer goods or services at discounted prices and offering him acquisition/retention incentives can be viewed from the following perspectives:

- **Strategic**: Discount is usually a tool for executing product-centered strategy while incentive is for customer-centered strategy. The subject in price discount is the products/services; whereas in acquisition/retention incentives, it is the customers.
- **Objectives**: The primary purpose for most price discounts is to increase demand. The purpose for incentives, however, is to attract or retain customers.
- **Operational:** Price discounts are usually not targeted towards a specific group of customer, and are often publicized. The incentives are usually targeted to certain groups of customers and sometimes are kept confidential.
- **Outcomes**: The outcome of the price discount is measured by the quantity of products/services sold. The outcome of the incentives is the number of customers acquired or retained.
- **Time frames**: Price discount can be regarded as a one-time transaction, whereas incentives bring a stream of transactions. The evaluation of the effect of incentives is usually in a multi-period context.

1.3.4 Summary

The main difference between a non-incentive price discount (including volume discount) and an acquisition/retention incentive is summarized in Table 2.

Chapter 2: Review of Literature

This review of literature examines the relevant views and evidences relating to the issues in customer acquisition and retention.

2.1 Customer Satisfaction, Loyalty, and Retention

2.1.1 Is a satisfied customer necessarily a loyal customer?

The importance of customer satisfaction has been heralded for decades, if not longer. The saying "customer is always right" exemplifies the emphasis on customer service and customer satisfaction. By increasing customer satisfaction, the companies hope to achieve customer loyalty because a loyal customer will even overlook the flaws of the company, therefore giving the company competitive advantages over its competitors. As Oliver (1999) puts it:

> *When a consumer voluntarily removes him- or herself from competitive overtures, effectively tuning out persuasive arguments to switch, he or she achieved a state not unlike the concept of love.*

So, if satisfied customers are loyal customers and loyal customers bring more profits to the company in the long run, then why do not companies make *all* of their customers satisfied by offering, for example, every customer acquisition and retention incentives?

Firstly, loyalty might be very costly to achieve and is not always attainable. Jones et al. (1995) find that "true long-term loyalty" is only achieved when customers are "completely satisfied". Customers who are less than "completely satisfied" will defect

easily when opportunities present. Oliver (1999) concludes that depending on the nature of the product or the segment of consumers, loyalty is not attainable by many firms. Therefore, many companies have to settle for various degrees of customer satisfaction, instead of customer loyalty.

Secondly, even complete satisfaction does not guarantee loyalty. In a study regarding the relationship between customer satisfaction and customer loyalty, Jones and Sasser (1995) characterize four types of customers based on their satisfaction and loyalty relations. The two types that have positive relations between satisfaction and loyalty are: the "loyalists", who are high on satisfaction and high on loyalty; and the "defectors", who are low on both satisfaction and loyalty. Interestingly, there are two types that do not have positive relations between satisfaction and loyalty. They are the "mercenaries" and the "hostages." "Mercenaries" are those who have high satisfaction level but low to medium loyalty level; and "hostages" are those who are low on satisfaction but high on loyalty.

Lee et al (2001) provide explanation on why some customers are low on satisfaction but high on loyalty. They find that switching costs play an important role in moderating the relationship between customer satisfaction and loyalty. The weak link between satisfaction and loyalty happens when the switching cost is high. Because high switching costs deter unsatisfied customers from defecting, the unsatisfied customers appear to be "loyal". Oliver (1999) argues that although satisfaction is a necessary

condition for loyalty, there are other mechanisms such as personal fortitude and social bonding that contribute to the loyalty.

As Simon (1955, 1972) proposes in his study about "bounded rationality" that humans are subject to the cognitive limitations and therefore often make decisions that are not rational. Customer loyalty clearly contains such non-rational components. For example, some loyal customers of Ford choose Ford automobiles not because they have rationally evaluated the choices but because their fathers and grandfathers all drove Ford automobiles.

Based on the above review, we can conclude that acquisition and retention incentive play a role in customer's "rational" switching decision process, except for the most "loyal" customers. The current study positions itself by examining only the rational aspect of customer switching. Specifically, in this study, it is assumed that all customers make their decision by evaluating the amount of switching cost and the incentive offered to them. Therefore, by manipulating the acquisition and retention incentive offering, a customer can be affected in his switching decision.

2.2 Valuing Customers

Recent studies hold the view that customer base is the assets of a company and its value can be assessed quantitatively. For example, Gupta & Lehmann (2003) quantitatively link a company's customer base to its profitability and its financial valuation. In their study, they estimate that the average value of an E*Trade customer is about $960.

Models that calculate customer values have been employed to direct the practice of customer acquisition and retention. For example, in marketing applications, Customer Lifetime Value (CLV or LTV), can be used to assist customer acquisition and retention decisions (Dwyer, 1989). It is often used as the objective function of an acquisition/retention effort. Lifetime value of a customer is the present value of future stream of costs that this customer incurs and incomes this customer brings. If we denote the profit margin that a customer generates during a specific period t as m_t, then the life-time value of the customer (LTV), with a discount rate of i, and a constant retention rate of r, is given by the following formula (Gupta, 2003):

$$LV = \sum_{t=0}^{\infty} \frac{m_t r^t}{(1+i)^t}$$

The emphasis of LTV formulation is on the multi-period perspective of customer cost and revenue stream. The unit of analysis in LTV formulation is individual customers or cohorts of customers. However, since the current study is primarily concerned with the allocation between acquisition incentive and retention incentives, and the goal is to solve for the optimal allocation between acquisition and retention incentive in any given single time period, I will not use a multi-period framework as the LTV. Nevertheless, the current model is consistent with the LTV formulation and the proof is provided in Appendix I.

2.3 Switching Cost Distribution

2.3.1 Switching Cost Distribution

Switching cost is one of the important factors in customer switching decision. Switching costs vary among different customers. Epling (2002) presents the empirical evidence of

heterogeneous switching costs among customers in the telecommunications industry. Although switching cost cannot always be observed directly, it can be estimated through other observable variables such as the number of switches within a certain period of time (Epling, 2002).

In switching decision process, a "rational" consumer evaluates between the option of switching and not switching in a similar fashion as he evaluates between the options of buying and not buying in a typical purchasing decision. The only difference is that in a typical purchase, the consumer makes comparison between his reservation price and the product price while in a switching decision the consumer compares his switching cost (including the future switch-out cost) with the incentive and the benefit of switching. Therefore, previous literature on consumer reservation price distributions provides reasonable indication of switching cost distribution.

Many studies assume uniform distribution for reservation prices of consumers (Venkatesh, R. & Kamakura, W. 2003; McGuire, T., and Staelin, R. 1983.). Shifted exponential distribution, which is composed of a constant plus an exponential random variable, is also examined (Lin, 2004). Since the demand function is a cumulative function of the reservation price, a uniform distribution of the customer reservation prices corresponds to a linear demand function of price. By using a linear demand function with an intercept, Pollak (1976) also implicitly applies a uniform distribution in his study. For the analyses in this study, I choose a uniform distribution for switching cost.

2.4 Price Discrimination/Targetability/Incentive Discrimination

Because the reservation prices vary from one customer to the next, the ability to identify each customer's reservation price will enable the firms to better price-discriminate. The term "price discrimination", meaning charging different prices to different buyers (Frank, R.H. 1994), is seen widely in economics literatures. In marketing literatures, terms such as "customer differentiation" and "targetability" are also used. For example, Pelham (1997) uses the term "customer differentiation" to describe a firm's ability to separate groups of customers whose buying needs and motives are different. Chen et al (2001) defines "targetability" as a firm's ability to predict the preferences and behaviors of customers for the purpose of customizing price or product offers.

The effects of price-discrimination or targetability have been studied primarily in a setting of competitive firms. Chen et al (2001) examine the consequences of firms' increased targetability on competing firms' strategies. They show that in a two-firm competitive market setting, the improvement in targetability can increase not only the firm's own profitability but also the competition's profitability.

Although discrimination has been studies previously, the primary focus of those studies is the product purchasing process, instead of acquisition and retention process. For this study, I will introduce the term "incentive-discrimination" to describe a company's ability to identify prospect or customers with different switching cost and offer acquisition incentives or retention incentives selectively as the result of such ability.

Continuous Model vs. Discrete Model in Predicting Switching or Response

In practice, the prediction about customers' preferences (or switching costs) is achieved through predictive modeling, which analyzes customer demographic, geographic, and purchase information and provides predictions. Many analytical tool such as logistic regression, neural networks, and genetic algorithms have been used in predictive modeling. Under the ideal situation, when the prediction is about customers' switching costs, a model that provides the detailed customer switching cost is better than a model that only predicts "high" and "low". However, Bodapati & Gupta (2004) demonstrated that when the information about prospects or customers is limited, the discretized model, which applies binary dependent variable such as response vs. no-response, performs better than a continuous model, which uses continuous dependent variable (household spending in dollars). This is because when the predictive models are statistically biased due to the quality of data and the limited availability of information, as it is very often the case in marketing and consumer purchasing data, the binary model helps lowering the bias and produces better predictions.

Based on the above review, in the current study, I will define the outcome of the analytics as the identification of a free rider or not (discrete), instead of his or her switching cost (continuous).

2.5 Optimizing Acquisition and Retention Spending

Since a dollar can be spent toward either acquiring a prospect or retaining a customer, this leads to the question of "How much money should be spent on acquisition incentives vs. retention incentive so that the cost of acquisition and retention is minimized?"

Blattberg & Deighton (1996) present a method of calculating optimal level of acquisition spending and retention spending. In their study, they assume that the acquisition rate is an exponential function of acquisition spending. After the function's parameters are estimated, and the margin per customer is known, the optimal level of acquisition spending can be calculated. The same process is applied to the calculation of the optimal retention spending. Their research examines the acquisition and retention separately but does not investigate the combined effects between acquisition incentive and retention incentive.

Berger & Nasr (1998) extend the above method by providing a nonlinear programming based solution to the optimal allocation between acquisition spending and retention spending. In the above study, however, the acquisition rate or the number of customers acquired is a function of acquisition incentive only. They do not include the ability to incentive-discriminate into the model, nor do they examine the effect of different customer switching cost distributions.

The optimal allocation between acquisition and retention resources has also been studied empirically. Reinartz et al (2005) use statistical model to estimate the parameters in their model and perform simulation analyses. However, in their model, the effects of incentive-discrimination is not studied.

2.6 Commonly Observed Level of Acquisition Rate and Retention Rate

The acquisition rate and retention rate can vary greatly between different industries, products, and services.

On retention rate, Clark (1997) uses two branches of a major retail bank in UK. The customer retention rate ranged from 60% to 75%. However, the study fails to specify the length of time period on which the retention rate is measured. Reichheld (1996) estimates that a typical company has customer defection rate of 10% to 30%, or retention rate of 70% to 90% annually. Gupta and Lehmann (2003) report the annual retention rate of several companies: CDNow, an internet startup company, 51%-68%; Capital One, 85%; AT&T, estimated at 81%; Ameritrade, an internet trading company, 94%-95%.

On acquisition rate, Birkin & Clarke (1998) report that direct mailing's response rate ranged from 1% in random mailing to 5% - 10% for mailings with geographic and/or demographic targeting. Schlegelmilch & Woodruffe (1995) cite a bank vice president as saying that the response rate for affinity credit card are normally around 2%, but could be as high as 5% to 7% for each round of solicitation.

2.7 Summary

The "ideal" solution to the problem of customer acquisition and retention is to attract or create "loyal" customers who "love" (Oliver, 1999) the product, the service, or the company. However, in many product or service markets, either satisfaction does not guarantee loyalty, or loyalty is not attainable at all. In these markets, facing the mostly "rational" customers who make switching decisions based on the evaluation of switching

cost and benefit, a company must employ incentives as means to acquire and retain customers. The effectiveness of such incentives will contribute directly to the profitability of the company. Although studies have been conducted in the area of price discrimination and the area of optimal incentive allocation, none was focused on the effects of incentive-discrimination on optimal incentive allocation in a customer acquisition and retention setting.

Chapter 3: Research Questions, and Model Framework

3.1 Motivation

In previous studies about optimal acquisition and retention spending (Blattberg & Deighton, 1996. Berger & Nasr, 1998.), acquisition or retention rate at a certain acquisition or retention spending level is treated as exogenous variable or "given". In those models, an incentive budget of $5million would correspond to, for example, an acquisition rate of 3%. So, in those studies, acquisition rate or retention rate is treated as a function of incentive spending only.

However, the situation is different in the real business world. For example, direct marketing companies have been utilizing "predictive modeling" techniques to predict the response or non-response of prospects and send out offers selectively in order to achieve a better response or acquisition rate. This indicates that acquisition rate is not only a function of incentive spending but also a function of the ability to identify different prospects' different reactions to incentives.

Therefore, in this study, acquisition rate is regarded not only as a function of acquisition spending but also as a function of ability to differentiate customers, or in the context of this research, the ability to incentive-discriminate. In addition, since a company can choose to increase its level of spending in "predictive modeling" or "analytics" to improve the ability to incentive-discriminate, this ability becomes a function of analytics spending. From a company decision maker's point of view, to improve the acquisition

rate, the company can spend money on both the incentives, which attracts prospects to become customers, and the analytics, which allows the company to target the incentives to certain customers. The question is: how much to spend on each of the above two items?

Also, there are seemingly contradictions between theory and practice. For example, the prevailing notion in CRM about customer acquisition and retention is that it costs 5 to 10 times more to acquire a new customer than to retain an existing customer. Despite this common knowledge, many companies are still characterized as "not spending enough" on retention.

In summary, this study seeks to answer the following questions:

- Given a customer pool and distributions of customer switching costs, what will be the optimal allocation of acquisition incentive spending vs. retention incentive spending vs. analytics spending, so that the total cost of the above three is minimized?
- Under what conditions there will be such situation that any combination of the following is true: the optimal acquisition incentive is zero (or non-zero), the optimal retention incentive is zero (or non-zero), and the optimal analytics spending is zero (or non-zero)?
- Also, practically, why is there a gap between the theoretical expectation of allocating more money on retention, and the observed behavior in practice that companies are not spending enough on retention? Does this mean it would be

cost-efficient for a company to allocate more of its resources to retention than to acquisition?

To summarize, what separates this research from the previous ones is that in this research, acquisition rate is not only a function of incentive amount, but also a function of ability to incentive-discriminate. In addition, the ability to incentive-discriminate is a function of analytics spending. The result of this research will help the marketing decision makers to optimally balance the resources between incentives and analytics spending.

3.2 Model Framework

In this section, the setting in which the model on acquisition and retention incentives is operated is established. Types of switching costs are examined and a time-based definition of acquisition and retention is proposed. The following terms will be defined or discussed:

- Switching cost
- Distinction between acquisition and retention
- Conditions for Acquisition and Retention

3.2.1 Switching Costs

Types of Switching Costs

Natural Switching Cost and Artificial Switching Cost

Based on whether they can be controlled or manipulated by a company in the short run, switching costs can be put into two categories. The "*natural*" switching cost is a

function of technology and customer's individual preferences, etc. The "*artificial*" or "contractual" switching cost (Klemperer, 1987) is usually controllable by the company through, for instance, contracts and early termination penalties. The significance of this categorization to the current study is that a company can use the following two means to influence the customers' switching decisions:

1) Control the artificial switching costs.
2) Predict prospects/customers' natural switching costs and act accordingly (incentive discrimination).

Switching-in Cost vs. Switching-out Cost

A *switching-in* cost is a switching cost that is incurred to a prospect when he becomes a customer of the company. The natural switching-in costs are, for example, costs of learning the new store layouts, learning the operation of new machines, and filling the account application, etc. The artificial switching-in cost may include initiation fees a health club charges, for example.

A *switching-out* cost is a switching cost to the customer if he defects. Money, time, and efforts spent on learning the layout of a competitor's store and the operation of a competitor's machines are natural switching-out costs. Early termination penalty is a typical example of an artificial switching-out cost.

Types of Customers and Their Related Switching Costs

The magnitude of switching-in cost is associated with the status of the prospect. A competitors customer usually has higher switching-in cost than an at-large prospect. The three types of customers are different in their switching cost characteristics as listed in Table 3.

3.2.2 Acquisition and Retention

Switching-Cost-Based Definition of Acquisition and Retention

Acquisition

In the current study, in addition to the apparent condition that an acquisition is when a non-customer becomes a customer of the company, the following criterion must also be met for a customer to become an *acquisition*:

There is a significant switching cost present or created.

This criterion ensures that an "acquired" customer is more than just a person who bought some products or services from the company. As discussed in Chapter 1, one critical justification for offering incentive (instead of simple price discount) is the existence or creation of switching cost. Based on this criterion, a person who stops by a grocery store to get a snack on his long-distance drive across the country is only a customer, but not an acquisition because there is no switching cost involved. In other words, since this customer will stop at almost any other store for his next stop freely and without any burdens (of switching cost), he is not an acquisition.

How large does the switching cost have to be to qualify for being "significant"? Quantitatively, we can use the ratio between switching cost and per-period revenue or profit to gauge how "significant" the switching cost is. For example, if a one-year cell phone contract comes with a $50 incentive and $150 early termination penalty, and the average profit per month is $30, assuming no "natural" switching costs, then the ratio is

(150-50)/30=3.3. Therefore, one can define a switching-cost-to-profit-margin ratio of, for example, 2 or higher as being a "significant" switching cost.

Retention

Retention is similarly defined as keeping an existing customer while creating or maintaining a *significant* switching cost. The difference between retention and acquisition is that when a prospect accepts an acquisition incentive, his net switching-in cost is lowers; when a customer accepts a retention incentive, his net switching-out cost is raised.

Time-based Definition of Acquisition and Retention

Sometimes the line between acquisition and retention is rather vague. For example, in the following case:

Pricing for Wireless Phones with Different Length of Contract

Term of the Contract	No contract	One-year contract	Two-year contract
Phone Pricing	$344	$294	$219

We can see that a one-year contract will have a saving of $50 over a no-contract plan, and a two-year contract will save $125 over a no-contract plan. As shown in the above example, different plans (no contract, one-year, or two-year) provide different amount of incentives. The longer the term, the higher the incentive is. How do we distinguish between an incentive that keeps the customer for one year and one that keeps the customer for two years? Are they both acquisition incentives? How should we evaluate between incentives that have different duration of impact?

As discussed in Chapter 1, switching cost is a necessary condition for offering incentives. In addition, I have also reasoned that a significant switching cost is a necessary condition for an acquisition. In this section, I will further develop the understanding of acquisition and retention and will form a time-based definition. The essence of time-based definition is still built on the switching-cost-based except that it emphasizes the time effect of switching cost. The rationale is that a significant switching cost often results in the customer's staying for a significant length of time. Put it differently, a significant switching cost will increase the probability that a customer will stay for a longer period of time. There can be two ways for the switching cost to prevent the customer from defecting too early. One is the natural switching cost: a customer simply will incur a lot of these costs if he switches frequently. The other is certain costs the company imposes, such as early termination penalty. Both types of the costs discourage customers from switching too early or too often. Because of the connection between switching cost and the expected length of stay, a time-based definition of acquisition and retention is actually an extension of the switching-cost-based definition.

Based on the above reasoning, the switching-cost-based definition of acquisition and retention can be extended as:

Acquisition is when a non-customer becomes a customer with a significant switching-out cost attached *and this switching-out cost usually prevents the new customer from defecting before completing a stay of a significant length of time*.

Retention is keeping an existing customer with *a significant switching-out cost and this switching-out cost usually prevents the existing customer from defecting before completing a stay of a significant length of time*.

In the example above, a one-year contract will save the consumer $50, and a two-year contract will save $125. So some people might think both the $50 and the $125 are acquisition incentives. However, the $125 is actually a retention incentive as well. Using the time-based definition, we can distinguish between acquisition incentives and retention incentives under these situations.

As discussed earlier, a necessary condition for a price discount to become an acquisition or retention incentive is the existence of a significant switching cost. For a 1-year contract, the $50 incentive is the acquisition incentive because it creates a significant switching cost in the form of an early-termination penalty and therefore raises the probability that customers will join and stay for one year.

Is the $125 incentive for a 2-year contract also an acquisition incentive? This question can be answered by comparing a one-year contract with a two-year contract. A two-year contract can be treated as a one-year contract offered to a new customer followed by a one-year contract offered to an existing customer. Therefore, the incentives accompanying a two-year contract is a mixture of acquisition incentive and retention incentive. From a time-based perspective, if we define a "significant length of time" as one year, then the completion of a one-year period is considered a successful acquisition

and any time period past one year should be regarded as retention. Therefore, the $125 is a mixed incentive that contains an acquisition incentive of $50 and a "pre-installed" retention incentive of $75. The $75 is a retention incentive because it raises the probability that customers will stay for an additional year after the first year is completed. (This is also an example of the difference between the time when incentives are administered and the time when incentives take effect. Specifically, in this case, the function of retention of the second year is actually performed when the acquisition is made.)

If one fails to recognize that an incentive on a two-year contract is actually composed of more retention incentive than acquisition incentive ($75 vs. $50) instead of only acquisition incentive ($125), he may mistakenly believe that the company spends more money on acquisition than retention. When retention cost is mistaken as acquisition cost, it will also add unjustified support to the notion of "companies spend more money on acquisition than retention".

To summarize, for contract of longer periods, by identifying the effects of incentives based on the "time-based" approach, one can distinguish retention incentives from acquisition incentives.

3.2.3 Conditions for Switching

In this section, the variables and the criteria for accomplishing acquisitions and retentions are stated. The goal is to establish a logical and quantitative link between switching

cost, switching cost distributions, incentives offered, and the outcomes of incentives, i.e., whether the customer is acquired/retained or not.

Reasons for Differences in Switching Cost among Different Individuals

Differences in consumer preferences will affect the way a customer evaluates a product/service and its values. Besides the differences in preferences about the products and services themselves, different risk tolerance and time discount also contribute to the differences in switching cost. For example, people with high risk tolerance would perceive the switching to a new product or seller less risky and have lower switching cost than people with low risk tolerance. Also, people who have higher time discount rates will perceive incentives are more valuable than those with low time discount rates. Therefore, the differences in switching cost among different individuals can be summarized as the differences in their respective "risk-adjusted net present values".

Conditions for Accomplishing Acquisition and Retention

Conditions for Acquisition of Competitors' Customers

Assuming that both the firm and its competitors offer identical services or products, the acquisition of a competitor's customer will be accomplished if net switching cost is less than zero, or equivalently, the acquisition incentive is larger than his switching cost. (The switching cost used in this research refers to the net switching cost after adjusted for any benefit but before applying the incentives. This will allow fair comparison when there is difference in quality or features between two firms' services or product. The difference can be expressed as a money-equivalent and be accounted into the calculation

of total switching cost. For example, in their study about wireless customer switching behavior, Shi et al (2002) demonstrates that larger networks offers more benefit than smaller networks by virtue of higher possibility of in-network calls. If in this case, the direct monetary value of the switching cost without accounting for the differences in network size is $100 and the new company's larger network is equivalent to $30, then the net switching cost is $100-$30=$70.)

Therefore, for competitors' customers:

If acquisition incentive > switching cost, then the customer is acquired.

Conditions for Acquisition of At-large Customers

Since at-large customers are not current users of a service or a product, switching cost will be defined as the perceived differences between the firm and its competitor. For example, if for the same price, the customer perceives firm A and B as offering values of $200 and $150 respectively, then the "switching cost" for becoming B's customer is $50. Therefore, an incentive of $50 or more from firm B is necessary to attract this customer. So, for at-large customers:

If acquisition incentive > switching cost, then the customer is acquired.

Conditions for Retention of Existing Customers

The purpose of retention incentives can be regarded as increasing effectively the total cost of switching. For example, if the switching cost (without retention incentives) is $100 and the benefit the competitor's offering is $120, then the customer has a negative net switching cost (or positive switching benefit) of $20 and will defect. However, if a

$50 retention incentive is provided, then it more than offsets the switching benefit, making switching unattractive. In fact, the minimum incentive necessary to retain the customer is: Benefits form the Competitor – Switching Cost = $120 - $100 = $20. Therefore, for existing customers:

If retention incentive> net switching benefit, then the customer is retained.

"Number Acquired" and "Number Retained"

The number of prospects acquired is a function of acquisition incentives. The higher the acquisition incentive (per person) is, the higher the number of prospect customers can be attracted. In most of the previous studies, s-shaped curve functions are used to describe acquisition rate (number acquired divided by total number of prospects). However, if customer switching cost function can be described as a known distribution, e.g., normal or uniform, and the parameters of the distributions are known (or assumed, as in this study), then the acquisition rate function can be derived directly as cumulative distribution of the switching cost function. For instance, when the preference distribution is a normal curve, its corresponding cumulative distribution function (cdf) is an s-shaped curve. When the preference follows a uniform distribution, the cdf, and the acquisition rate function is a straight line with an up-ward slope.

(In addition to the amount of incentives, there are other factors affecting a particular consumer's switching/staying decisions. For example, Feinberg et al (2002) argue that consumers' reaction to firm's promotional offers is affected not only by the offer the

consumers themselves receive but also the offers available to others. In this study, I will assume that this effect be negligible.)

Example

This example will illustrate how customer preferences and the amount of incentive offered determine the acquisition rate.

Assuming everything else being constant, customers' switching cost distribution is determined by their preferences. If we know the preference distribution and consequently the switching cost distribution, then we can calculate the acquisition rate given the amount of incentives offered. For example, if there are 10 customers, and their switching costs are \$1, \$2, … \$10 respectively, then the switching cost distribution is known. And if the company's incentive offering is \$8 per person, then by applying the acquisition condition: "*If acquisition incentive > switching cost, then the customer is acquired"*, we can see that eight customers, those whose switching cost are less than or equal to \$8, will be acquired. Therefore the acquisition rate is 8/10=80%.

Mathematically, if we express the switching cost distribution as F, then the acquisition rate is the cumulative distribution of F divided by the total number of customers.

3.2.4 Time Periods

In this section, time period for the administration of the incentives and the time period for the effects of the incentives are distinguished.

Time Period for The Actions of Giving Acquisition/Retention Incentives

Incentives can be administered on either a continuous basis or a discrete basis. Regardless of which format it takes, in this study, the amount of incentive is defined as the aggregated sum of incentives in a given period of time. For example, when the incentive amount is needed for evaluating/comparing the effectiveness of acquisition incentives and retention incentives, one can use one month (or one quarter, etc) as the time frame for aggregating incentives.

Time Period for the Effects of Acquisition/Retention

Sometimes the duration of the effects of acquisition/retention is very close to the duration that incentives are administered. For example, many credit cards accrue bonus points on a monthly basis continuously and the effects of retention can be regarded as extending the tenure month-by-month. However, the effects of acquisition/retention do not necessarily match the length of time the incentive is administered. For example, in a marketing campaign of one week, a one-time incentive provided on a cell phone service contract can effectively retain the customer for an additional year.

Time Periods in the Current Study

Without losing its generality, a shorter length of time period for administrating incentive and a longer one for the effects of incentives are used respectively. Specifically, I will choose to use a period of one month as the length of time for incentives administration, i.e., both the acquisition incentives and the retention incentives, are calculated or aggregated respectively on a monthly basis. I will then choose to use a period of one

year as the length of time for the effects of acquisition and retention, i.e., a customer acquired or retained is defined as a customer who will at least stay with the company for one year or one additional year.

To summarize, in this study, the acquisition incentive is the cumulative amount of acquisition incentives that is administered in a month and it raises the probability of non-customers joining and staying for one year.

The retention incentive is the cumulative amount administered in a month and it raises the probability of existing customers staying for another year.

3.2.5 Summary of the Model Framework

To facilitate a clear understanding of the terms used in this study, a table of definition is provided in Table 4. As discussed in the above paragraph, I will use one month as the time period on which the administration of the incentives is measured.

One-time Customer vs. Acquisition vs. Retention

The distinction between a customer, acquisition, and retention is summarized as follows:

- A one-time customer is NOT an acquisition.
- An acquisition is achieved when a prospect becomes a customer and a significant switching-out cost (natural or artificial) is accompanied. As a result of this switching cost, the probability that customer will stay for at least a minimum length of time with the company is raised.
- A retention is achieved when an existing customer extends his tenure with the company and a significant switching-out cost is accompanied.

- Retention incentives can be offered to prospects as well. For an incentive offered to a prospect, if the accompanying contract imposes more than the minimum length of time requirement that qualifies it as an acquisition, then it is a mixed incentive, meaning that one part of it is acquisition incentive and the other part of it is retention incentive.

The advantages of the "time-based definition" of acquisition and retention

- Prevents certain "pre-paid" retention cost from being mis-labeled and mis-categorized as acquisition cost. This can clarify some of the confusions that result in claiming that more money is spent on acquisition than retention.
- Provides a method of cost accounting that truly reflects the true effects of the acquisition incentives vs. that of retention incentives.
- Provides a tool to decompose mixed incentives and compare incentives of different effective durations.

Summary of Model Framework

- A customer's decision of whether to switch is dependent on the level of his switching cost and the level of incentives.
- There are two types of switching costs: natural and artificial.
- The level of natural switching cost is a function of the technology, regulation, customer's preferences, etc. The natural switching cost is usually not controllable by the firm in the short run, or, at least, not controllable by the marketing function of the firm.

- The natural switching costs vary among customers or prospects.
- The level of artificial switching cost is mainly controllable by the firm.
- A prospect will be acquired if the incentive offered is no less than his switching cost.
- An existing customer is retained if the incentive offered is no less than his switching benefit.
- Customer acquisition rate is a function of customer preference distribution (therefore the switching cost distribution) and the incentive level per customer.

This framework is illustrated as Figure 1.

The firm can influence customer's switching decision by controlling or managing incentives and artificial switching cost, as well as predicting customer's preferences.

3.3 Free Riders

3.3.1 Definition and Examples of Free Riders

In the last section, I illustrated the effects of ability to incentive-discriminate customers on acquisition and retention incentives allocation. A natural follow-up question will be "Under what circumstances is it optimal to offer acquisition incentives, retention incentives, or both?" In addition, "Given a certain level of ability to discriminate its prospect customers and a certain level of ability to discriminate its existing customers respectively, what will be the optimal acquisition incentive amount and retention incentive amount?" To answer the above questions, in this section, I will first introduce the concept of "Free Riders" in acquisition and retention process.

Background and Definition

In economics, the term "free rider" with respect to public goods or collective goods is used to describe people or groups who do not contribute their shares but still benefit from the public goods offered (Samuelson, P.A. 1954). The benefit is also considered "positive externalities", meaning that it is unaccounted for by the pricing system. Although the term "free riders" does not necessarily imply that they ride for free intentionally or deliberately, there is a strong incentive for individuals to misrepresent their true marginal utility for a public good in a game theoretic setting.

The term "free rider" has also been used in many other areas as well. For example, in international trade, World Trade Organization defines free-rider as a "country that does

not make any trade concessions but profits, nonetheless from tariff cuts and concessions made by other countries negotiating under the most-favored nation principle." In electric utility industry, providers have difficulty implementing different pricing for different levels of reliability because the customer and its neighbors all connect to the same power line and therefore all sign up for the lowest reliability plan, hoping to free-ride off their neighbors (Brown & Marshall, 2001).

In marketing, "free-riders" often refers to those consumers who take advantage of services (that are often free) offered by one company (or marketing channel) but make the purchase from another company (a competitor) or channel. For example, a consumer can go to company A's store or website to learn about a product and then place an order from company B for lower prices. Therefore, these consumers are free-riding off company A's services. (Company B can also be regarded as free riding off company A because it benefits from company A's services without paying for it.) A second example would be that when a company has two marketing channels, for example, "brick and mortar" and "internet". The "brick and mortar" offers more services such as product demonstration by salespersons, but at a higher price than the "internet" channel. A consumer can free-ride if he gets the product demonstration in "brick and mortar" but buys it from the "internet" for less. Wu et al (2004) studied the implication of free riding in e-commerce.

Same as the cases of free-riding on public goods, the free-riders on acquisition incentives and retention incentives do not necessarily hide their marginal utility (or propensity)

deliberately. However, they "free-ride" by taking the incentives that are not intended for them. It is the job of the companies and marketing professionals to identify and reduce these free-riders because doing so will not only improve the profit from a company's perspective but also will improve efficiency from an economy's perspective. The term "free-riders" defined in this study takes the meaning of "hidden preferences" and "taking the benefit that is not intended for them".

Examples

In this study, I propose the concept of "free-riders" in the setting of customer acquisition and retention. Some examples of free-riders in this setting are: 1) a consumer who will buy a product anyway but still takes an incentive offer that is meant for enticing undecided customers; 2) a cell phone user who will renew the service contract anyway but still receives renewal incentives; 3) a new home owner who is ready to install a cable TV service takes advantages of the incentive offer aimed at inducing satellite subscribers to switch. In these cases, consumers free-ride on incentive offers. Incentives spent on these free-riders are "wasted" because they will purchase the product or service even without the incentives.

Free-rider Characterized in the Context of Switching Cost and Incentives

This section characterizes free-rider in the contexts of switching cost and incentives as they were defined earlier this chapter. The motivation of doing so is to regard free-riders as special cases of customers or prospects with certain characteristics.

Free-rider in Acquisition

A free rider in acquisition is someone whose net switching-in cost is very low or less than zero. For example, a new home owner who is very eager to sign up a cable TV service is equivalent of having very low switching costs. As discussed earlier, *if net switching cost is less than zero, then the customer is acquired*. Therefore, for a customer like this, an incentive will be a "waste" of money and will allow the free rider to free-ride. Apparently, the rule for efficient use of acquisition incentive is: The lower the switching-in cost is, the lower the acquisition incentive is needed. For free riders, the best strategy is to offer them no incentives.

The more effective and efficient use of acquisition incentives includes:

1) Discriminate: identify each customer's natural switching-in cost. Offer incentives only enough to offset their switching-in costs.
2) Attract customers whose natural switching-in cost are lower. (However, it has been realized that some low-switching-cost customers can also have low switching-out cost, making it difficult to retain them.)
3) Decrease their artificial switching-in cost. For example, new cell phone carriers welcomed the regulation of cell phone number portability, which allowed cell phone number to be kept by the consumer even when they switch carriers.

Free-riders in Retention

A free rider in retention is someone whose switching-out cost is very high. Even without being offered any incentives, these customers will still not defect. A retention incentive offered to them creates free-riding. For example, a discount on a two-year cell phone contract for people who consider switching carrier "not worth the trouble" will

result in free-riding of the retention incentives. Another example is a renewal incentive offered to a user who does not intend to switch at all.

Therefore, the strategy of efficient retention incentive is: The higher the switching-out cost is, the lower the retention incentive is needed.

The company can take the following measures to improve effectiveness:

1) Discriminate: identify each customer's natural switching-out cost. Offer incentives only to those with low switching-out costs.
2) Attract customers whose natural switching-out cost are higher. (Note: Actually, if a customer's switching-out cost is negligible, then the customer is not considered an acquisition by definition used in this research.)
3) Increase the artificial portion of switching-out cost. (Note: This is often the result of customer receiving retention incentive in exchange of a contracted early termination penalty. However, non-contractual ways of increasing artificial switching cost can also be implemented, e.g., increased services/features such as bank's on-line bill-pay.)

3.3.2 Summary

The following table summarizes the definition of free rider and non free rider in acquisition and retention, as well as the conditions (in terms of incentives) need for being acquired or retained.

The Figure 2 illustrates the switching-cost based definition of free rider, the criterion for acquisition, and the effect of acquisition incentives.

The Figure 3 illustrates the switching-cost based definition of free rider, the criterion for retention, and the effect of retention incentives.

In this study, we assume that the pool of prospects and the pool of existing customers, as well as switching cost distribution, and the number of free riders in prospect and existing customers are exogenous, i.e., the company can neither change the characteristics of its prospects or customers, nor can it manipulate the switching cost.
The only measure that the companies can take is to try to incentive-discriminate, i.e., to identify free riders and prevent them from receiving incentives.

3.4 Incentive Discrimination and Its Effects

3.4.1 Incentive-Discrimination

In the context of acquisition and retention free riders discussed above, incentive-discrimination in this model is defined as the ability to distinguish free riders from non free riders. This ability can be mathematically expressed as the percentage of free riders that the company can identify. A company without such ability will be able to identify 0% of the free riders. A company with a perfect ability will be able to identify 100% of the free riders.

3.4.2 The "Targeting" Effect of Incentive-Discrimination

When a company can incentive-discriminate, it can make "targeted" offers to certain prospects/customers, and save money as a result. For example, in customer acquisition, if a company is not able to incentive-discriminate, it has to offer all prospects incentives. However, if the company has the ability to incentive-discriminate, it only needs to give incentive offers to non free riders. This will 1) reduce promotion/marketing costs, e.g., mailing cost, by only sending the offers to the customers whose decisions will be swayed by the incentives, and 2) reduce incentive costs by only giving incentives to these customers (non free riders). Therefore, when a company can incentive-discriminate, the marketing cost and acquisition cost will be less than that when it cannot discriminate.

3.4.3 The "Favoring" Effect of Incentive-Discrimination on Acquisition and Retention Incentive Allocation

Another effect of incentive-discrimination is that it can affect the optimal allocation of money between acquisition incentive and retention incentive.

Suppose that a company has 100 existing customers whose retention costs follow a uniform distribution ranging from -$20 to $80 in $1 increment, if the company would like to allocate all its money on *retention*, then to retain 90 of them, without any ability to discriminate, the company would need to offer an incentive of $70 per person to everyone. The total cost of retaining 90 customers is $70*90=$6300.

Also suppose that it has 300 prospects whose acquisition costs follow a uniform distribution ranging from -$20 to $80 in $1 increment, If the company would like to

spend all its money on *acquisition*, then to attract 90 of them, with the knowledge of who the free riders are, the company will have a significant advantage. Realizing that even without offering any incentives, there will still be 20% (or 60) of the prospects joining the company because they are free riders (whose switching cost is less than zero), the company would only need to offer $10 per person to the non free riders. This would attract an additional 30 prospects. The total cost of acquiring 90 prospects is $10*30=$3000.

The result shows that it is better for the company to spend money on acquisition than retention. This is the case because the ability to identify free riders makes it more efficient to provide more incentives to acquisition than retention. In other words, the relative strength of the ability to incentive-discriminate in acquisition makes it more favorable to spend on acquisition.

3.4.4 Discussion

From the above examples, we can observe that: first, it is possible that spending money on acquiring new customers can be just as effective as retaining existing ones; second, the optimal allocation between acquisition and retention depends on customer preferences and incentive-discrimination on both the acquisition and the retention. In other words, we have a preliminary answer to the questions raised at the beginning of this chapter, e.g., whether or not to spend money on acquisition incentives or retention incentives, or both. The answer is that the optimal allocation will depend on the following factors:

- Existing customers' preferences

- Prospects' preferences
- Ability to differentiate existing customers
- Ability to differentiate prospects

This also proves that the popular belief that retaining customer is less expensive than acquiring customer is not always true. First of all, the assumptions about the retention cost and acquisition cost refer to average costs. If we take existing customers as a whole and the prospects as a whole, then it is generally true that the average retention cost per existing customer is much less than the average acquisition cost per prospect. However, it is important to point out that not all existing customers are equal in terms of retention reservation price. The same is true for prospect customers, i.e., not all prospects have the same switching costs.

Therefore, although on average, it is more costly to acquire a new customer than to retain an old customer, at the individual level, it is possible that it is less costly to acquire a particular new customer than to retain a particular existing customer. The key is to identify those particular new customers, specifically, those new customers with low acquisition costs. The example also shows that to provide more conclusive answers to the questions raised in the beginning of the chapter, a more systematic way of studying the quantitative relations between the factors and the outcomes is needed.

Chapter 4: Methodology: Mathematical Model

4.1 Why Mathematical Model?

As stated in Chapter 3, the central question this study will answer is: Given a customer pool, a customer preference distribution for acquisition and retention, what will be the optimal level of acquisition spending vs. retention spending vs. analytics spending, so that profit is maximized?

The above question requires the study of the determinants of optimal incentive decisions and the solution in a quantitative manner. Therefore, to study the effects of these determinants quantitatively, a mathematical model is suitable. A mathematical model uses mathematical variables and functions to describe the relations it represents. The real-world factors/determinants that affect the outcome are represented by mathematical variables in the model. The relations between the factors are represented by mathematical functions. Not only that the research question makes it necessary for us to employ a mathematical model, but also that the knowledge of the variables, function forms, or the properties of the relations between variables makes it feasible to construct such a model. For example, as discussed in Chapter 3, the condition for switching can be clearly expressed mathematically, i.e., the relation between number of free riders identified and the analytics spending can be expressed in mathematical functions that are consistent with the property of diminishing returns. Therefore, all of the above knowledge about the mathematical relations between variables affords us the feasibility of formulating a mathematical model.

4.2 Mathematical Model vs. Other Methods

Besides mathematical model, other methods such as numerical optimization and survey research have also been used in the study of business/marketing decisions. However, mathematical model has its unique advantages over other methods. Mathematical model is very suitable for solving optimization problems because of it uses clearly defined mathematical functions. Comparing to numerical optimization method such as some software packages, mathematical model has its advantages in that it provides not only the result of an optimal solution, but also a transparent mapping of the relations between the parameters and the outcome. It is also possible to reach a closed-form solution, which the numerical optimization usually cannot.

The advantages of mathematical model over survey method also lies in its explicit expression of the relationship between variables. Also, because mathematical models' clear and concise representation of the relations, and its flexibility for modification and revision, as well as its ability to perform what-if analysis, it is more advantageous to utilize this method whenever the conditions allow.

(However, the use of mathematical model in solving an optimization problem does not necessarily exclude the use of numerical optimization or survey, etc. In fact, when certain types of problems or certain assumptions/relations of the problems make it too complex to interpret a mathematical model, numerical optimization should be used instead. Also, survey method can provide the foundations on which the mathematical models are built. For example, the assumed relationship between any two variables can be modified, either in terms of function form, or in terms of parameter values, if the

survey results demonstrate a different reality than the mathematical model had originally portrayed.)

4.3 Relevance in Mathematical Representation

A good mathematical model should closely reflect the reality it abstracts from. In the current research, the model is formulated based on the understanding of the concept and the relations of the elements and factors in customer acquisition and retention. Certainly, there are more than one way of mathematically expressing these concepts and relationships, nevertheless, the analysis is robust enough to encompass variations. For example, as we will see in the next chapter, the relationship between free riders identified and the analytics spending is expressed in a quadratic function. The real-world function might be different. However, the quadratic function captures the most important properties of the relationship, such as the concavity, i.e., in this particular case, the diminishing return of the analytics spending.

4.4 Advantages and Possible Future Expansions

One of the major advantages of utilizing a mathematical model is that we can plug in different assumptions by changing different function forms or parameters. Using mathematical model also makes it possible to expand the current model.

The current research built on the previous studies on optimal incentive allocation (references here), and can potentially be developed or modified into either part of a larger model or a model with different assumptions on the detailed level. For example, one of the assumptions of this model is that the price is already determined. An expansion of the model can allow both price and incentives to change. Under that situation, the number of free-riders will be a function of price, instead of an exogenous variable in the current model. This can also allow us to study the optimal combination of price and incentives, e.g., low-price-low-incentive or high-price-high-incentive. The net price (price minus incentive) might be the same between the above two options, but the effects are different because the effect of price and incentive are different (the high-high combination is usually accompanied by a longer contract and is therefore more "captive" than the low-low combination, for example.)

Another possible variation of the current model is to use exponential function, instead of quadratic function, to describe the relations between analytics spending and the free riders identified. Also, the customers' and the prospects' preferences distributions, which are currently assumed to be uniform distributions, can be changed to other type of distributions.

In summary, there are numerous possible expansions or variations of this model that would afford the future researchers abundant opportunities for exploration and improvement.

Chapter 5: Base Model: Acquisition Incentive vs. Retention Incentive

5.1 Model Formulation

In this section, I will propose a constrained optimization model, make certain assumptions about the relationships and the parameters, and solve for the optimal level of acquisition incentives and retention incentives.

Incentive-Discrimination

In the context of free riders discussed above, incentive-discrimination in this model is defined as the ability to distinguish free riders from non free riders. Mathematically, it is expressed as percentage of free riders that the company can identify. A company without such ability will be able to identify 0% of the free riders. A company with perfect ability will be able to identify 100% of the free riders.

Assumptions

There following assumptions are for the base model only. In the extended models, assumption 4 will be changed.

Assumption 1 (Equal margin assumption): All customers, once acquired or retained, make equal contribution to company's profitability.

Assumption 2 (Uniform distribution assumption): Customer reservation prices follow a uniform distribution.

Assumption 3 (Linear function assumption): The acquisition rate and retention rate are linear functions of acquisition incentives and retention incentives respectively. (Consequently, the Marginal Acquisition Rate and Marginal Retention Rate, which are the slopes of the acquisition rate and retention rate function, are constants.)

Assumption 4 (Cost components): The cost of acquisition incentives and retention incentives are the only variable components of acquisition and retention cost. The cost for devising the incentive-discrimination, administering and implementing the incentives are excluded. The reason for this is that the base model is primarily concerned with the allocation of incentives between acquisition and retention when discrimination is involved. Therefore, other factors are treated as control variables or constants.

Problem Definition

For a corporate executive who is in charge of acquisition and retention functions, his goal is to make decisions at the beginning of the month so as to reach/maintain a pre-determined number of customers at the end of the month at the minimum costs. The pre-determined number of customers is set by the corporation. At the executive's disposal is the allocation of incentive expenditure between acquisition and retention.

Therefore, this situation can be summarized as follows:

- Objective: Minimizing Total Acquisition and Retention Expenditures

- Constraints: Maintaining a Predetermined Number of Total Customers at the End of the Month
- Decision Variable: Allocation of incentives
- Parameters/Assumptions: As listed in the above sections.

5.2 Solving for Optimum

The above defined problem can be characterized as a constrained optimization problem. Lagrange Multiplier method is used to solve this problem.

Variables and their definitions are listed in Table 6.

Note: the detailed discuss of r1 and r2 are in section 3.3.2.

The objective function *v* (sum of total acquisition expenditure and retention expenditure) and constraint function *u* (sum of number of customers acquired and retained) are formulated as follows:

Let *u* be the total cost of acquisition and retention, and *v* be the total number of customers.

Since the total number of customers is composed of four groups:

- the total number of free-riders among prospect customers acquired f_1
- the total number of non free-riders among prospect customers acquired $g_1 \frac{x_1}{r_1}$
- the total number of free-riders among existing customers retained f_2
- the total number of non free-riders among existing customers retained $g_2 \frac{x_2}{r_2}$

Therefore, $v = f_1 + g_1 \frac{x_1}{r_1} + f_2 + g_2 \frac{x_2}{r_2} = C$

Since the total expenditure is composed of the incentive costs for the above four groups respectively, we have $u = f_1 x_1 + \frac{g_1}{r_1} x_1^{\,2} + f_2 x_2 + \frac{g_2}{r_2} x_2^{\,2}$

To set up Lagrange Multiplier, let

$L = u - \lambda(v - K)$

where λ is the Lagrange Multiplier.

Set partial derivatives of the above function equal to zero:

$$\frac{\partial L}{\partial x_1} = 0$$
$$\frac{\partial L}{\partial x_2} = 0$$
$$\frac{\partial L}{\partial \lambda} = 0$$

Solving the above equations, the optimal acquisition incentive (x_1 *) and the optimal retention incentive (x_1 *) are:

$$\lambda = \frac{r_1 r_2 (2c - f_1 - f_2)}{g_2 r_1 + g_1 r_2}$$
$$x_1 * = \frac{\lambda g_1 - f_1 r_1}{2 g_1}$$
$$x_2 * = \frac{\lambda g_2 - f_2 r_2}{2 g_2}$$

Therefore,

$$\rightarrow x_2 * = x_1 * + \frac{f_1 r_1}{2 g_1} - \frac{f_2 r_2}{2 g_2}$$

5.3 Discussion: The Advantages and Disadvantages of Retention vs. Acquisition

From a company's perspective, although a typical existing customer usually has switching cost advantages over a prospect, there are some disadvantages in implementing retention incentives compared with acquisition incentives.

As it is shown in the above numeric example, when the free-riders are 15% of the prospect customers and 50% of the existing customers, the company's optimal strategy is to offer $27.36 in acquisition incentives per person vs. $10.70 in retention incentives per person. In this particular case, the optimal strategy is to give prospect customers about two to three times the level of incentives offered to the existing customers.

If a company cannot detect whether a particular customer will churn or not, then it has to offer the same retention incentives to all existing customers. The problem with this situation is that there can be more existing customers who are not contemplating churning than those who are. A blanket retention incentive will be "wasted" on these "free riders", customers who are not considering churning anyway.

On the acquisition side, however, an acquisition incentive will not be "wasted" on customers who do not want to join because a customer cannot get the incentive unless he signs up with the company.

However, there are potential free riders in prospect customers as well - people who would sign up anyway even without the incentive, in a competitive market, where the competitions offer incentives, the number of these "wasted" acquisition offers would be negligible. So in this sense, acquisition incentives are "naturally" more targeted than retention incentive in that the former is much less likely given to the free riders than the latter.

The above example also demonstrates that when there are significant free-riders, the optimal allocation of retention and acquisition will shift. Although the reservation price for an existing customer is often only a fraction of the reservation price for a prospect customer, because the company cannot identify free-riders, any incentive given to this existing customer will be offered to other customers (including free-riders) as well. Therefore, the existence of free-riders dilutes the company's retention efforts.

Since there are more free-riders in retention than in acquisition, the retention efforts are more diluted than the acquisition efforts. This explains why many companies appear to be "under-spending" on retention.

It is interesting to note that economists generally agree that free riders can bring the following consequences, which are similar to the effects of free riders on retention:

1) Goods affected are under-produced. The presence of free riders diminishes the company's incentives for providing these goods and services, such as free website information and review.

2) As a result of the first consequence, the overall market demand will decrease because of a lower level of information and confidence and a higher level of uncertainty.
3) Market will be less efficient.

An important distinction must be made to avoid possible confusion. In early sections it was stated that the companies usually have more information about their existing customers than about the prospect customers. More information usually leads to a better ability to incentive-discriminate. However, the reason why retention efforts have more "waste" is that the process of acquisition has its "built-in" mechanism of self-screening, i.e., only those who explicitly changed their status (from a prospect customer to a customer) will receive the acquisition incentives. In retention, every existing customer receives the retention incentives, whether he is considering leaving or not.

Sometimes companies can certainly give incentives only when a customer is in the process of leaving. This would avoid giving incentives to the customers who are not considering leaving. However, sometimes it is already too late when the customer has already made the move, for example, signed contract with another provider. Another issue is that the customer could be "bluffing" in order to get a better deal. This situation belongs in the domain of game theory and will be briefly discussed in chapter 7 of this dissertation.

5.4 Summary - Levels of Discrimination and Consequences on Acquisition/Retention with Free Riders

The optimal acquisition and retention incentive formula $x_2 = x_1 + \frac{f_1 r_1}{2g_1} - \frac{f_2 r_2}{2g_2}$ shows that:

1) The relative level of optimal acquisition incentive and retention incentive depends on the number of free riders among prospects and existing customers.

2) The relative level of optimal acquisition incentive and retention incentive depends on the effectiveness of acquisition and retention incentives.

3) The higher the number of free riders in prospects, the lower the optimal acquisition incentive per person, and vice versa.

4) The higher the effectiveness of acquisition incentive, the higher the optimal acquisition incentives per person.

Since the number of free-riders is negatively related to the ability to incentive discriminate, we can conclude that a better ability to discriminate (either a population of prospect customers or existing customers) will increase the optimal spending on that population.

5.5 Consistency with LTV (Life-time Value) Model

The popular LTV model uses a multi-period approach, but the current research model uses a one-period set-up. Is the conclusions drawn from this research consistent with the popular LTV model's calculation?

Yes, if the following assumptions are met. The first two assumptions are the common assumptions used in LTV models (Gupta et al, 2003). The third assumption is part of the base model.

1) *Constant margin of a customer in the calculation of LTV of a customer*: The constant margin means that the profit margin remains the same from period to period for the same customer.
2) *Constant retention rate in the calculation of LTV of a customer*: Although for a particular customer, his retention rate for any period is either 0 or 1, to calculate his LTV, which is actually an "expected" value of LTV, we use the portfolio's retention rate. So the constant retention rate is also with respect to time period, meaning that the retention rate of the portfolio remains the same from one period to the next.
3) *Equal margin of customers in the base model*: This is an assumption for the base model only. Here, the "equal margin" means all customers have the same amount of profit margin regardless whether he is a new customer or an existing customer. The reason for this assumption is that it allows the customer portfolio's value to be represented by the number of customers in that portfolio minus the cost of acquisition and retention. This will simplify the calculation

involved and still maintain the model result's reasonable robustness and its ability to generalize.

Because the above assumptions are usually an adequate approximation to reality, the conclusion drawn from the current research is valid under the LTV calculation. The detailed proof is in Appendix I.

Chapter 6: Extended Model: Optimizing Analytics Spending and Incentive

6.1 Optimizing Analytics Spending

In the last section, the ability to incentive-discriminate customers is treated as exogenous. The analysis answers the question of "how to optimally allocate money if the company can only choose between acquisition incentives and retention incentives?" In this section, we will add analytics spending to the above situation and the ability to incentive-discriminate is defined as a function of analytics spending. So the analysis will answer the question of "how to optimally allocate money if the company can choose between acquisition incentives, retention incentive, and analytics spending?"

A direct effect of analytics is the increased ability to differentiate customers. An increase in analytics spending can usually improve the ability to differentiate/incentive-discriminate. However, because the effect of analytics spending varies from one project to another, it is difficult to have a universal function form that describes the relationship between money spent and the discrimination achieved. Nevertheless, on any specific project, one can often obtain the cost and discrimination information about different analytical methods.

6.2 Model Formulation

Variables and Units

The variables used in this extended model are listed in Table 7.

The General Model and the Reduced Model

The general model, which examines the effects of the incentives and analytics spending, includes the following four variables: acquisition incentive, retention incentive, acquisition analytics spending, retention analytics spending. Assuming the total number of the free riders in retention is f_r, then the total cost is consisted of the following six components: cost of incentive to acquisition free riders, cost of incentive to acquisition non free riders, cost of incentive to retention free riders, cost of incentive to retention non free riders, cost of acquisition analytics spending, and cost of retention analytics spending respectively:

$$f_1 x_1 \frac{(m_1 - z_1)^2}{m_1^2} + \frac{g_1}{r_1} x_1^2 + f_r x_2 \frac{(m_2 - z_2)^2}{m_2^2} + \frac{g_2}{r_2} x_2^2 + z_1 + z_2$$

Our preliminary testing on such a "general model" shows that it is not mathematically tractable for closed form analysis, thus rendering the results almost uninterpretable. Therefore, a "reduced" version, which assumes that retention analytics spending is a constant and its effect is also a constant, is examined instead. Although holding the retention analysis spending constant prevents us from examining the dynamic effects of simultaneously changing acquisition analytics spending and retention analytics spending, as the results show below, the "reduced" model still provides a satisfactory level of insight into the interactions between analytics spending and incentives while maintaining its generalizability despite the simplifying assumptions. In addition, this treatment actually reflects many real-world situations, under which it is only possible for firms to

vary the spending on analytics of either the acquisition or the retention side. For example, since in many companies, acquisition analytics spending budget is usually controlled by marketing department and retention analytics spending budget is controlled by customer service department, it is realistic to assume that a company is only able to control or change one of its analytics.

Since the only effect of retention analytics spending in the general model is to reduce the retention free-riders, the effect of a constant retention analytics spending with a particular number (f_r) of unidentified retention free-riders is mathematically equivalent to the effect of no analytics spending with a reduced number (f_2) of total retention free-riders. Therefore, the general model with a constant retention analytics spending is equivalent to a reduced model with the following three variables: acquisition incentive, retention incentives, and acquisition analytics spending. With this simplification, we have the following cost function:

$$f_1 x_1 \frac{(m_1 - z_1)^2}{m_1^2} + \frac{g_1}{r_1} x_1^2 + f_2 x_2 + \frac{g_2}{r_2} x_2^2 + z_1$$

For convenience, this research assumes that the retention analytics is a constant and the only effect of analytics spending examined is that of acquisition analytics. Because of the symmetry between acquisition and retention in this mathematical model, the result and conclusion of the current analysis also applies to when the acquisition analytics spending is a constant and the retention analytics spending is a variable. The only changes to the analysis and conclusion will be to switch all “acquisition” to “retention”.

The "reduced" form of the model will be examined in this study.

The Effect of Analytics Spending: Quadratic Function Form

In this study, the effect of analytics spending is characterized as the identification of free-riders among customers, or the reduction of unidentified free-riders. In general, the more the company spends on analytics, the more free-rider it will be able to identify, and the fewer free-riders will remain unidentified. Since there was no previous study about the effects of analytics spending on the identification of free riders, there is no readily available mathematical function form for the relation between analytics spending and percent of free riders remaining or unidentified. However, by examining the situation I propose the following properties for the mathematical relation between analytics spending (z_1) and the percent of free riders remaining (q):

1. A monotonically decreasing function. This is because the more money a firm spends on analytics, the better the analytics will be, or the better the predictive model predicts. As a result, more free riders will be identified and the free riders remaining unidentified will be less.
2. q is equal to 100% when z_1 is zero, and 0% when z_1 is equal to m_1. This means that when no money is spent on analytics, no free riders will be identified. The remaining free riders will be 100%. And if the company spends enough money (m_1), all free riders will be identified and the remaining free riders will be zero.
3. A diminishing return of the analytics spending. This means that if it is less costly to identify the most apparent free riders than the least apparent ones. The law of

diminishing returns is one of the common assumptions between the money or resources allocated and the outcome of the input (Samuelson, 1954). Taking retention of existing customers as an example, it is reasonable to assume the diminishing return of analytics because the free riders with highest switching-out costs are usually the easiest to identify. These customers usually exhibit behaviors that are very "loyal" such as having long tenure and having purchases of high quantities. However, the switching behavior of those whose switching-out cost is close to zero are usually more difficult to predict since they are "borderline" free riders. More information and advanced analytical solutions are usually required to identify these "less apparent" free riders, making it more costly to identify them than the "more apparent" free riders.

The following function form satisfies the requirement of the properties of the relation between analytics spending (z_1) and percent free riders remaining unidentified (q) and it has a simple function form.

$$q = \frac{(m_1 - z_1)^2}{m_1^2}$$

Where

q is the proportion of free-riders remaining (unidentified)

m_1 is the "Analytics dollar required to identify all acquisition free-riders"

z_1 is the "Analytics spending"

Another function form, an exponential function, was also examined. However, a preliminary examination of the exponential form shows that the mathematical functions

become too complex to reach a closed form solution. Therefore, since no theoretical or empirical evidence is present to favor other function forms, and the quadratic form maintains the feasibility of a closed form solution and in the meantime possesses the desirable properties, it is chosen as the function form between free riders remaining unidentified and the analytics spending.

The Figure 4 shows that when $100,000 spending on analytics is needed to identify all free-riders (m_1=$100,000), the effect of actual analytics spending z_1 will have on the free-riders. For example, when the analytics spending is at $50,000, there will be 25% of the free-riders remain unidentified.

Objective Function and Constraints

Since the goal of the company is to maintain a preset level of number of customers and minimize the costs of acquiring and retaining these customers, we define the objective function as the sum of the cost of acquisition incentives ($f_1 x_1 \frac{(m_1 - z_1)^2}{m_1^2} + \frac{g_1}{r_1} x_1^2$), the cost of the retention incentives ($f_2 x_2 + \frac{g_2}{r_2} x_2^2$), and the cost of the acquisition analytics (z_1).

$$\text{cost} = f_1 x_1 \frac{(m_1 - z_1)^2}{m_1^2} + \frac{g_1}{r_1} x_1^2 + f_2 x_2 + \frac{g_2}{r_2} x_2^2 + z_1$$

We define the constraints as the sum of total number of customers acquired ($f_1 + \frac{g_1}{r_1} x_1$)and retained ($f_2 + \frac{g_2}{r_2} x_2$):

$$C = f_1 + \frac{g_1}{r_1} x_1 + f_2 + \frac{g_2}{r_2} x_2$$

6.3 Analysis and Results

We have examined the effects of different m_1 on the three other variables. The analysis has directly answered the question of "what will be the optimal strategy, in terms of spending on analytics, acquisition incentives, and retention incentives at different difficulty levels of identifying free-riders?"

The above constrained optimization leads to a fourth degree function. This function shows that the total cost of incentives and analytics spending varies as the amount of analytics spending varies. Also, for a given level of analytics spending (z_1), there exists an optimal combination of acquisition incentive (x_1) and retention incentive (x_2) that minimizes the cost of incentives under this specific analytics spending. By varying the amount of analytics spending, the optimal acquisition incentive and retention incentive will also vary accordingly. The function allows us to solve for the optimal level of analytics spending that minimizes the total cost of acquisition incentives, retention incentive, and analytics spending.

Taking derivative of the above fourth degree function gives us a cubic function. The cubic function is then solved and the conditions of the solution, the feasibility of the solution, and the boundary conditions are examined.

Although there are many parameters in the model, the analysis primarily focuses on the effect of the level of m on optimal strategies. The discussion of the extended model is

structured in the level of m, the analytics spending required to identify all free-riders. The range of *m* is divided into three regions: low, medium, and high.

In the following sections, I will examine the conditions and the behaviors of the analytics spending, incentives, and the total cost in those three regions. Attention will also be given to the two boundaries, or the thresholds, that separate the three regions. The following analysis is based on the assumption that the budgeted total customer number is not only greater than the total free-riders but also less than the total free-riders plus one type of non-free-riders. These assumptions exclude any possibility that no spending on analytics or incentives is necessary to fill the customer spots. In other words, we assume that to meet the requirement of the budgeted total number of customers, there will need to be some non free riders acquired or retained and there are enough non-free-riding prospects or customers to fill the spots.

The analysis shows that when holding all other variables constant, the level of *m* will lead to different patterns of optimal spending strategies.

6.3.1 The Three Regions of *m*

Three categories of *m* in its increasing order are: Low, Medium, and High. In business languages, these categories correspond to increasing degrees of difficulty in identifying free-riders. In terms of the amount of money that it requires to identify all free-riders,

these respective three categories can be characterized as: less costly, moderately costly, and very costly.

A Special Value: M_H

The boundary between "moderately costly" and "very costly" analytics is expressed in terms of a dollar amount M_H. If m, "the amount of money that is required to identify all free-riders", is less than M_H, then the analytics is "Moderately costly". If m is greater than M_H, then the analytics is "Very costly". The exact value of this amount M_H can be calculated by the following formula:

$$M_H = \sqrt{\frac{4(f_2 + 2(C - f_1 - f_2))^3 r_1 f_1 g_1 r_2^3}{27(g_2 r_1 + g_1 r_2)^2 g_2}}$$

The ratios g_2/r_2 and g_1/r_1 represent the effectiveness of retention incentive and acquisition incentive respectively. For example, if g_1, the number of non free riders, is 10,000 and r_1, the maximum switching cost is \$200, then the ratio g_1/r_1 is 50. This means that for a \$1 per person increase in acquisition incentive, there will be an additional 50 people acquired. Similarly, $\frac{g_2}{r_2}$ can be regarded as the "effectiveness" of retention incentives.

For example, in calculation of number of customers ($C = f_1 + \frac{g_1}{r_1} x_1 + f_2 + \frac{g_2}{r_2} x_2$), $\frac{g_2}{r_2}$ is the number of customers retained when each existing customer is given an incentive of \$1. Therefore, when the incentive per person is x_2, $\frac{g_2}{r_2} x_2$ customers will be retained.

We use notation e to represent this ratio. Therefore, by substituting e_2 for g_2/r_2, and e_1 for g_1/r_1, we have,

$$M_H = \sqrt{\frac{4(f_2 + 2(C - f_1 - f_2))^3 r_1 f_1 g_1 r_2^3}{27(g_2 r_1 + g_1 r_2)^2 g_2}}$$

$$= \sqrt{\frac{4(f_2 + 2(C - f_1 - f_2))^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$$

$$= \sqrt{\frac{4(2C - 2f_1 - f_2)^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$$

Or, simply:

$$M_H = \sqrt{\frac{4(2C - 2f_1 - f_2)^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$$

The following are the descriptions of the three categories, both in mathematical terms and in plain English.

Low *m*

In mathematical terms, when *m* is small enough to satisfy the condition: $m \le M_H$, the unconstrained z leads to a negative x_2. Because the constraint is x_2>=0 (no negative incentives), the optimal z under this constraint, i.e., the constrained optimal z, is z_0, which is the value of z that minimizes the total cost when x_2=0. The optimal solution under this situation is: z= z_0, x_2=0, x_1>0.

In plain English, this means that when it is "less costly" to identify the acquisition free-riders, the optimal strategy is to spend money on acquisition analytics (z>0) to identify most of the free-riders. And since the identification of free-riders makes the acquisition

incentives more effective, the firm should spend money on acquisition incentives ($x_1>0$). But since the retention incentive becomes relatively ineffective, no money should be spent on retention incentives ($x_2=0$).

Figure 5 shows that under the constraint of $x_2>=0$, the total cost reaches its minimum point when analytics spending is greater than zero – in this particular case, around $10,000.

Medium *m*

Mathematically speaking, when *m* is still small enough to satisfy the condition $m \leq M_H$ but large enough to lead to an unconstrained x_2 that is positive, the optimal z will be determined by minimizing a fourth degree function subject to constraints. The local minimum is found when the first derivative is zero and the second derivative is positive, as in the point around $10,000 in the above graph.

The optimal solution is: z=z-optimal, $x_2>0$, $x_1>0$.

In plain English, this means that when it is "moderately costly" to identify the acquisition free-riders, the optimal strategy is to spend some money on acquisition analytics ($z>0$), some on acquisition incentives ($x_1>0$), and some on retention incentive ($x_2>0$).

Similar to the above case, the total cost is minimized with a positive analytics spending. The z-and-total-cost graph for this case is similar to the one above.

High *m*

Mathematically, when *m* is so large as to make $m > M_H$, the optimal z is 0. x_1 and x_2 are determined by the "base model" as described in sections a), b) and c) below.

In plain English, this means that when it is "very costly" to identify the acquisition free-riders, the optimal strategy is not to spend money on analytics (z=0). Instead, the money will be better spent on acquisition incentive and retention incentives directly.
The amount spent on each incentive depends on the relative effectiveness of the two incentives. Sometimes it is optimal to spend all on acquisition incentive; sometimes it is optimal to spend all on retention incentives; sometime it is optimal to spend some on each.

Figure 6 shows that when *m* is large, the unconstrained optimal z is negative. Therefore, the boundary condition of z>=0 is applied. So when the analytics spending is zero, the total cost is minimized.

a) Very Effective Retention Incentives

The ratio of g_2/r_2 to g_1/r_1 represents the relative effectiveness of the retention incentives to that of the acquisition incentives. The higher this ratio is, the more effective the retention incentive is relative to acquisition incentive.

If the ratio is greater than the value $\frac{(2c - f_1 - f_2)}{f_1} - 1$, meaning that the retention incentive is very effective relative to acquisition incentive, then the optimal strategy is to spend all money on retention incentives only (x_1=0, x_2>0).

As Figure 7 shows, since the mathematically unconstrained optimal x_1 is less than zero, the boundary condition, $x_1=0$, effectively becomes the best incentive level that leads to the lowest total expenditure.

b) Moderately Effective Retention Incentives

If the ratio of g_2/r_2 to g_1/r_1 is between $\frac{f_2}{(2c-f_1-f_2)-f_2}$ and $\frac{(2c-f_1-f_2)}{f_1}-1$, meaning that the retention incentive is moderately effective relative to acquisition incentive, then it is optimal to spend money on both the acquisition and retention incentives ($x_1>0$, $x_2>0$).

As Figure 8 shows, the mathematically unconstrained optimal x_1 is greater than zero. Therefore, it is the optimal acquisition incentive.

c) Weakly Effective Retention Incentives

If the ratio is smaller than the value $\frac{f_2}{(2c-f_1-f_2)-f_2}$, meaning that retention incentive is not effective, then the optimal strategy is to spend money on acquisition incentives only ($x_1>0$, $x_2=0$). This is shown in Figure 9.

6.3.2 The Boundaries

There are two boundaries separating the three regions discussed above. The first is the boundary between "moderately costly" and "very costly" analytics. The threshold

between "moderately costly" and "very costly" analytics is the value M_H, which is given by the following equation:

$$M_H = \sqrt{\frac{4(2C - 2f_1 - f_2)^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$$

Where $e_1 = \frac{g_1}{r_1}$ and $e_2 = \frac{g_2}{r_2}$

The second is the boundary between "less costly" and "moderately costly" analytics

It is difficult to algebraically express this threshold in terms of the parameters *C*, *f*, and *e* due to the complex function forms such as cubic and trigonometric functions. However, this boundary point can be identified by the point at which the unconstrained retention incentive (x_2) becomes 0. (In the "less costly" region, the unconstrained x_2 is always less than 0. And in the "moderately costly" region, the unconstrained x_2 is always greater than 0.)

The *m* level that makes this point, M_L, can be calculated through the use of "solver" or other mathematical tools by solving the value of m_1 that makes x_2 equal to 0.

At this boundary point, the optimal analytics spending:

$$z_0 = m_1 - \frac{m_1^2 g_1}{2f_1(C - f_1 - f_2)r_1}$$

The optimal acquisition incentive:

$$x_1 = \frac{C - f_1 - f_2}{g_1} r_1$$

The optimal retention incentive:

$x_2 = 0$

Table 8 summarizes the optimal strategy under the three regions in the increasing order of m_1.

6.4 Interpretation of the Results and Discussions

6.4.1 Ceiling of the Acceptable Cost of Analytics

Since in formula $M_H = \sqrt{\frac{4(2C - 2f_1 - f_2)^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$, C is known, *f* and *e* can be estimated from historical data, a firm can calculate the value M_H. According to the analysis above, when the cost of analytics required to identify all free riders (m_1) is greater M_H, the optimal analytics spending (z_1) is zero. Since m_1 can usually be estimated by examining the total cost of analytics project, including data gathering and predictive modeling, etc, a company can evaluate how valuable the analytics will be. If the analytics is less valuable (more expensive), then it makes it unfavorable for the firm to spend any money on analytics. Since the value M_H is determined by other parameters such as number of free riders, its value marks the threshold above which the analytics will not be valuable relative to incentives and therefore the firm should not spend on analytics. This provides a very useful tool for evaluating the cost and benefit of analytical projects before the project is started and the cost is incurred.

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6.4.2 The Effects of Free Riders and Effectiveness of Incentives

Section 6.3 examined the effects of m_1, "the cost of analytics required to identify 100% of the acquisition free riders", has on the optimal spending between acquisition incentive and retention incentive. In this section, I will examine how the optimal levels of incentives and analytics spending are affected by other parameters such as number of free riders and effectiveness of incentives.

Since the formula for the high-m boundary M_H is:

$$M_H = \sqrt{\frac{4(2C - 2f_1 - f_2)^3 f_1}{27(\frac{1}{e_1} + \frac{1}{e_2})^2 e_1 e_2^3}}$$

Where $e_1 = \frac{g_1}{r_1}$ and $e_2 = \frac{g_2}{r_2}$

We can observe the following relations from the examination of the above equation:

1. When the number of acquisition free riders (f_1) is at a critical value, (2C- f_2)/8, M_H will be the highest. This means that analytics is most valuable (inexpensive) at this point. Money spent on analytics will be more effective than that spent on incentives. Therefore the optimal strategy is to allocate more money on acquisition analytics. However, when the number of free rider is either lower or higher than this point, the analytics becomes less valuable (too expensive). On the one hand, since the effect of acquisition analytics is to identify a percentage of acquisition free riders, the more the free riders are, the more free riders will be identified by the analytics, making the spending on analytics more effective. When the number of acquisition free riders is lower, a lower amount of savings will be realized from identifying these free riders. On the other hand, since free

riders are those prospects who would still be acquired even without the incentives, when the number of acquisition free riders becomes too large, the firm would not need to direct its resources towards analytics and incentives and will still be able to attract enough customers. Therefore, the analytics is more valuable when the number of free riders is at an intermediate value. Too few or too many free riders will make the analytics less valuable and result in less spending or even zero spending on analytics.

2. If the number of retention free riders (f_2) is sufficiently large, then M_H will be lower. This means that when there are a sufficiently large number of retention free riders, the acquisition analytics is "very costly" relative to incentives and therefore less valuable. The optimal strategy is to allocate little or no spending on acquisition analytics.
3. If the acquisition incentive is sufficiently effective (a large enough e_1), then M_H will be higher. This means that when the acquisition incentive is very effective, the acquisition analytics becomes "less costly" or "moderately costly" relative to incentives and it is more valuable. Therefore the optimal strategy is to spend more on acquisition analytics. The reason for this is that if the acquisition incentive is very effective, then it will be more cost-efficient for the company to allocate its money to acquisition incentive. The acquisition analytics spending further enhances this effectiveness.
4. If the retention incentive is sufficiently effective (a large enough e_2), then M_H will be low. This means that the acquisition analytics is "very costly" relative to incentives and it is less valuable. Therefore the optimal strategy is not to

spending on acquisition analytics but allocate all spending on incentives. This is the opposite case of the very effective acquisition incentive discussed above. So the result is also opposite to the above case.

The above relations will provide managerial directions for marketing function of the company to anticipate the changes in its target market, customer base, customer characteristics, etc. For example, if a company anticipates a new customer group to become part of the target market, and if this customer group can be characterized as having fewer free-riders, then it might be prudent for the company to consider increasing its spending in analytics, even if it was optimal for them not to do so before.

6.4.3 Other insights and observations

"Less costly" (low-m) vs. "Very costly" (high-m)

Although under both the "less costly" analytics (low-m) and the "very costly" analytics (high-m) situations, the optimal retention incentive (x_2) can be zero, the reasons are somewhat different: For low-m, x_2 is zero because a low-m makes it efficient to identify f1, thereby increasing the relative effectiveness of and decreasing the relative effectiveness of x_2. Under the high-m, the optimal strategy is to spend nothing on analytics (z). However, if even without the help of analytics, x_1 is still highly effective compared to x_2, then the optimal x_2 can also become zero.

"Less costly" (low-m) and "Moderately costly" (medium-m) vs. "Very costly" (high-m):

In “less costly” (low-m) and “moderately costly” (medium-m) cases, the spending on analytics will help to make the incentive spending more cost effective, thus reducing the total expenditure. In “very costly” (high-m) case, any spending on analytics will be less effective than to give incentives to the customers directly, therefore the optimal is not to spend on analytics.

6.5 Summary

By bringing in the effect of analytics spending into the model, we are able to examine how the optimal allocation is affected by the “cost of analytics spending required to identify all free riders”, “the number of free riders”, and “the effectiveness of incentives.” The formula of the ceiling of the acceptable cost of analytics is derived. This would enable the companies to better assess the financial aspect of their analytics projects. Interpretation of other parameters provides managerial insight and directions on what the spending on analytics should be when there is a change in the composition of customer base or market competition.

Chapter 7: Discussions

7.1 Summary of Contributions

This research makes contribution to the managerial science and its application in marketing by providing new knowledge in the following aspects: Conceptually, this research builds on the tradition of managerial sciences by taking a quantitative approach to develop a new way of distinguishing key concepts involved in acquisition and retention. First, it defines the difference between customer and acquisition by using the amount of switching cost. Second, it distinguishes retention from acquisition by using the duration of the contracts. Such treatment enables us to correctly identify acquisition and retention and model them mathematically. In addition, this research is anchored in the business practice by providing a practical interpretation of a phenomenon by introducing the concept of "free rider" in acquisition and retention. Methodologically, this research formulates a mathematical model that seeks the balance between reflecting the reality and maintaining its relatively concise form and transparent interpretation of the model and results. Mathematically, it analyzes the behavior and interaction between incentives and analytics spending, and provides the boundary conditions under which the following is true: the optimal acquisition incentive is zero (or non-zero), the optimal retention incentive is zero (or non-zero), and the optimal analytics spending is zero (or non-zero). The formula of the ceiling of the acceptable cost of analytics is derived. This would enable the companies to better assess the financial aspect of their analytics projects.

7.2 Specific Contributions

7.2.1 Acquisition vs. Customer, Incentive vs. Discount

In previous studies, little attempt has been made to distinguish between a customer and an acquisition. This research makes it clear that not all customers are acquisitions. The emphasis on switching cost as a necessary component of acquisition (and retention) is an important contribution of this research. With this definition of acquisition, i.e., "a customer with a significant switching cost," a marketing manager will not treat any customers that are attracted by a price discount as an acquisition. In addition, the definition of "significant" in the term "significant switching cost" opens the possibility for future researches to use specific quantitative measures to define acquisition and distinguish an acquisition from a customer. This distinction also encourages companies to treat the customers with different switching costs differently.

7.2.2 Acquisition vs. Retention

Because in most of the cases, the difference between acquisition and retention is clear, i.e., acquisition is when a prospect becomes a customer; retention is when an existing customer remains a customer, there were no significant discussions devoted to the distinction between the two. However, as discussed in Chapter 3, when the accuracy of the amount of acquisition and retention incentives is important, and when there are different contracts of different lengths and different discounts, it is crucial to make clear distinctions between an acquisition, a retention, and a mixture of acquisition and retention. For example, the time-based definition of acquisition and retention, as

proposed in this study, offers a clear and practical way of separating retention and retention incentives from certain marketing offers such as a two-year contract, which is essentially a mixture of acquisition and retention. This distinction is not only important to the current study, but also is significant for any future studies that require correct accounting of the amount of acquisition and retention incentives.

7.2.3 Free Rider

Another important contribution of this research is the introduction of the "free rider" concept into the area of acquisition and retention. Not only does the free rider concept put the prospects or customers into two categories, i.e., free riders and non free riders, based on their switching costs, but also it can be expanded by incorporating game perspective. For example, in future researches, one can study the scenario when consumers play "game" with the company by masking their true preferences or engaging in bluffing, etc. This would bring the study into the field of game theory.

7.2.4 Modeling

This research examines in detail the conditions under which the optimal strategy is to have acquisition analytics spending, or retention incentive, or acquisition incentive, or a combination of the three. More specifically, it identifies the link between the cost of analytics, the effectiveness of the incentives, and the optimal allocation of money. This would provide the marketing managers a tool to optimally allocate funds between incentives and analytics spending.

7.3 Possible Future Research Directions

Many possible expansions can be built on the current research by modifying certain assumptions or formulations. For example, instead of using the "number of free riders identified" to operationalize the concept "incentive-discrimination", in future researches, one can use different measures such as Kolmogorov-Smirnov statistics (Chakravart, Laha, and Roy, 1967), which is often used in evaluating credit scoring models. Additional attention can be paid to incorporating mis-classifications into the model, for example, how to optimize analytics spending and incentive spending when the effectiveness of analytics spending is expressed in not only the "number of free riders identified," but also the number of free riders or non free riders misclassified.

Another direction in the future research would be to conduct surveys or data analysis to test and modify the current model. As discussed in Chapter 4, the mathematical modeling method used in the current study can be modified or supplemented by other methodologies.

There are several limitations or constraints in the current model that can be modified or relaxed in the future researches. For example, one limitation of the current model is that it defines the "incentive-discrimination" only as "identifying the free riders". A more "thorough" discrimination that not only identifies the free riders, but also further distinguishes the high-cost non free riders from the low-cost non free riders can also be studied. Also, the current research placed a constraint of positive incentives on the

model. In practice, although a company cannot explicitly impose a negative incentive (or a penalty) on a prospect or customer, it can use other means, e.g., membership fees, initiation fees, and renewal fees, to achieve the objective of negative incentive. One needs to be careful in taking such an approach because there might not be a continuum from incentives to neutrality to disincentives that customers react to in a linear fashion. This is at least partly due to the fact that companies tend to brag about positive incentives and bury the negative ones in the fine print. Nevertheless, a model allowing negative incentive and also negative acquisition and retention that discourages unprofitable prospects or customers can be a possible direction of future studies.

Finally, from an even broader perspective, one can connect the current research to other related issues. For example, many marketing companies utilized geo-demographic data clusters that categorize consumers into different clusters or segments instead of continuous scores. Therefore, we can view this as an additional constraint to the model that the criteria for classifying customers are discrete, instead of continuous.

Tables

Table 1. Examples of Switching Cost and Incentive

	Level of natural switching cost	Artificial switching cost created by contract?	Incentives (Examples)
Cell Phone	Low	Yes	One-time Cash discount
Cable TV/Satellite	Low	Yes	One-time Cash discount
Credit Card	Low	No. Point/ Mileage	Low Introductory Rate/ Point or cash rebate
Bank Accounts/ Trading Accounts	High	No. On-line Services	One-time Cash Bonus ($50-$100)

Table 2. Price Discount vs. Incentive

	Specific Questions	**Price Discount**	**Acquisition/Retention Incentives**
Strategic	Product-centered or customer-centered?	Product-centered	Customer-centered
Specific Objectives	Is switching cost involved? Is it aimed at acquisition/retention?	No	Yes
Operational	Scope of Target? Publicized	Mass targeted Publicized	Individual/group targeted nd sometimes confidential.
Effects (Time Perspective)	Affect current period or multi-period demand?	Increases current period demand only	Increases current period and multi-period demand

Table 3. Customer Types and Switching Costs

Type of Customers	**Natural Switching-in Cost**	**Natural Switching-out Cost**
Existing Customers	N/A	Low or High
At-large Customers	Low	N/A
Competitors' Customers	High	N/A

Table 4. Terms in the Model

Terms	Definition	Unit	Operational Calculation
Acquired	A new customer who signed up and will stay for a minimum of one year		
Retained	An existing customer who will stay for a minimum of one additional year		
Acquisition Rate	Customers acquired as a percentage of total prospect customers in a month	%	Number of Acquired/ Number of Total Prospect
Retention Rate	Customers retained as a percentage of total existing customers in a month.	%	Number of Retained/ Number of Total Existing
Acquisition Incentive	Amount of money offered to a prospect customer for the purpose of acquisition in a month	$ per person	
Acquisition Expenditure	Total Amount of money spent on acquisition incentives in a month	$	
Retention Incentive	Amount of money offered to an existing customer for the purpose of retention in a month	$ per person	
Retention Expenditure	Total Amount of money spent on retention incentives in a month	$	

Table 5. Free Riders and Non Free Riders

	Free rider	Non free rider	Incentive needed to acquire or retain
Prospects	Switch Cost<=0	Switch Cost>0	Incentive>Switch cost
Existing Customer	Switch Cost>0	Switch Cost<0	Incentive>- Switch Cost (or Incentive>Switch Benefit)

Table 6. Variables in the Base Model

variables	Definition	Unit
x_1	the acquisition incentive dollar amount offered to prospect customers	$/Person
x_2	the retention incentive dollar amount offered to existing customers	$/Person
f_1	the total number of free-riders among prospect customers	Person
f_2	the total number of free-riders among existing customers	Person
g_1	the total number of non free-riders among prospect customers	Person
g_2	the total number of non free-riders among existing customers	Person
r_1	the maximum switching-in cost of prospect customers	$/Person
r_2	the maximum switching-out benefit of existing customers	$/Person
C	the predetermined target of total number of customers (sum of acquired and retained)	Person

Table 7. Variables in the Extended Model

variables	Definition	Unit
x_1	the acquisition incentive dollar amount offered to prospect customers	$/person
x_2	the retention incentive dollar amount offered to existing customers	$/person
f_1	the total number of free-riders among prospect customers	Person
f_2	the total number of free-riders among existing customers	Person
g_1	the total number of non free-riders among prospect customers	Person
g_2	the total number of non free-riders among existing customers	Person
r_1	the maximum reservation price of prospect customers	$/person
r_2	the maximum reservation price of existing customers	$/person
C	the total number of customers (sum of acquired and retained)	person
z_1	Analytics spending on acquisition	$
z_2	Analytics spending on retention	$
m_1	Analytics $ required to identify all acquisition free-riders	$
m_2	Analytics $ required to identify all retention free-riders	$

Table 8. Summary of Extended Model Results

Cost of analytics required to identify all free riders	**Less Costly**	**Moderately Costly**	**Very Costly**
m_1	$0 < m_1 < M_L$	$M_L < m_1 < M_H$	$M_H < m_1$
Optimal Acquisition Analytics Spending (z_1)	$z_1=z0$	$0< z_1<z0$	$z_1=0$
Acquisition Incentive (x_1)	$x_1>0$	$x_1>0$	Base model
Retention Incentive (x_2)	$x_2=0$	$x_2>0$	Base model

Figures

Figure 1. Determinants in Customer Switching Decision

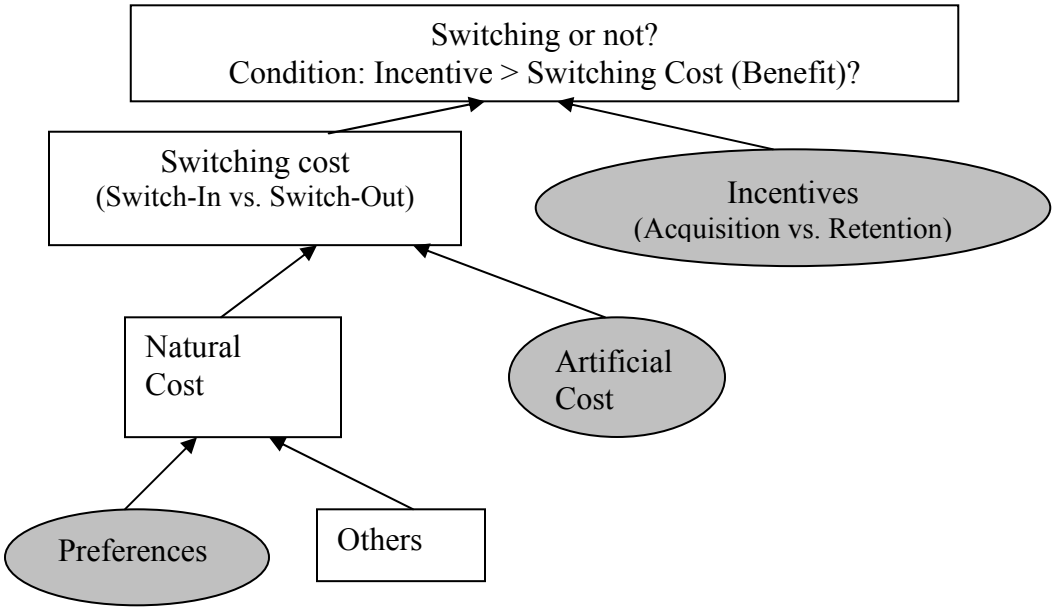
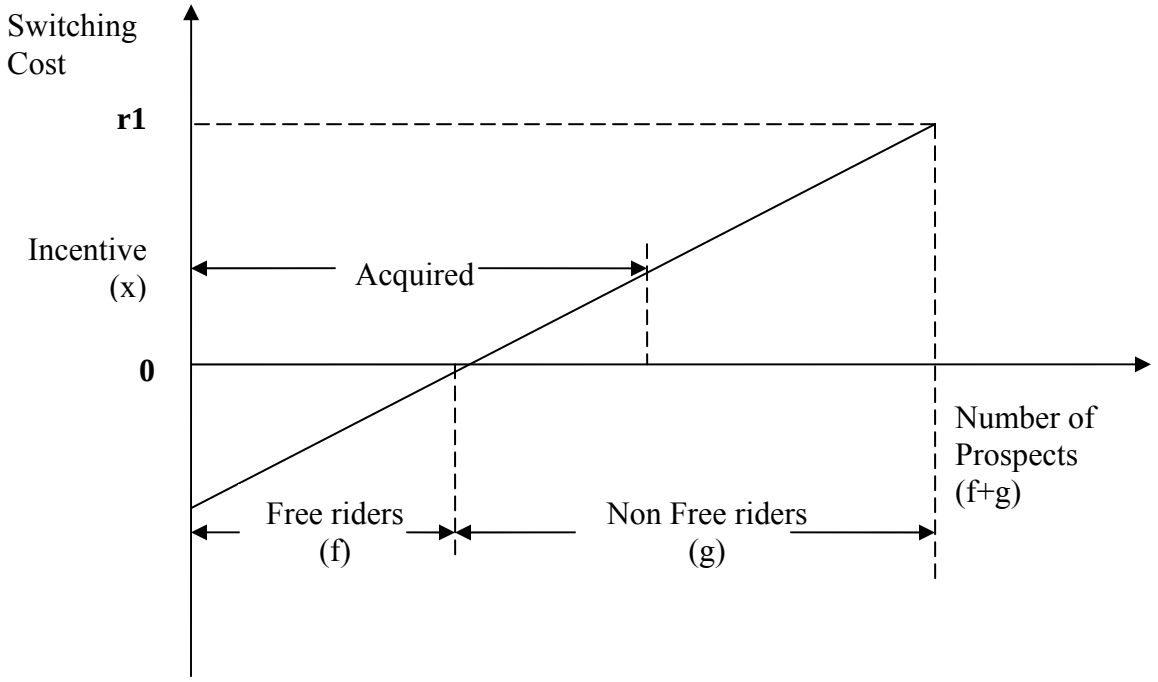


Figure 2. Acquisition Free Riders



Number Acquired=All Free Riders + x/r1 * Non Free Riders
Where r is the maximum switching cost

Figure 3. Retention Free Riders

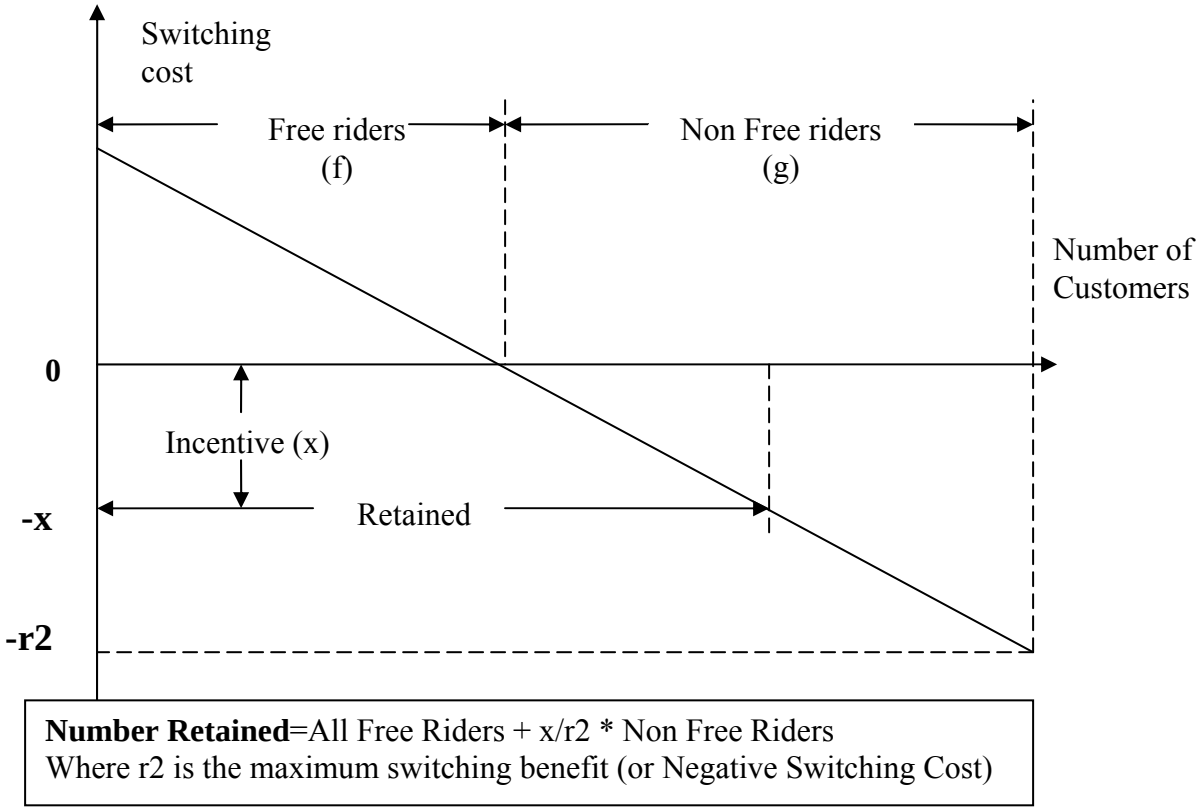


Figure 4. Unidentified Free Riders as a Function of Analytics Spending

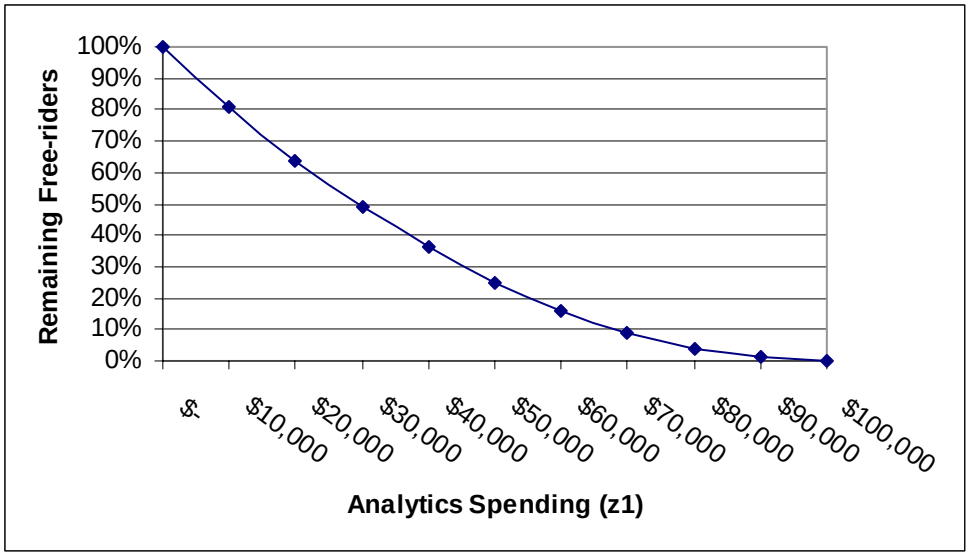


Figure 5. Analytics Spending and Total Expenditure: Low m

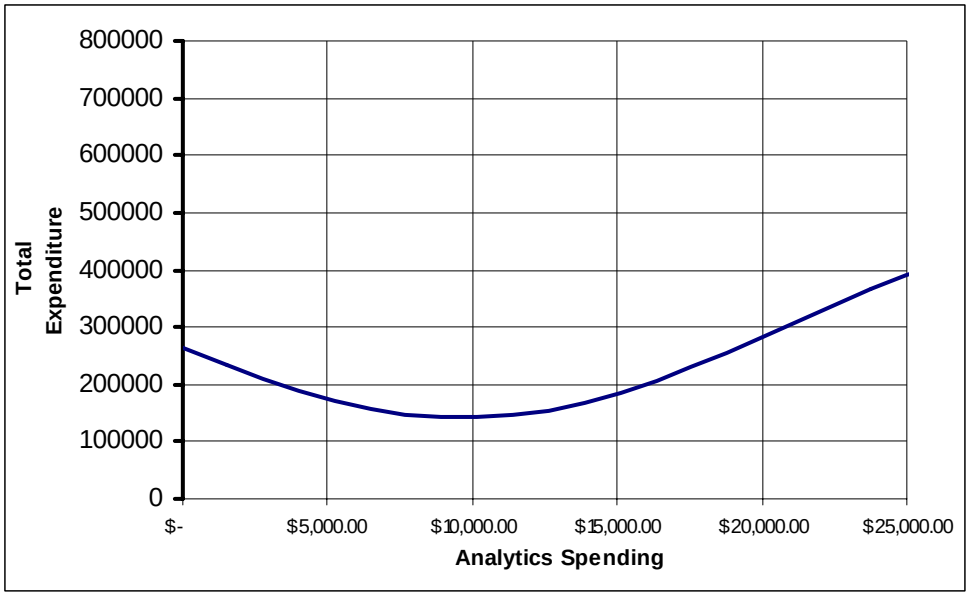


Figure 6. Analytics Spending and Total Expenditure: High m

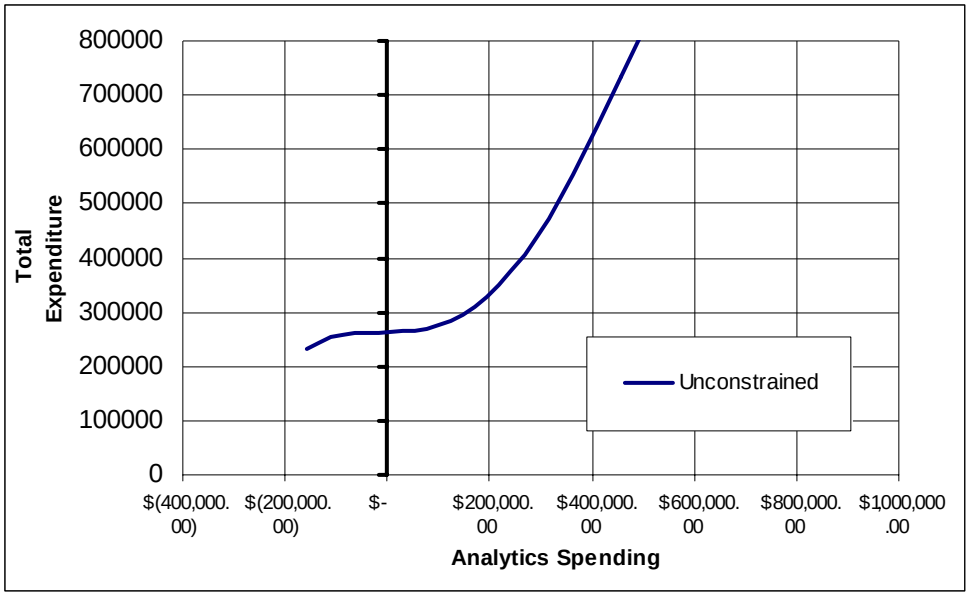


Figure 7. Effects of Very Effective Retention Incentive

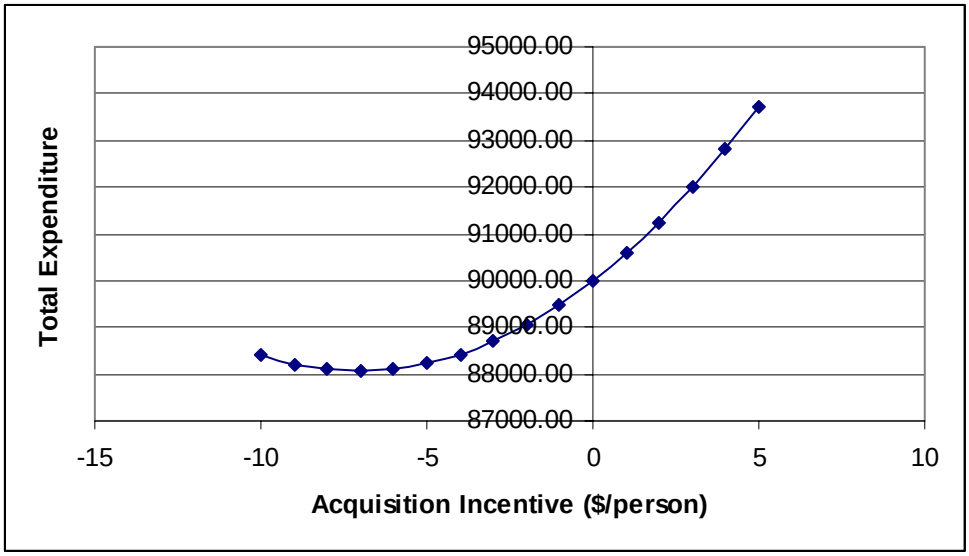


Figure 8. Effects of Moderately Effective Retention Incentive

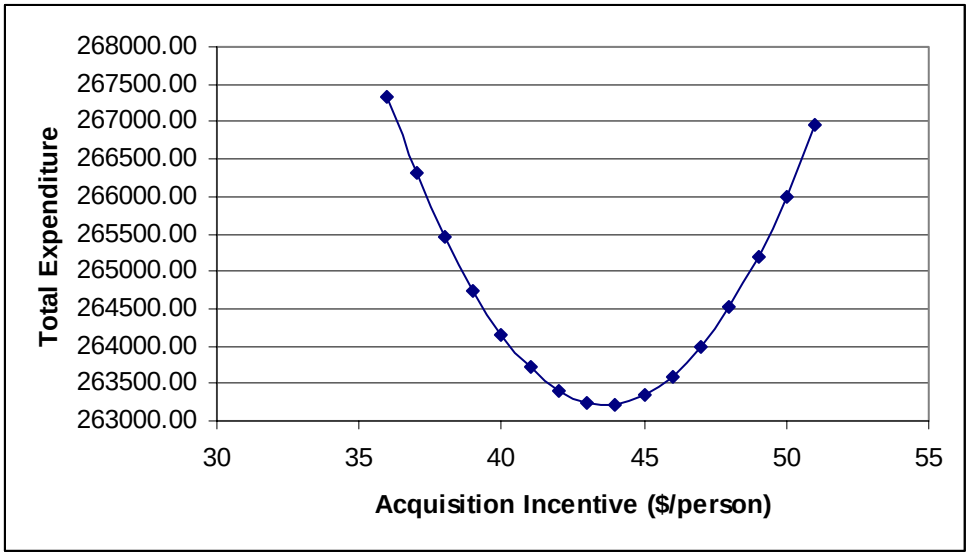
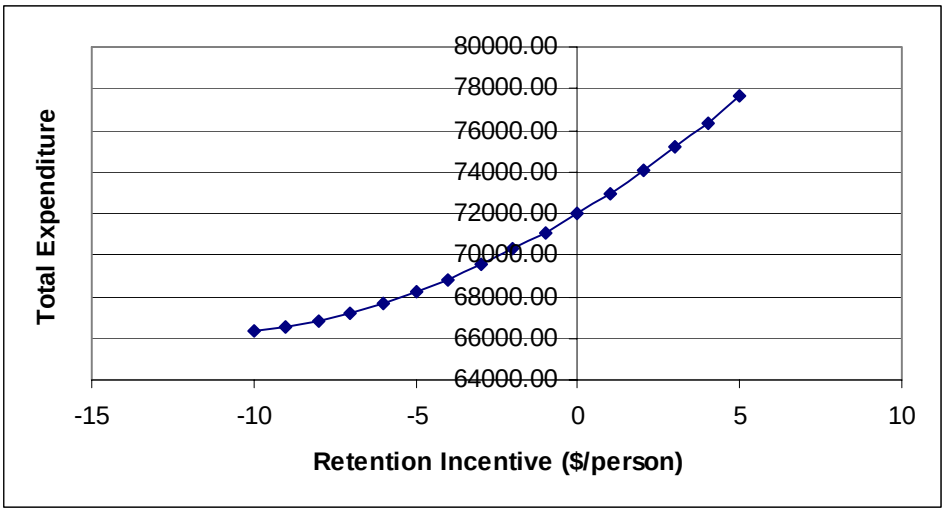


Figure 9. Effects of Weakly Effective Retention Incentive



Appendix I: Consistency with Life-Time Value (LTV) formulation

In this section, I will demonstrate that the current model is consistent with LTV model formulation, and the conclusions drawn from this model is equally valid under several simple assumptions.

LTV (Life-time value) definition and calculation

Life-time value of a customer is the present value of future stream of incomes this customer brings. It is recognized as a common tool for evaluating customer values. Gupta (2003) presents LTV calculations in a three-step fashion. First, the LTV of a customer is calculated; then customers are aggregated to "cohorts"; finally cohorts are aggregated to the portfolio. LTV can be regarded as the value of the customer portfolio.

Many conditions can be assumed to simplify the calculation and aggregation, for example, one can assume the constant profit margin of a customer from period to period, etc.

LTV can incorporate various costs. For example, Gupta (2003) lists the basic LTV that calculates on profit margin (or income) only and an LTV that account for both profit margin and acquisition costs. For this study, I will name a few varieties:

LTV (M): profit margin only. This will be used in the proof that multi-period LTV can be simplified to single period.

LTV(M,A,R): profit margin, acquisition, and retention costs. This will be used in the base model.

LTV (M,A,R,D): profit margin, acquisition, retention, and discrimination costs. This will be used in the extended models.

Scenario: Portfolio with a preset number of customers

Because of the economics of production, a firm often has a volume of output that is optimal with respect to production costs and revenue. The goal of the marketing department is then to maintain this optimal level of demand, or in our case, an optimal number of customers.

Therefore,

1) The optimal number of customers based on production constraints and optimal output level is N.
2) Without efforts of acquiring new customers and retaining existing customers, natural attrition will decrease the number of customers to a level below the optimal N.
3) Consequently, the goal of acquisition and retention is to maintain the number of customers at the level of n for the current period. Mathematically, this can be expressed as: Number acquired + Number retained = N.

Assumptions

These assumptions will be important in simplifying the calculation and making the mathematical derivation valid.

4) *Constant margin of a customer in the calculation of LTV of a customer*: The constant margin means that the profit margin remains the same from period to period for the same customer.
5) *Constant retention rate in the calculation of LTV of a customer*: Although for a particular customer, his retention rate for any period is either 0 or 1, to calculate his LTV, which is actually an "expected" value of LTV, we use the portfolio's retention rate. So the constant retention rate is also with respect to time period, meaning that the retention rate of the portfolio remains the same from one period to the next.
6) *Equal margin of customers in the base model*: This is an assumption for the base model only. Here, the "equal margin" means all customers have the same amount of profit margin regardless whether he is a new customer or an existing customer. The reason for this assumption is that it allows the customer portfolio's value to be represented by the number of customers in that portfolio minus the cost of acquisition and retention. This will simplify the calculation involved and still maintain the model result's reasonable robustness and its ability to generalize.

Proof of Equivalency between Single-period and Multi-period

Life-time value of a customer is the present value of future stream of incomes this customer brings. If we denote the profit margin that a customer generates during a specific period t as m_t, then the life-time value of the customer (LV), with a discount rate of i, and a constant retention rate of r, is given by the following formula (Gupta, 2003):

$$LV = \sum_{t=0}^{\infty} \frac{m_t r^t}{(1+i)^t} \qquad (1)$$

Under the assumption of an equal revenue stream (constant margin) and a constant retention rate, the life-time value can be reduced to a single-period value scaled by a constant.

Proof:

Assuming constant margin for all time period, then $m_t = m$, therefore,

$$LV = \sum_{t=0}^{\infty} \frac{m_t r^t}{(1+i)^t} = m \left(\sum_{t=0}^{\infty} \frac{r^t}{(1+i)^t}\right) = m * g \qquad (2)$$

Where *m* is the constant margin and g is a constant (g is a function of i, the discount rate, and r, the retention rate. Since both i and r are assumed constant, g is a constant.)

If we define First-Period-Value (FPV) as the life-time value given t=0, then

$$FPV = LV\,|_{t=0} = \sum_{t=0}^{0} \frac{m_t r^t}{(1+i)^t} = m_0 = m \qquad (3)$$

(Or simply, FPV is the current period's margin.)

From (2) and (3), we have

$$LV = FPV * g \qquad (4)$$

Where g is a constant, $g = \sum_{t=0}^{\infty} \frac{r^t}{(1+i)^t}$

Interpretation: The life-time value (based on multi-period calculation) can be expressed as a constant times the First-period Value.

In summary, with the assumption of constant margin and constant retention rate, maximizing the single period (current period or first period) value is equivalent to maximizing LV(Life-time Value). Therefore, the conclusion drawn from single-period evaluation will be equally valid under multi-period or Life-time situations.

Unit of analysis: Cohorts, Portfolio

The unit of analysis in Gupta's (2003) LTV model is a "cohort" of customers. Because of attrition, a percentage of the cohort will churn in every time period. So a retention rate is included as one of the parameters in the calculation of the LTV. Alternatively, as the case in similar calculations by other researchers, the attrition is represented by the expected length of tenure, meaning that customer-ship in that cohort will effectively all die off after an expected number of periods. In a typical portfolio, there are many

cohorts each at various stages of "degeneration". After each cohort's LTV is calculated, the entire portfolio's LTV is then calculated by aggregating all the cohorts.

Since the analysis in this study is based on a single period time frame, there are only two cohorts: new customers acquired and existing customers retained. And because of the assumption of "equal margins", the two cohorts differ only in their respective acquisition cost and retention cost. Therefore, to maximize the portfolio's value, we need to maximize the summation of the value of the two cohorts. And since the total number of the two cohorts is a constant and the margin of each customer in both cohorts is equal, the goal of maximizing portfolio's value can be achieved by minimizing the summation of two cohorts' costs, which is the summation of total acquisition cost and retention cost (this will be the objective function).

LTV model (Gupta, 2003) vs. CPV in this study

As the mathematical proof shows, with the assumptions of the "*Constant margin of a customer"* and "*Constant retention rate",* a customer's LTV (life-time value) can be represented by a CPV (current period value) scaled by a constant. The CPV of the portfolio in the base model of this study is CPV (M,A,R), which is the CPV calculated based on profit margin, acquisition cost, and retention cost. And because of the assumption of "*Equal margin of customers in the base model*", and the assumption of fixed number of total customers in the portfolio, the income of the portfolio is a constant. The only factors that will vary are the costs of acquisition and retention.

Therefore, when the total cost of acquisition and retention is minimized, as it is achieved in the current study, the CPV (current period value) of the portfolio of the customers is maximized. Consequently, the LTV is maximized. This is how this study is consistent with typical LTV models.

Key differences between Gupta's LTV and my CPV and how they reconcile

	Time period	Unit	Optimization
LTV (Life time value)	Multiple period	Multiple Cohorts at various stages of "degeneration"	Maximize Income minus costs
CPV (Current period value)	Single period	Two cohorts: acquired and retained	Minimize costs
Reconcile under the condition of	Assumptions of *Constant margin* and *Constant retention rate*	Single period	Assumption of *Equal margin* and *Fixed number of customers*

Summary

The objective function of the study will be to maximize life-time value (LTV) of the portfolio.

For the base model, with the assumptions listed above

Maximize LTV of the portfolio

= Maximize the sum of cohort of the acquired and the cohort of the retained (Standard LTV definition)

=Maximized the CPV of the two cohorts (see proof of multi-period to single period equivalency, with the assumption of constant margin and constant retention)
=Minimize sum of (acquisition cost + retention cost) (with the assumptions of equal margin and fixed number of customers)

Therefore, the objective function is reduced to minimizing the total acquisition and retention costs. Because of the mathematical equivalency proved above, the conclusion drawn from this analysis will be valid under LTV criterion.

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