



Teaching Note

This case is written for business students and is flexible enough to fit either into an introductory quantitative modeling course, including operations management, business economics or business statistics. The case has a depth of complexity that has permitted its use at both the senior undergraduate level and at the MBA level. The VA-TX case is used to jumpstart basic quantitative business analysis skills. The case uses simple calculations of profits, revenues, and costs. These calculations require an understanding of only simple probabilities and some notion of averages. The subject matter (corporate product) in the VA-TX case is credit cards. Since almost everyone is familiar with credit cards, the instructor can focus on discussing the included management problems rather than being sidetracked by the intricacies of, say, widget production. It also touches on the ideas of a basic definition of risk (Hi vs. Ave vs. Low method), the idea of tradeoffs between two conflicting alternatives, and a basic method to describe optimality. The case is particularly useful as a group presentation device and this teaching note is addressed to instructor interaction with the presentation.¹

Possible Case Questions:

- (i) On average what is the base case revenue VA-TX is currently making on its credit card operations?
- (ii) What are the current costs/expenses/losses that VA-TX is currently incurring on its credit card operations?
- (iii) What occurs with regard to default rates when VA-TX begins to raise customer credit limits?
- (iv) What happens to revenues and costs as VA-TX raises customer credit limits?
- (v) What occurs with regard to the customer base as VA-TX spends extra dollars on an advertising campaign?
- (vi) What does the relationship between revenues, profits, and costs look like as VA-TX spends extra dollars on an advertising campaign?
- (vii) Taking into account all possibilities and the fact that raising credit limits and running an advertising campaign are mutually exclusive, what should Nicole Lee do?

Teaching Plan and Analysis:

The first objective of the case is the modeling of business fundamentals: profits, revenues, and costs. Since almost everyone has some understanding of these terms, the instructor can focus on discussing the student's formulations. The instructor introduces the group and the group begins its presentation. The group should identify themselves and describe the background of the problem. This usually takes about five minutes. Very quickly the students will move to discuss their formulation of profit maximization. Generally the students will rush through this because of its "obviousness." But, there are a number of

through this because of its "obviousness." But, there are a number of assumptions that should be highlighted and the instructor may interrupt with questions on these assumptions.

Revenue Generation, Costs, General Assumptions, and Finally Profit

The case identifies one source of revenue, the interest rate charged to cardholders that carry a balance on their credit card. The case identifies two sources of costs: (1) a "cost of capital" rate to the corporation for the total balance carried by the cardholders and (2) a cost for "default" on the balance carried by some cardholders. In most cases, the students begin by discussing the cardholder base and balances cardholders carry.

Cardholders and Cardholder Balances

The case specifies that there are 100,000 cardholders and the credit limit on all cards is \$5000. The case also provides some information about the distribution of balances carried by the cardholders -- 25% carry no balance or an insignificant balance; 95% of the others carry a balance between \$100 and \$300 and 5% of the others carry some other balance.

The students quickly calculate that 25,000 cardholders carry a \$0 balance, that is $100,000 \times 25\% = 25,000$. In addition, the students calculate that 71,250 cardholders carry a balance between \$100 and \$300, that is, $100,000 \times 75\% \times 95\% = 71,250$.

Some groups will assert an assumption that these cardholders carry an "average" balance of \$200. But the case specifies no distribution associated with balances between \$100 and \$300. The instructor may question the group on this. Other than asking the basis for their assumption, the instructor can ask a preliminary sensitivity analysis question - "Is there an effect if you use a different assumption?"

The maximum differential effect is $\$300 - \$100 = \$200$ for 71,250 cardholders, a total of \$14,250,000. From the extreme values to the middle value the difference is \$7,125,000. In the scale of the case, these numbers are quite large, and thus very important.

Some groups will assert an assumption that the cardholders carry a balance of \$300. See the previous paragraphs comments for the dollar effects of this assumption. Some groups may call this a "worst case." But, since carrying balances is profitable for the corporation, this is in fact the "best case" and this assumption will overstate profits. The instructor may ask the group if they are willing to tie their pay to corporate realization of this estimate.

The assumption that the cardholders carry an average balance of \$200 may also be recommended. Once again, refer to the comments in the previous paragraph for the dollar effects of this assumption. Some groups may call this a "best case." But, since carrying balances is profitable for the corporation, this is in fact the "worst case" and this assumption will understate profits. The instructor may ask the group if they are willing to tie their pay to this estimate of corporate success.

Impacts of Varying Cardholder Assumptions

Some groups will consider the consequences of varying this assumption. The "best" answers will look for a "tipping point" at which if the assumed balance is below that point then a different decision would be made than the decision that would be made if the assumed balance is above that point.

In each of the above cases, the instructor should use the occurrence of the necessity of assumption as an example of the inherent incompleteness of any problem, either

- i. the data does not exist,
- ii. the data exists but is unavailable or expensive,
- iii. the data exists and is available but someone has to request it.

And, by understanding the importance of various assumptions they will be able to prioritize their requests for additional information.

The students calculate that $100,000 \times 75\% \times 5\% = 3,750$ cardholders carry some other balance. As above, whatever the assumption is regarding this balance, it may be questioned.

Some groups will assert an assumption that 3,750 cardholders are insignificant. The instructor can point that if the other balance they carry is \$5000, then the group is asserting that \$18,750,000 is insignificant. The group should not then be surprised if the company evaluates the importance of their being paid as even less significant.

Groups may assert an assumption that 3,750 cardholders carry a balance between \$0 and \$5000. But, the instructor can question them regarding the principle of mutual exclusivity and whether or not the information should be read to indicate that the balance carried is in fact from \$300 and \$5000.

The assumption that 3,750 cardholders carry a balance of \$5000 may also be offered. This assumption will overstate profits using the same logic that was demonstrated a number of paragraphs earlier. Groups asserting the assumption that 3,750 cardholders carry a balance of \$300 should be reminded of the logic behind the paragraph on understating profits.

In addition, some groups will assert some form of "average" balance when no underlying distribution has been specified. However, the groups considering the consequences of varying this assumption are potentially on the right track. The "best" answers will look for a "tipping point" at which if the assumed balance is below that point then a different decision would be made than the decision that would be made if the assumed balance is above that point.

Calculation of Total Amount of Credit Carried by VA-TX and Resulting Revenues

Again, in each of the above cases, the instructor should use the occurrence of the necessity of assumption as an example of the inherent incompleteness of any problem, and refer to the ideas presented earlier regarding data and prioritizing requests for additional information.

The students consolidate the assumptions above in order to calculate an expected value for the total amount of credit carried by the company. For example, $25,000 \times \$0 + 71,250 \times \$200 + 3,750 \times \$1,000 = \$0 + \$14,250,000 + \$3,750,000 = \$18,000,000$.

Using the result calculated in the previous paragraph, the groups calculate the revenue for the corporation. The corporation charges a 15% APR. Thus, for example, the company's revenues would be $\$18,000,000 \times 15\% = \$2,700,000$.

Although credit card interest is usually calculated or forgiven on a monthly basis, this amount may be accepted for the purposes of the analysis. If the instructor wishes to make an even stronger point regarding the assumptions, the following point may be made, though we never have. What is the difference between APR and effective APR? In this case, a 15% APR if collected monthly is an effective APR of $(1 + 15\% / 12)^{12} - 1 = 16.08\%$. On an outstanding balance of \$18,000,000, the difference is \$194,400, a significant amount.

Typically the groups will erroneously calculate the revenue of the corporation using the differential credit rate. The corporation charges a 15% APR. The corporation pays 5% APR as the cost of capital. Therefore, the students use the "revenue" rate as 10% of the total outstanding balance. For example, $\$18,000,000 \times 10\% = \$1,800,000$ as their "base case."

Calculation of Costs

It is important for the instructor to point out that the 5% has nothing to do with revenue but is a cost. The groups may argue that the resulting profit is the same. Of course, by the distributive property of multiplication this is true. But, if the capital requirements of the corporation are ever to be considered, then reporting revenues in this fashion will grossly understate both revenues and costs.

In effect, the credit exposure of the corporation is fraudulent. Credit exposure is not within the call of this case, but the instructor can use this as an example of proceeding orderly in arranging information according to commonly accepted terms. Employing the same methodology as before, the groups proceed to calculate the costs for the corporation.

Capital Costs

The cost of capital is usually the starting calculation for costs. It is stated that the corporation pays 5% APR. Thus, for example, this corporate cost is $\$18,000,000 \times 5\% = \$900,000$. As was stated earlier, it would be possible, though we never have, to point out that the effective APR of 5% if collected monthly would be $(1+5\%/12)^{12} - 1 = 5.12\%$. On an outstanding balance of $\$18,000,000$, the difference is $\$21,600$.

Sometimes the groups may want to argue that the cost of capital is impossibly low because even the "risk-less" rate of T-bills is generally above 5%. The raising of this point by the group demonstrates a good common sense understanding of financial principles. (If the group doesn't raise the question, the instructor may - but at some point the questioning of assumptions becomes too much for practical solution).

In most cases, one usually counters the student observation with some other tangential common sense: if the person that hires you tells you a hard number, is questioning or arguing with that person (and implicitly their competence) the first thing that you will do? Alternatively, the instructor can ask a sensitivity analysis type question of what the group then did in response to varying this assumption.

Default Costs

In turn, the cost of default is the next calculation for cost. The case specifies a rate of 0.01%. Some groups calculate first the number of defaults. Typically, they use the number of cardholders, and calculate $100,000 \times 0.01\% = 10$ defaulters. The instructor may question though whether since 25% of the cardholders carry a \$0 or insignificant balance, whether then this is saying that 2.5 of the defaulters default on a \$0 or an insignificant balance. And, if so, does that assumption make sense? The students may answer that although the rate is calculated on the total cardholder base the actual defaulters are likely to be persons carrying some balance and that it is not the case that the default rate applies uniformly across each subclass.

The second step for these groups is to estimate the amount of default. Here the assumption is a garden variety of "averages" between \$0 and \$5,000 or a worst case of \$5,000. Note that the worst case loss is $10 \times \$5,000 = \$50,000$. Again, if the students argue that the default loss is insignificant then ask them if the average MBA salary is insignificant. Other times, the students may research the issue and find that in the industry the actual default rate is much higher. But, see the comment made earlier regarding practical tangential common sense responses.

Some groups will calculate the loss on the total amount of credit. For example, $\$18,000,000 \times 0.01\% = \$1,800$. Again, the instructor may point out that this means, effectively, that some customers default on a \$0 or insignificant amount and that some customers default on a balance of \$100 to \$300. And, if so, does that assumption make any sense?

Calculation of Profit

With the worst case of loss at \$50,000 and since this amount is such a small percentage of costs or of revenues, the instructor may switch the inquiry again. The purpose, to point out that here, finally, is a case where the assumption is of relatively little importance in the analysis. One general answer for the calculation of base case profits based on the previous comments would be: $\$2,700,000 - \$900,000 - \$50,000 = \$1,750,000$. With this result and if this questioning is followed, this marks a transition point in the presentation.

At this point, the students are well understanding of disciplined, orderly thinking and not to mention shell-shocked. The last question allows them to see that the questioning of assumptions is not an interminable Wittgensteinian process of increasing refined definitions, but rather that the process of questioning assumptions will begin to converge. At this point, the students can be allowed to proceed on towards the other conclusions to which they invested so much effort.

Sensitivity Analysis

Once a base case or status quo profit value is obtained, it can be used in comparison to the other alternatives. It is enlightening to point out that if the general equations are flexible, each of the other alternatives may be analyzed in approximately the same manner. Students should become lucid to the idea that the process of setting up the general equations first, then making a number of assumptions for each alternative and plugging those assumptions into the general equation set will allow them to make more efficient and effective decisions regarding Nicole's problem.

Group members may wish to continue discussing intricacies of the assumptions being made, such as, interest rate fluctuations, cost of capital, human nature of the card holders and default, etc. One should lead the group away from detailed discussion on these topics and direct the dialogue towards the idea of "what if" analysis if at all possible. This will allow for a good transition into the idea of performing sensitivity analysis.

Worst Case/Best Case Analysis and Discussion of Trade-offs

It will be quickly evident, even in a small group, that there are many differences in opinion regarding certain assumptions. Some will raise the issue about using only average values to calculate profits and in turn only explaining half the story. Some may even become frustrated with the sheer amount of numbers and/or changing values in the case and attempt to tune out. This can be thwarted by a quick suggestion that the group analyze worst case/best case scenarios (you may wish to use the words Hi/Low method or maximum/minimum method also to get the point across).

As soon as this idea of worst case/best case scenarios is established or accepted, a link back to the general equation set should be made. This facilitates integration of the main concepts in the case and provides for a quick review and allows for an introduction of the "Where have we been?" notion.

Using the Hi and Low values of each parameter and the basic assumptions set down earlier, the case begins to venture into the realm of trade-offs, risk analysis, and issue of basic optimality, especially in the advertising option (for a brief aside on this see the note on optimality and Figure 1). Sensitivity analysis is an important part of this case, but may be optional, due to time constraints, or assigned as a follow-up exercise.

Key points to remember when initiating discussion regarding sensitivity analysis:

- i. Establishment of Hi/Low Scenarios for the base case and each alternative
- ii. Short Term vs. Long Term issues
- iii. Impact of changing assumptions

Lessons Learned

One may find time running short (usually it is) and to sum up it is important to repeat and re-emphasize the main lessons that should be taken away from the case. The following is a list of main lessons, but an instructor should feel free to add any items that they feel are of import with regard to their unique class or analysis.

- (i) Proper identification of revenues and costs, especially the idea of cost of capital
- (ii) Impact of overestimation or underestimation of revenues and costs that result from group assumptions with regard to the average balance issue and the distribution of cardholders
- (iii) Awareness of the concept of a trade-off or "tipping" point at which a change of decision would occur, especially when varying the assumptions noted in (ii)
- (iv) Realization of the inherent incompleteness of real life problems and the necessity of assumption coupled with the analysis of the trade-off or "tipping" point
- (v) Use of best case/worst case or hi/low analysis to determine the significance of certain assumptions and/or issues such as default amounts
- (vi) Discernment between the linear and non-linear relationships with regard to the two alternatives, specifically, that the credit limit increase scenario has a linear effect on profits and the advertising campaign has a non-linear effect on profits
- (vii) Perception of optimality and the articulation thereof, relate this to the linear/non-linear concept in (vi)
- (viii) Consideration of short-term vs. long-term time frames with regard to the two alternatives

In conclusion, a final note on the overall pedagogy of the case. Truly there is a degree of "art" that is coupled with the basic math or "science" regarding the overall enumeration, progression, and the elucidation or the lessons to be learned. The instructor may use the case in its entirety or use just portions to emphasize or review specific points or lessons.

Note on Optimality and the Advertising Campaign

This section is optional but does provide a simple and effective method of speaking to the concept of optimality. In the case of the advertising campaign, groups usually modify the base set of equations to obtain profits for the advertising campaign. Many times suggestions will be made with regard to the "best" or "most effective" amount of money to be allocated for the advertising budget. This is a very auspicious occasion for the introduction of the idea of optimality.

One may find that some groups (usually your best groups) will have already completed this analysis. In this case, questions such as "Why is this the best case?" or "How did you determine that dollar amount?" should be asked with the intent on leading the group into a discussion of the concept of simple, non-calculus based optimization.

The best method to facilitate and demonstrate the concept is through a simple graph. Figure 1 depicts generally the graph of profit as a function of advertising dollars spent under the assumption that the firm must spend in \$10,000 increments.

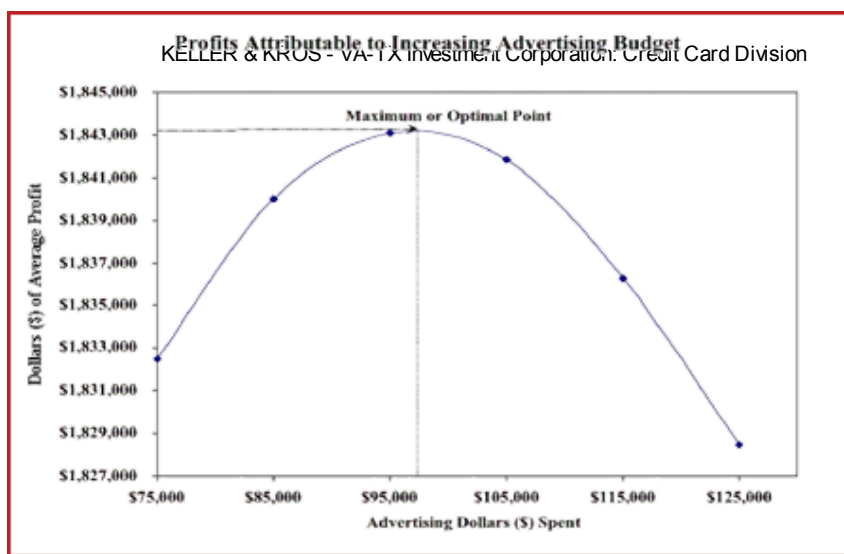


Figure 1. Profits Attributable to Increasing Advertising Budgets

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The instructor should through the explanation of the graph, lead groups through the concept of optimality without really speaking to the mathematical or calculus based theory of optimality. One can see from Figure 1, that profits have a curvilinear relationship with regard to advertising dollars spent and that over a local area (around \$95,000 dollars) a maximum exists.

A short discussion can then be carried out asking groups to recall their previous algebra (or calculus, for the more advanced groups) lectures regarding graphing and optimality. This will more than likely bring many pained looks from groups and maybe even booing and hissing.

However, these reactions provide an opportune moment to relate how the concept of optimality was just presented without the need for calculus based analysis. In sum, remind the groups that their audience may respond similarly to such analysis as was presented in this lesson. The instructor should encourage each individual to take note of opportunities to simplify complex principles by using intuition, graphs, and common language.

Example of Expectation for Student Deliverable - Memorandum

Memorandum

To: Christopher Keller
 From: Jane Student
 Date: July 3, 200X

RE: ALTERNATIVES TO IMPROVE CREDIT CARD OPERATIONS
 LEON DIVISION OF VA-TX INVESTMENT CORPORATION
 Attachment 1 - ([Case](#))
 Attachment 2 - ([Excel model](#)

The Leon Division of VA-TX Investment Corporation oversees credit-card operations. The Division is considering two alternative proposals to improve profitability: increasing individual credit-card limits or advertising to increase the credit-card user base. The Division provided estimates of the effects of both new proposals. A decision information model was created in [Excel](#) .

The Division provided data on its operations, (see [Case](#)). The Division's current profitability was estimated (see [Case](#) and [Excel Model](#)). Current profitability is summarized below:

Worst-Case	Mid-Case	Best-Case
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Profits	\$795,000	\$2,493,750	\$4,187,500
Revenues	\$1,237,500	\$3,815,625	\$6,393,750
Costs	\$442,500	\$1,321,875	\$2,206,250

Analysis of the proposals is summarized:

A – Increase Limit. The Division has proposed increasing credit-card limits from \$5,000 to \$7,500. This increase is expected to provide a 5-10% increase in total carrying balance. The potential additional profitability of this proposal was determined (see [Case](#) and [Excel Model](#)).

B – Increase Base. The Division has proposed spending at least \$75,000, and up to \$125,000 in special annual advertising promotion. This spending is expected to provide a one-time 8-12% increase in the customer base. The potential additional profitability of this proposal was determined (see [Case](#) and [Excel Model](#)).

Proposal	Worst-Case	Mid-Case	Best-Case
A-Increase Limit	\$46,250	\$72,031	\$268,750
B-Increase Base	\$12,627	\$148,436	\$322,120

The advertising to increase the customer base dominates the credit-card limit expansion proposal.

Explanations and Calculations to Accompany Example Student Memo

Note: This is usually reserved until after the case has been turned in by students

STUDENT, INC. Analysis of Alternatives to Improve Credit Card Operations

Section 1: Operational Data

Data provided by the Leon Division of VA-TX Investment Corporation.

Total number of customers = 100,000.

Balance Carried	Number of Customers
Negligible: \$0-\$100	25,000
\$100-\$300	71,250
\$300-\$5,000	3,750

The data provided states that 25% of the customers carry a negligible balance. A negligible balance is assumed to mean a balance less than the balance carried by the majority of customers. The data provided does not explicitly state the balance carried for 5% of the customers who carry forward a monthly balance. The balance carried by these customers is assumed to be mutually exclusive to the other categories of customers. In any case, these limiting assumptions are specified as parameters in the Excel model provided. The model allows for instantaneous re-analysis for any changes in assumptions.

Revenues are 15% of the balance carried (annual).

Costs are of two types:

Balance carrying costs are 5% of the balance carried (annual), e.g. the cost of capital.

Default costs are determined based upon the default rate of 0.01%.

The number of defaults is modeled as a binomial distribution with 100,000 trials and the probability of default at 0.01%, see the customer default probability Table-2 in the Excel model. Defaulting customers are assumed to default at the credit limit of \$5,000.

Number of Defaulting Customers	Maximum Default Loss	Probability
<6	\$25,000	<5%
=10	\$50,000	Expected Value
≤15	\$75,000	>95%

In any case, default costs represent no more than 15% of total costs.

Section 2: Current Profitability

Since there are ambiguities in the underlying data as noted above in Section 1, three alternatives estimates of current profitability are provided. Different scenarios and alternative assumptions may be implemented in the Excel model. In the Worst Case scenario, the Mid Balance customers, \$100-\$300, are the principal contributors to profit. In both the Mid-Case and the Best Case scenarios, the 3,750 High Balance customers, less than 4% of the customer base, contribute approximately 40% to the bottom line. Extensive reliance on this small customer base increases the Leon Division's risk.

Worst Case – Use the lowest possible carrying balance for each of the three categories of customers: \$0, \$100, and \$300, respectively. These balances are weighted according to the total number of customers in each category in order to determine an estimate of total carrying balance:

$$\$0 \times 25,000 + \$100 \times 71,250 + \$300 \times 3,750 = \$8,250,000$$

Low Balance customers: 0% of the total

Mid Balance customers: 86%

High Balance customers: 14%

Mid-Case – Use the mid-point of the carrying balance interval: \$50, \$200, and \$2500 (for simplicity), respectively. Total carrying balance:

$$\$50 \times 25,000 + \$200 \times 71,250 + \$2,650 \times 3,750 = \$25,437,500$$

Low Balance customers: 5% 7% of the increase

Mid Balance customers: 56% 41%

High Balance customers: 39% 51%

Best Case – Use the highest possible carrying balance: \$100, \$300, and \$5,000, respectively. Total carrying balance:

$$\$100 \times 25,000 + \$300 \times 71,250 + \$5,000 \times 3,750 = \$42,625,000$$

Low Balance customers: 6%

Mid Balance customers: 50%

High Balance customers: 44%

Revenues are equal to 15% of the total carrying balance. Costs are equal to total default costs plus 5% of the total carrying balance. Profits are equal to 10% of the total carrying balance, Revenues minus Costs. Because of the correlation of assumptions the Worst-Case scenario uses the 5% lower-bound of maximum default losses, the Mid-Case scenario uses the expected value of maximum default losses, and the Best-Case

uses the expected value of maximum default losses, and the Best-Case scenario used the 95% upper-bound for maximum default losses.

Section 3: Additional Profitability of the Increase Limit Proposal

The Leon Division has proposed increasing credit-card limits from \$5,000 to \$7,500 in increments of \$500. Each step increase is expected to provide a 1-2% increase in total carrying balance.

An increase in credit limits also causes an increase in the probability of a card-holder defaulting. This increased risk was estimated by the Leon Division as 0.0025% for every \$500 increase above \$5,000.

Thus an increase to \$7,500 would increase default risk by $5 \times 0.0025\% = .0125\%$.

The number of defaults is modeled as a binomial distribution with 100,000 trials and the probability of default at 0.0225%, see the customer default probability Table-2 in the Excel model. Defaulting customers are assumed to default at the credit limit of \$7,500.

Number of Defaulting Customers	Maximum Default Loss	Probability
<15	\$112,500	<5%
~23	\$168,750	Expected Value
≤31	\$232,500	>95%

The increases to default losses by probabilistic category indicate an increased cost of at least \$100,000. The default costs of the Increase Limit proposal represent at least 25% of the total costs of the proposal. As described in Section 2, the correlating assumptions between Case scenarios and default costs are used.

In selecting among the various step increase, an equal likelihood weighting of the Worst Case, Mid-Case, and Best Case scenarios shows that if the credit limit is to be increased then it should be increased the full \$7,500. The newly estimated additional total carrying balances are:

WorstCase:	$\$8,250,000 \times 5\% = \$412,500$
Mid-Case:	$\$25,435,750 \times 7.5\% = \$1,907,813$
Best-Case:	$\$42,625,000 \times 10\% = \$4,262,500$

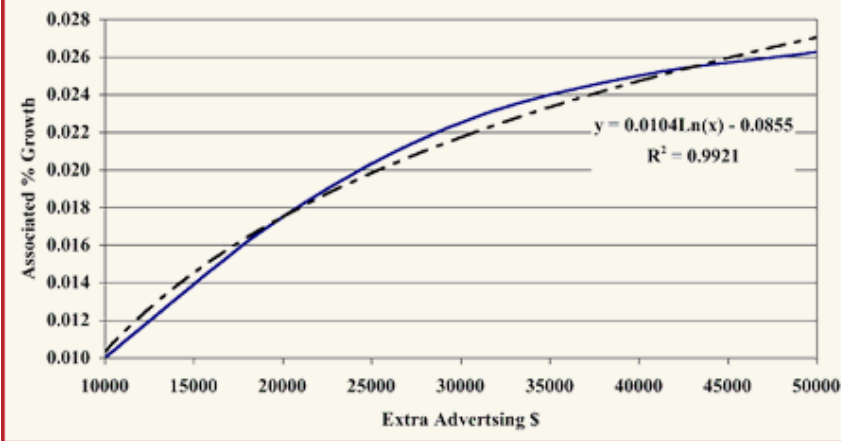
Additional Revenues are equal to 15% of the additional balances. Additional Costs are equal to 5% of the additional balances plus the additional default costs detailed above. Additional Profits is Additional Revenues minus Additional Costs.

Section 4: Additional Profitability of the Increase Customer Base Proposal

The Division has proposed spending at least \$75,000, and up to \$125,000 in special annual advertising promotion based on the assumption that the firm can spend any positive \$increment from \$10,000 to \$50,000. This spending is expected to provide a one-time 8-12% increase in the customer base. According to the information provided by the Division's advertising firm, the base campaign will increase the customer base by 8-10%. The ad firm provided information on additional advertising (solid line) and a relationship was estimated (dotted line):



Customer Base Growth via Extra Ad Expenditures



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Using the Worst Case, Mid-Case, and Best Case scenario structure provided previously, three separate estimates are provided using the base estimates of 8%, 9%, and 10% together with the increases as determined by maximizing additional advertising returns, using Solver. The newly estimated additional total carrying balances are:

Additional Ad Scenarios

	Additional Total Carrying Balances	Additional Profit
Worst-Case:	$\$8,250,000 \times (8+0.8)\% = \$725,726$	\$8,000
Mid-Case:	$\$24,875,000 \times (9+2.0)\% = \$2,549,470$	\$26,000
Best-Case:	$\$42,625,000 \times (9+2.6)\% = \$4,505,302$	\$44,000

Additional Revenues are equal to 15% of the additional balances. Additional Costs are equal to 5% of the additional balances plus advertising and default costs. Additional Profits is Additional Revenues minus Additional Costs.

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 Keller, C.M. and J.F. Kros, (2004), "VA-TX Investment Corporation: Credit Card Division," *INFORMS Transactions on Education*, Vol. 4, No 2, <http://ite.pubs.informs.org/Vol4No2/KellerKros/>