15.810 Analytics Funnel
Problem Set (Beta 1.0 Version)
September 20, 2015

Students in previous years requested more analytic content in 15.810. We've been adding this content. (Although we continue to have quite a bit of qualitative content.) In Fall 2014, students requested that we try problem sets to illustrate a few of the analytics concepts. This is the first attempt. It is a beta version, hence optional.

In this problem set we pose a purely hypothetical example of a firm that offers automobile loans to its customers. (I am working with one such firm in China, but the numbers in this problem set are fictional.)

After you complete this problem set, you should find the analysis in the BBVA Compass case easier. The analysis in this problem set is based on the Romanian Bank illustration in class. Question Set A is basic material; Question Set B is slightly more advanced.

Analyses are sometimes done with spreadsheets. More advanced firms use database management software and analytics software. The spreadsheets illustrate the underlying concepts which you can then extend to real-world problems.

I've created a companion spreadsheet, "15810 Analytics Funnel Spreadsheet Sept 2015.xlsx." You will need to think through which formulae to enter in the boxed yellow cells. Once you are satisfied with these formulae, you can paste them into the green cells. I hope a simple "paste" will work, but check. After all, this is beta 1.0. Once the spreadsheet is complete, you should be able to answer the questions easily.

The answers depend upon the percentages in each of the funnel levels. Feel free to play with these percentages to see how they affect the answers.

I have given your TA the "instructors" version of the spreadsheet with cells automated to produce the answers. After you have cogitated on your spreadsheet, if it still does not make sense, talk to your TA.

Basic Managerial Challenge

In Question Set A, you are a brand manager of an automobile loan company. You have been approached by two banner advertising networks, two search engines, a telemarketing firm, and marketing firm that can place "take-1s" with automobile dealers. Take-1s are mini-brochures about your auto loans that will be on display in automobile dealers. Consumers are encouraged to take one home.

Each media company has told you how much they will charge and how many potential consumers they will reach. For example, Banner Network A will charge you $600,000 and promises 310 million impressions. (One impression is one consumer visiting a webpage that displays the banner, one time.)

But you are astute, so you ask other questions such as "What percent of consumers will click through?," "If they click through, what percent with start a loan application?," and "If they start a loan application, what percent will complete it?" The answers to these questions and other questions are given in the table below (and already entered in the spreadsheet).

	Banner Network A	Banner Network B	Search Engine C	Search Engine D	Telemarketing	Dealer Take-1s
Cost quoted by medium	$600,000	$400,000	$500,000	$300,000	$200,000	$100,000
Impressions, calls, or take-1s	310,000,000	47,000,000	20,000,000	50,000,000	10,000	$1,000,000
Click Through Rate	0.010%	0.020%	3%	1.5%		
Percent reach potential customer (call or take-1)					70%	1%
Percent who begin the application	15%	25%	7%	2%	40%	10%
Percent who complete if they begin	40%	70%	15%	10%	80%	50%
Percent of completes who are approved	75%	90%	60%	50%	60%	60%
Percent who buy the auto and accept the loan	55%	75%	70%	50%	50%	50%
Revenue per loan (net of servicing cost)	$850	$1,000	$700	$550	$800	$900

To analyze these data, first compute the "hit rate," that is the rate at which consumers accept loans given they are exposed to an impression, call, or take-1. Then compute the revenue, cost, and profit per impression. You can also compute total revenue, total cost, and total profit for each of the media.

For the purpose of Question Set A, we will assume that each medium is independent. (This is clearly not true; we'll relax this assumption in Question Set B.) By "independent," I mean that each medium reaches a separate set of potential consumers.

Question Set A

1. In which media should you invest?
2. If you could choose only one medium, which is the best?
3. If you only had $500,000 to spend, how would you allocate your resources?
4. If you only had $1,000,000 to invest, how would you allocate your resources?
5. What is the general principle that enabled you to answer Questions 4 and 5?

More Advanced Managerial Challenge

Question Set B relaxes the independence assumption. To focus on the basic concept, we've reduced the options to two banner advertising networks and one search engine. In this more advanced world, banner advertising has a direct effect (click throughs), but it also influences whether or not consumers search for our loan company.

The interactions are summarized by the following table. For example, 68% of the consumers who search, do so after seeing no banners from either Banner Network A nor Banner Network B. These consumers click through on the sponsored search advertising at a rate of 1.5%. In addition, 25% of the consumers who search, do so after seeing a banner from Banner Network A. For these consumers the click-through rate increases to 2%.

	Banners		Search Engine			
	Banner Network A	Banner Network B	See no banners	See Banner from A	See Banner from B	See Banner from A & B
Percent in each exposure category			68%	25%	6%	1%
Cost quoted by medium	$600,000	$400,000		$500,000		
Search cost allocated			$340,000	$125,000	$30,000	$5,000
Impressions	310,000,000	47,000,000		20,000,000		
Search impressions allocated			13,600,000	5,000,000	1,200,000	200,000
Click Through Rate	0.010%	0.020%	1.5%	2%	4%	4%
Percent who begin the application	15%	25%	5%	6%	10%	10%
Percent who complete if they begin	40%	70%	10%	10%	60%	60%
Percent of completes who are approved	75%	90%	40%	50%	80%	80%
Percent who buy the auto and accept the loan	55%	75%	50%	50%	75%	75%
Revenue per loan (net of servicing cost)	$850	$1,000	$550	$850	$1,000	$1,000

To analyze these data, we repeat the analyses we did for independent media. We do so for situations in which we invest in both banner networks and search. We repeat the calculations for other combinations such as Banner Network A only, plus search. In the companion spreadsheet, I "brute forced" the calculations by simply repeating them. There are other more-efficient ways to do the calculations, that I leave to an advanced analytics course.

I also made some assumptions. For example, I assumed that none of the consumers who saw banners would click through had they not seen the banners. Uses these assumptions to answer the questions in Question Set B. However, feel free to use the spreadsheet to explore other assumptions.

To complete the spreadsheet, enter the appropriate formulae in the yellow box. These formulae should be similar to those in the independence case. Then copy them to the green cells. You should be able to use the summary at the top of the spreadsheet to answer the following questions.

Question Set B

1. Is it better in this example to invest in banners but no search or search but no banners?
2. What is the best strategy?
3. What combination of media gives the highest marginal return?
4. Should you invest in banners without search?
5. Should you invest in search without banners?

Additional Questions

You should be able to answer these additional questions by simply thinking about the spreadsheets, but feel free to try different percentages to see if you can produce examples.

1. Can it be the case in which you invest in a banner advertising network with low click-through rates if it dramatically increases the click through on subsequent search?
2. Suppose you could bargain on the price quotes. How can you use the spreadsheets, especially the spreadsheet in which media interact, to bargain with the media representatives?
3. What assumptions are built into the spreadsheets? How would you test the veracity of these assumptions?
4. If you could not get the relevant percentages from the media companies, how would you obtain them?

15.810 Marketing Management: Analytics, Frameworks, and Applications
Fall 2015