Notes on OPTIM Test Data

1. Introduction

As of November 2019, OPTIM had a catalog of over 800 test runs. These test runs form the basis for CDS claims that all Mass Mailers (MM) of one ounce first class mail pieces of any size (say, 2 million mailings per month and higher) suffer easily correctable multi-million dollar annual short-falls in Third Party Marketing (3PM) Operations. Further, given the low interest rates, these multi-million short-falls indicate capital value short-falls of 30 million dollars for every million dollars of unrealized profit. These notes outline the characteristics of the test data used in the OPTIM test/diagnostic runs. We believe the test data provided very conservative estimates of the magnitude of the profit short-falls in 3PM operations. These notes assume the user is relatively aware of what OPTIM does and how it relies upon the concepts of Probability of Sale (POS) and Variable Pricing (VP) to generate Customer Access Charges (CAC) laid out in the CDS White Paper at critisys.com. The CAC is what the Marketer pays and the Mass Mailer receives whenever an Insert is included in a given Recipient's mail piece. The test/diagnostic runs were meant to assess 3PM operations associated with Credit Card billing under a wide range of varying assumptions.

2. Notes on the OPTIM Test Data

The main elements of the test data for every test/diagnostic run consist of:

2.1. A Customer File (CF)
2.2. A number of Insert Scored Files (SF)

The largest test runs had a CF with 1.5M Customers (mail Recipients) in it and 201 SF containing a POS of that Insert for every Customer in the CF. The SF enable OPTIM to calculate an offer price, the Customer Access Charge (CAC), for every combination of Recipient in the CF and Insert. In the largest test runs there were more than 300M Recipient-Insert Pairs (RIP) and it was OPTIM's task to maximize the profits from 'executing' RIPS (actually including a given Insert in a Recipient's mail piece) given the "disjoint" cost mechanisms of mail insertion machines. By "disjoint" we mean that there is no easily discernable answer to the question of what the added costs are from scheduling any particular RIP. A production run might result in an average of 4.5 RIPs being executed per Customer. Assuming 10% of the Customers are blocked from receiving 3PM materials then the perhaps the number of RIPs actually executed might be approximately 6M (4.5 * 1.35M = 6.075M) out of the roughly 300M possibilities for RIP executions.

Clearly, any aggregate profit results arising from test/diagnostic runs are heavily dependent on the average CAC/Insert in the "universe" of RIP possibilities. A more sophisticated view is that profit results are heavily dependent upon the average "efficiency" (CAC/gram) in the "universe" of RIP possibilities. Given these preliminary discussions, the test data can be described in more detail for the largest test cases.

The CF details:

2.3. contains 1.5M mail Recipients
2.4. ~10% were marked ineligible to receive 3PM Inserts – leaving ~1.35M potential 3PM Recipients
2.5. Recipients had varying numbers of Bill Pages (transaction details) but ~90% had just one Bill Page

Generating SF with desired characteristics is more complicated. There were 201 possible Inserts for consideration by OPTIM. The first task was to assign a weight to the inserts, For the test cases the Inserts, indexed by 0 to 200, were assigned a weight according to the following formula:

2.6. wt[i] = 2.00 + 3.00 * (i/200) or
2.7. wt[i] = 2.00 + (3.00/200) * I -> wt[i] = 2.00 + 0.015 * i

Given the index of the Insert we know its weight for simulation purposes: There is a slight issue because OPTIM standards specify that all weights are stated to the nearest 0.01 grams. The above formula, however, increments weights by half that: 0.005 grams. So rounding up to the nearest 0.01 grams took place when necessary. Below is a table of some weight calculation examples:

Index	Weight
0	2.00
1	2.02 (2.00 + 1 * 0.015 rounded up)
2	2.03
3	2.05 (2.00 + 3 * 0.015 rounded up)
18	2.27 (2.00 + 18 * 0.015)
100	3.50 (2.00 + 100 * 0.015)
200	5.00 (2.00 + 200 * 0.015)

Construction of the test data then assigned a maximum CAC that could occur for any insert. It was also a function of the Insert index:

2.8. max CAC[i] = wt[i] * 0.01 cents/gram

For Insert indexed 0 the max CAC possible for any possible Recipient/Customer would be $0.02000, for Insert indexed 18 it would 0. $02270, for Insert indexed 100 it would $0.03500 and so on. Max CAC[i] were given to the nearest $0.00001, one thousandth of a cent, to highlight the OPTIM standard that all CAC are stated to that level of precision.

The test data generator further specified other Insert characteristics based on Insert index:

2.9. Print Cost, PC[i] = wt[i] * 0.001 cents/gram

For Insert indexed 0 the Print Cost would be 0.00200, for Insert indexed 18 it 0.00227, for Insert indexed 100 it would 0.00350, and so on. Likewise, precision for Print Costs is $0.00001, one thousandth of a cent.

All Inserts were given the same Gross Profit and desired ROI:

2.10. Gross Profit, GP[i] = $27.50 for all Inserts
2.11. ROI[i] = 0.25 (25%) for all Inserts

Given the above information for each insert, the creation of the SF for each insert can be described. Given specification of a max CAC[i] for each Insert, it is straightforward to "back out" the max POS[i] from the EROI equation that would produce that particular max CAC[i]:

2.12. $EROI[i] = \frac{POS[i]*GP[i]}{CAC[i]+PC[i]} - 1$ for all Inserts

This can be reworked to solve for POS[i]:

2.13. $POS[i] = \frac{(1+EROI[i])(CAC[i]+PC[i])}{GP[i]}$ which to the particular case where $\mathrm{CAC} = CAC_{max}$:

2.14. $POS_{max}[i] = \frac{(1+EROI[i])(CAC_{max}[i]+PC[i])}{GP[i]}$

Since every term on the right side of the above equation has been specified for every Insert, the $POS_{max}[i]$ for every Insert is known. It is then straightforward to generate test data for the SF. The SF for each Insert consists of 1 record for each Recipient in the CF. For each Recipient record, r, in the SF file:

2.15. Generate a random number to get a Recipient specific number between 0 and 1, R[r], say
2.16. Set the Recipient specific POS[r] = R[r] * max POS[i]
2.17. Specify all Price Options as "V" for VP
2.18. Generate a random number as above to set the Managerial Priority to "D" (Do Not Send) for approximately 1/6 of the Customers, otherwise set the Managerial Priority to "N" (Normal)
2.19. Write this particular Recipient's record out to the SF

The above process essentially sets POS for each RIP that VP will use to generate EROI equalizing CAC ranging from 0 to max CAC[i] for each Insert. At this point, randomized test data has been generated for every Insert that, on average, conforms to the desired properties of:

2.20. Highly correlating average CAC per Insert to the weight of the Insert
2.21. Generating CAC for each Insert that is relatively conservative

The generated CAC are conservatively set in terms of "richness" of the RIP. The aggregate CAC (revenue) per gram over the universe of RIPs is conservative for two reasons – either or both of which can be adjusted to modify the "richness". First, setting the desired ROI at 25% is a rather high rate of return compared to what marketing campaigns generally earn, especially in an economy where interest rates are around 3%. Lowering the desired ROI would result in a general rise in the max CAC[i] for every Insert and, in turn, a general rise in the CAC for every single RIP. The second assumption is the initial setting of max CAC[i]. Specification of this variable (and the assumption of a uniform distribution of CAC) allows for an easy calculation of what the average CAC is for the highest p percent (a number between 0 and 1) of the Mass Mailer's Customer list. This calculation should provide a good estimate of what the Fixed Price (FP) would be under current mail channel pricing policies:

2.22. FP(p) = (p + 1)/2 * max CAC[i]

The table below provides some examples that depend on the max CAC[i] being set at wt[i] * 0.01 cents/gram as laid out above:

Index	max CAC[i]	P	FP	Wt(g)	CAC/g
0	0.02000	0.90	0.01900 (0.90 + 1.00)/2 * 0.02000	2.00	0.95
0	0.02000	0.80	0.01800 (0.80 + 1.00)/2 * 0.02000	2.00	0.90
0	0.02000	0.70	0.01700 (0.70 + 1.00)/2 * 0.02000	2.00	0.85
100	0.03500	0.90	0.03325 (0.90 + 1.00)/2 * 0.03500	3.50	0.95
100	0.03500	0.80	0.03150 (0.80 + 1.00)/2 * 0.03500	3.50	0.90
100	0.03500	0.70	0.02975 (0.70 + 1.00)/2 * 0.03500	3.50	0.85
200	0.05000	0.90	0.04750 (0.90 + 1.00)/2 * 0.05000	5.00	0.95
200	0.05000	0.80	0.04500 (0.80 + 1.00)/2 * 0.05000	5.00	0.90
200	0.05000	0.70	0.04250 (0.70 + 1.00)/2 * 0.05000	5.00	0.85

In each of these cases the ratio of CAC/gram is less than 1.00. Our experience is that this ratio is often higher than 1.00 for Inserts under FP. This is just further indication that the test data pricing assumptions are conservative, i.e. likely to be surpassed by higher levels of CAC/gram in real world RIP universes.

The CF consisting of 1.5M Customer records and the 201 SF that provide POS information in a way that generates CAC in a structured way drove the test/diagnostic runs with the largest content. There were two general modifications to these datasets with two objectives in mind:

2.23. Varying the richness of the RIP universe
2.24. Varying the number of Customers in CF to quickly produce OPTIM analyses efficiently

The best way to explain the structured variation in "richness" (average CAC/gram) is by reviewing the manner in which the resultant CAC were created for each Recipient Insert Pair (RIP). That process boiled down to setting a max POS[i] to generate a fixed max CAC[i] for each Insert based on its weight and then randomizing the POS for each Recipient in the SF so that resultant CAC would always be between 0 and the max CAC[i].

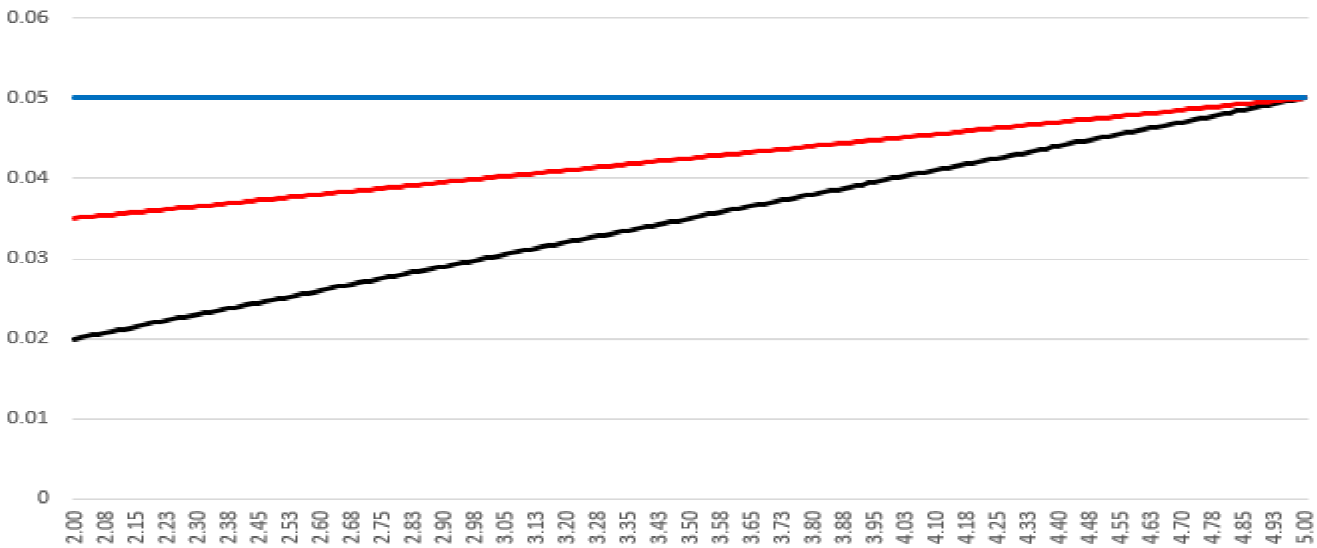
Conceptually, two other sets of "richness" datasets were constructed and analyzed: Moderate and Optimistic. The process for creating SF for Inserts was identical to that described above save for the fact the initial max CAC[i] have were modified. The table below provides high level comparisons of the max CAC[i] and the aggregate CAC/weight in the data:

Case	max CAC[i]	Average CAC/g
Conservative	$0.01/g * wt[i]	$0.005
Moderate	$0.01/g * (wt[i] + 5.00)/2	$0.006
Optimistic	$0.01/g * 5.00	$0.007

Raising the max CAC[i] generally raises the CAC for every RIP in the universe of RIPS. Some sample comparisons of max CAC[i] are given below:

Case	Weight	max CAC[i] Conservative	max CAC[i] Moderate	max CAC[i] Optimistic
1	2.00	$0.0200	$0.0350	$0.0500
2	2.50	$0.0250	$0.0375	$0.0500
3	3.50	$0.0350	$0.0425	$0.0500
4	5.00	$0.0500	$0.0500	$0.0500

The chart below depicts the max CAC[i] by weight for each of the three cases:



2.25. Conservative (black line) - "richness" = $0.05/gram
2.26. Moderate (red line) - "richness" ~= $0.06/gram
2.27. Optimistic (blue line) - "richness" ~= $0.07/gram

In addition to all the "direct", "industrial size" test/diagnostic runs using the datasets described above there were a number of "inferential", "small scale" runs performed. These runs used sets of CF and SF that ranged from 5,000 Customers to 15,000 Customers in increments of 2,500 Customers. SF were constructed in identical manners to those used in the "direct" runs. However, these runs "cheated the system" by scaling down the Set Up charges used by 1/100. The rationale was that if one scaled down the Recipient count in the CF along with scaling down the Set Up charge by 1/100 then the financial analysis results would be virtually the same in terms of final Revenue per Customer and number of Set Ups required to the test cases involving Recipient counts 100 times higher. We found this to be the case when comparing the "direct" runs on CGF with 1.5M Recipients with the "inferential" runs on CFs with 15,000 Customers.

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