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Optimizing Your Optimizations by Maximizing the Financial and Business Impacts of SAS® Marketing Optimization Scenarios

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ABSTRACT

Whether you are a current SAS® Marketing Optimization user who wants to fine tune your scenarios, a SAS® Marketing Automation user who wants to understand more about how SAS Marketing Optimization might improve your campaigns, or completely new to the world of marketing optimizations, this session covers ideas and insights for getting the highest strategic impact out of SAS Marketing Optimization. SAS Marketing Optimization is powerful analytical software, but like all software, what you get out is largely predicated by what you put in. Building scenarios is as much an art as it is a science, and how you build those scenarios directly impacts your results. What questions should you be asking to establish the best objectives? What suppressions should you consider? We develop and compare multiple what-if scenarios and discuss how to leverage SAS Marketing Optimization as a business decisioning tool in order to determine the best scenarios to deploy for your campaigns. The following topics are discussed in depth: establishing high-impact objectives, with an emphasis on setting objectives that impact organizational key performance indicators (KPIs); performing and interpreting sensitivity analysis; return on investment (ROI); evaluating opportunity costs; and comparing what-if scenarios.

INTRODUCTION

As a marketer, you continually face the challenge of developing campaigns that produce significant financial results. SAS® Marketing Optimization is a market leader in helping you do this in a more automated fashion, while leveraging sophisticated optimization algorithms. You can improve your optimization results even more by using the money making features built into SAS® Marketing Optimization designed to obtain the maximum business objectives to drive improvements in your Key Performance Indicators (KPIs). As you design your SAS Marketing Optimization scenarios, your primary goal is often to maximize the Return on Investment (ROI) and profitability of your campaigns. This paper will illustrate how to modify and enhance your scenarios to achieve optimal results based on your organization's unique goals. The features you will learn how to leverage are:

- KPI Based Objective
- ROI Equations
- Sensitivity Analysis
- Opportunity Costs
- Scenario Comparisons

ALIGNING YOUR SAS MARKETING OPTIMIZATION OBJECTIVE WITH KEY PERFORMANCE INDICATORS (KPIS)

It is important to align your SAS Marketing Optimization scenario objective with your corporate or department Key Performance Indicators. KPIs are a refined set of metrics that represent a key set of metrics that uniquely reflect the health of an organization and give leading indicators of change. All KPIs are metrics, but not all metrics are KPIs. Below are some of the questions you should consider when establishing KPIs.

- What should you measure?
- How many KPIs should you have?
- How often should you measure?
- Who is accountable for the KPIs?

- How complex should your KPIs be?
- What should you use as a benchmark?
- How do you ensure your KPIs reflect strategic drivers?

Figure 1 gives just a few examples of common marketing-based KPIs addressing profitability, conversion, and behavior.

Figure 1. Common KPI Metrics for SAS Marketing Optimization Objectives

Once you have identified your KPIs, it is important that you build scenarios with those KPIs as your Objectives in a set of optimization scenarios. You will then be able to compare the results of scenarios built with a variety of hard hitting objectives to determine the best one to promote and deploy. By doing this, you will advance your SAS Marketing Optimization project by creating a test and learn decisioning tool.

ESTABLISHING A BEST PRACTICES TEST AND LEARN PROCESS FOR SAS MARKETING OPTIMIZATION

You should establish a rigorous test and learn process to get the most out of your SAS Marketing Optimization campaigns. SAS Marketing Optimization does an excellent job of solving the problem that you put in front of it, but you have to be the one that evaluates the alternatives from a business perspective and gives it the best problems to solve based on the best objective and constraint limits. Additionally, there is often missed opportunity, caused by constraints that are too tight or too loose, that can be identified and evaluated using Opportunity Costs, Sensitivity Analysis, ROI measures and Report Only Constraints. All of these features give you the insights necessary to evaluate and modify your constraints in order to improve your results. An example of a process flow you can use to improve your optimization results is shown in Figure 2.

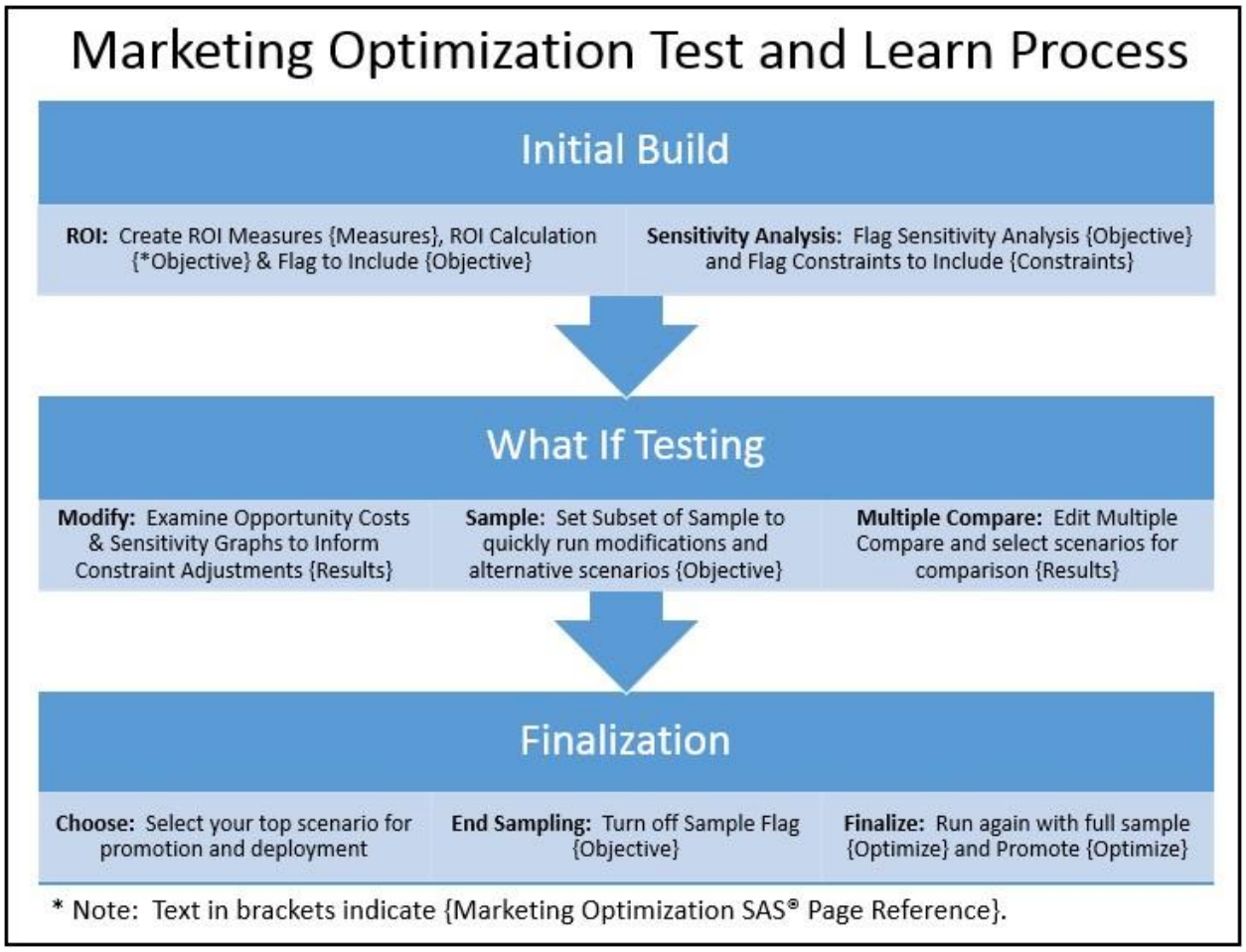
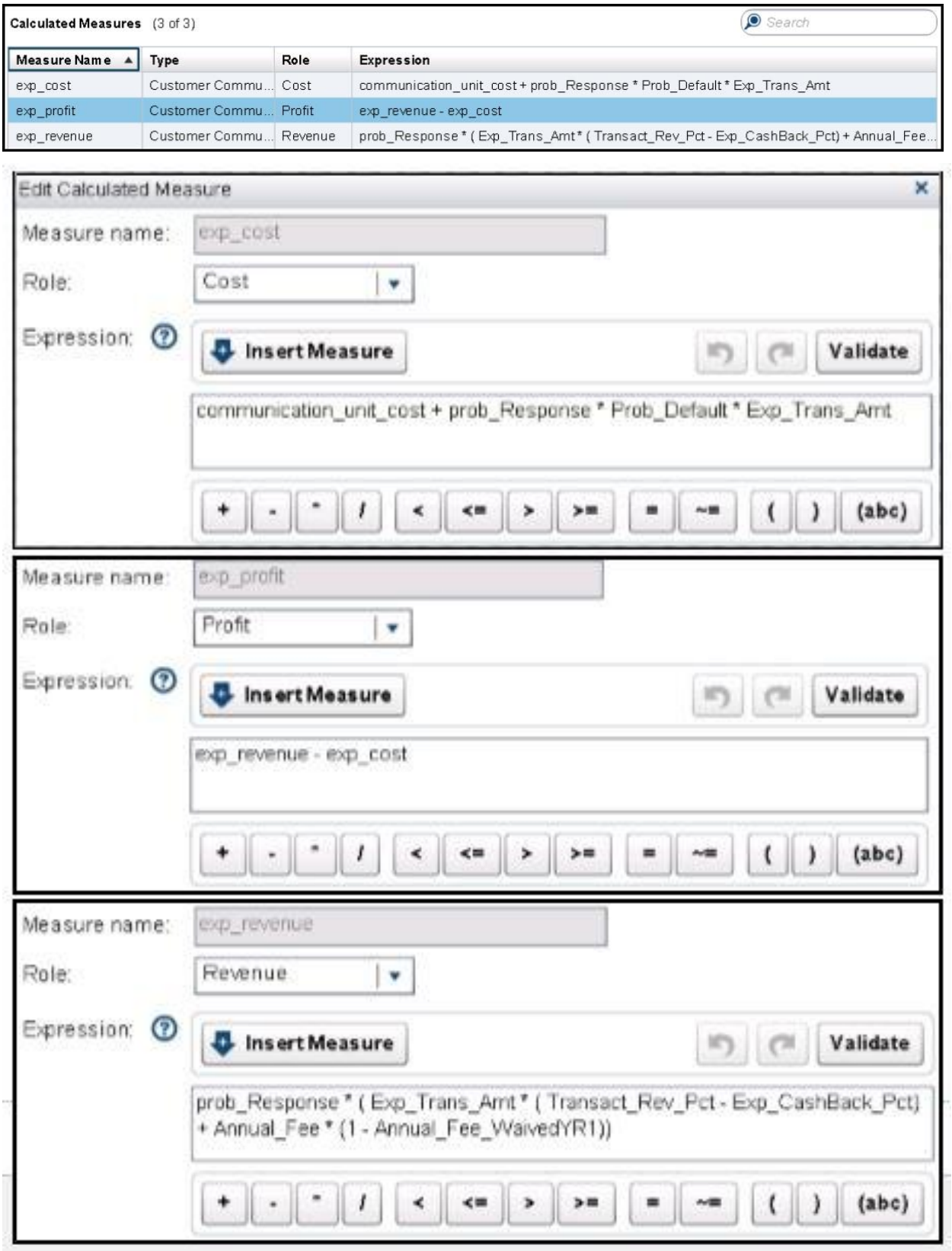


Figure 2. MO Best Practices Test and Learn Process Diagram

As you can see, there are a variety of features built into SAS Marketing Optimization that are designed to help you evaluate and improve the financial impacts of your optimizations so that you can achieve the unique KPIs established by your organization.

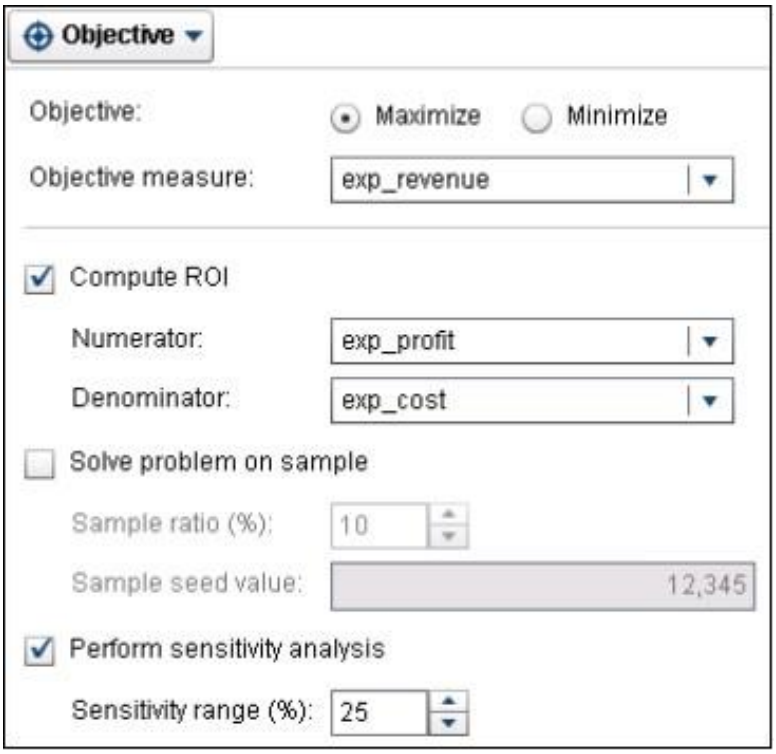
COMPUTING ROI FOR REPORTS

In order to compute ROI for reports and scenario comparisons, identify or create the core measurements to be used in the calculation. Display 1 shows a typical example of creating calculated measures for expected cost, expected revenue, and expected profit.



Display 1. Creating Calculated Measures for ROI Formula

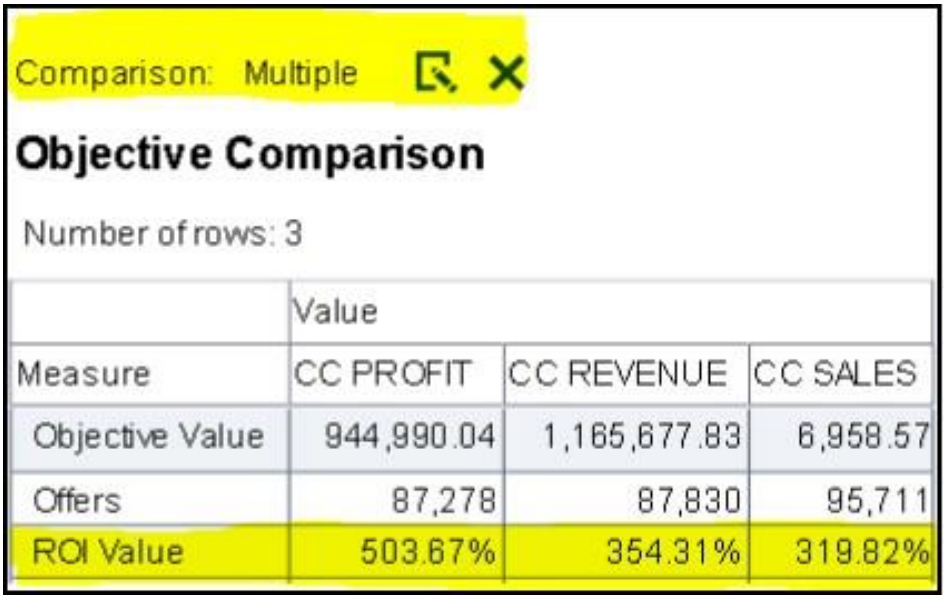
These calculated measures are then available to use in the Compute ROI formula in the Objective Page. For example, in Display 2, ROI is calculated by exp_profit/exp_cost calculated measures.



Display 2. Compute ROI and Perform Sensitivity Analysis

In addition to Compute ROI, the Objective page (Display 2) contains the options for Perform Sensitivity Analysis, Sensitivity Range, as well as the option to solve the problem with a Sample using a Sample Seed Value (see Display 10 for another example).

You are now able to evaluate the ROI calculations in your results. By comparing multiple scenarios, as shown in Display 3, you are able to see the ROI approximations for alternative business objectives.



	Value		
Measure	CC PROFIT	CC REVENUE	CC SALES
Objective Value	944,990.04	1,165,677.83	6,958.57
Offers	87,278	87,830	95,711
ROI Value	503.67%	354.31%	319.82%

Display 3. View ROI Value of Scenario on Results Page

USING OPPORTUNITY COSTS AND SENSITIVITY ANALYSIS

Sensitivity Analysis and Opportunity Costs have a symbiotic relationship and should be used together to inform selections and adjustments to test alternative scenarios. Both of them indicate constraints that can be adjusted to improve results. Display 4 indicates two constraints that can be adjusted for improvements in the Objective.

OPPORTUNITY COSTS

Constraint Summary

Number of rows: 12

Type ▲	Name	Operator	Limit	Value	Opportunity Cost
Budget	Max Budget 50K	At most	50,000.00	50,000.12	0.34
Cellsize	Max 7K offers credit LE 600	At most	7,000.00	7,000.00	4.39
Channel	Wk1 Max 15K Calls	At most	15,000.00	5,990.00	0.00
Channel	Wk1 Min 5K Calls	At least	5,000.00	5,990.00	0.00
Miscellaneous	Max Avg Default Rate 4pct	At most	0.0400000000	0.0018065682	
Miscellaneous	Min ROI 200pct	At least	2.0000000000	5.0366591867	
Report Only	RPT Avg Default Score	At least	0.0010000000	0.0018065682	
Report Only	RPT Exp Cost	At least	1.00000	187,622.39205	
Report Only	RPT Exp Pct Default	At least	0.0000100000	0.0270367281	
Report Only	RPT Exp Profit	At least	1.00000	944,990.04458	
Report Only	RPT Exp Revenue	At least	1.0000	1,132,612.4366	
Report Only	RPT Products Sold	At least	1.00000	5,831.83199	

Display 4. Identify Opportunity Costs

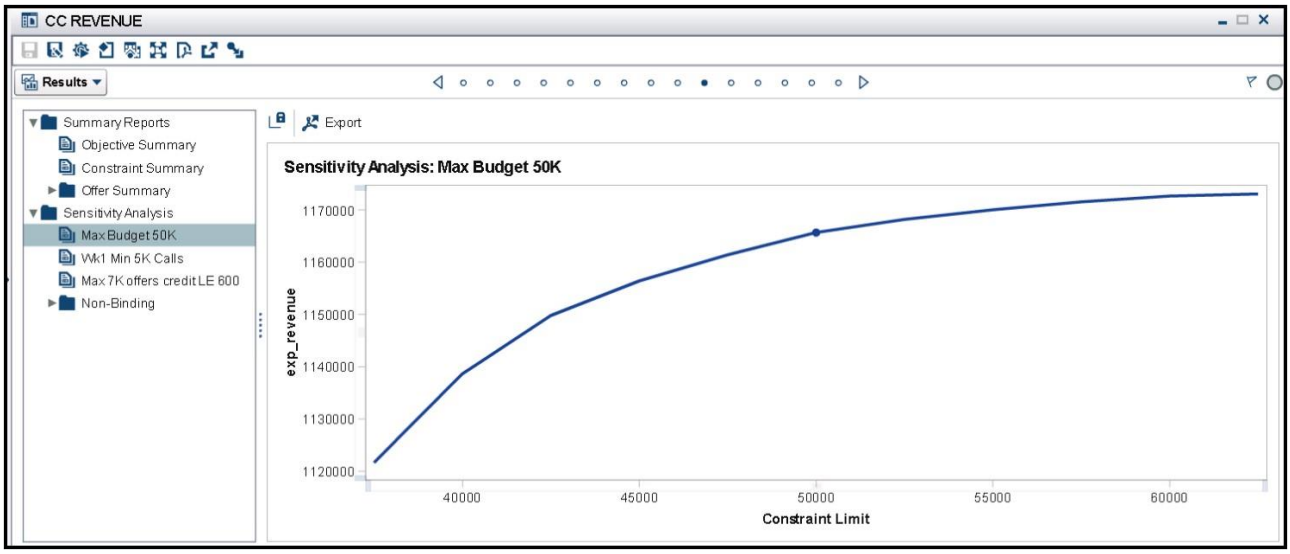
As you can see in Display 4, the first two constraints show opportunity cost. Opportunity cost is an estimate, or approximation, of the marginal change in the objective value if the limit of a constraint is increased by one unit, while keeping all other constraints unchanged. You can use the opportunity cost information to identify constraints most likely to have the largest impact if adjusted. Opportunity costs can be positive (indicating the opportunity to increase the constraint limits) or negative (indicating the opportunity to decrease a constraint limit). See further discussion of negative impacts below.

Always re-run your scenario to determine the true impact of your constraint adjustments. Re-running the scenario with adjusted constraints will not result in exact increases indicated in the original scenario, but will be similar due to the heuristic nature of SAS Marketing Optimization algorithms.

Note: Opportunity costs are not calculated for Average and Ratio constraints, Report Only constraints, and Customer and Household level constraints.

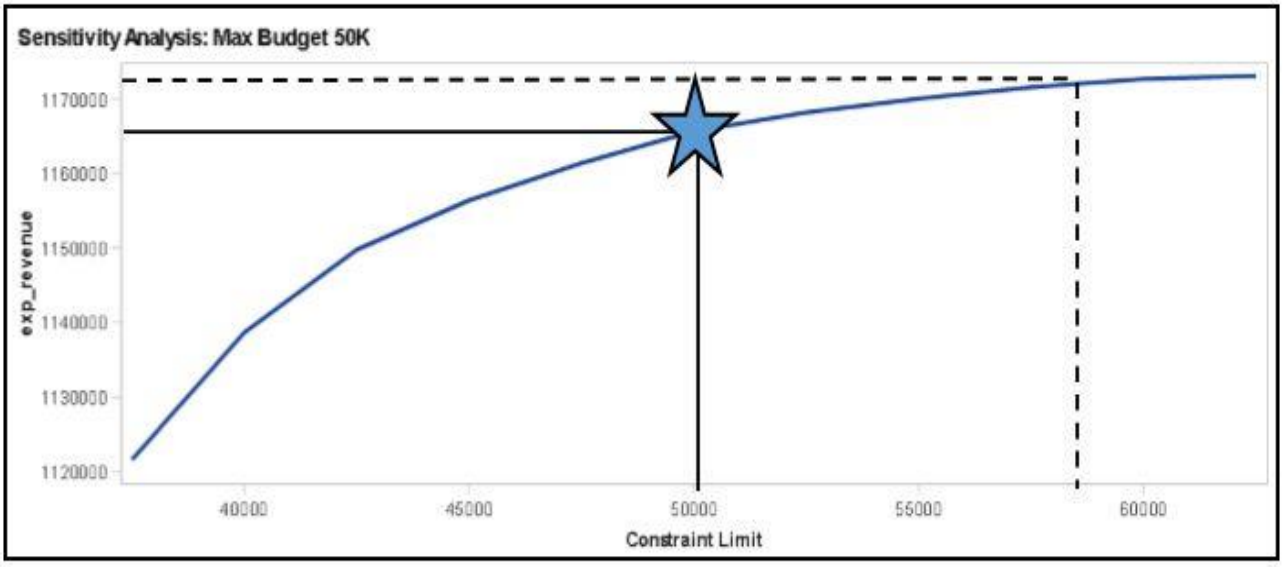
SENSITIVITY ANALYSIS

Sensitivity Analysis provides a chart showing a range around a constraint and its relationship, or impact, on your objective. Positive or negative slope on the sensitivity graph indicates opportunity to increase or decrease the constraint being graphed to improve your objective. The difference between sensitivity analysis and opportunity cost is that sensitivity analysis is a graph of the range and the approximate impact of changing the constraint across that range, whereas opportunity cost is the approximation of the impact one unit of change in the constraint has on the objective. Steep slopes (Displays 4-7) indicate high opportunity, or sensitivity, while flat slopes (Display 8) indicate little to no opportunity.



Display 5. Sensitivity Analysis for Max Budget $50k

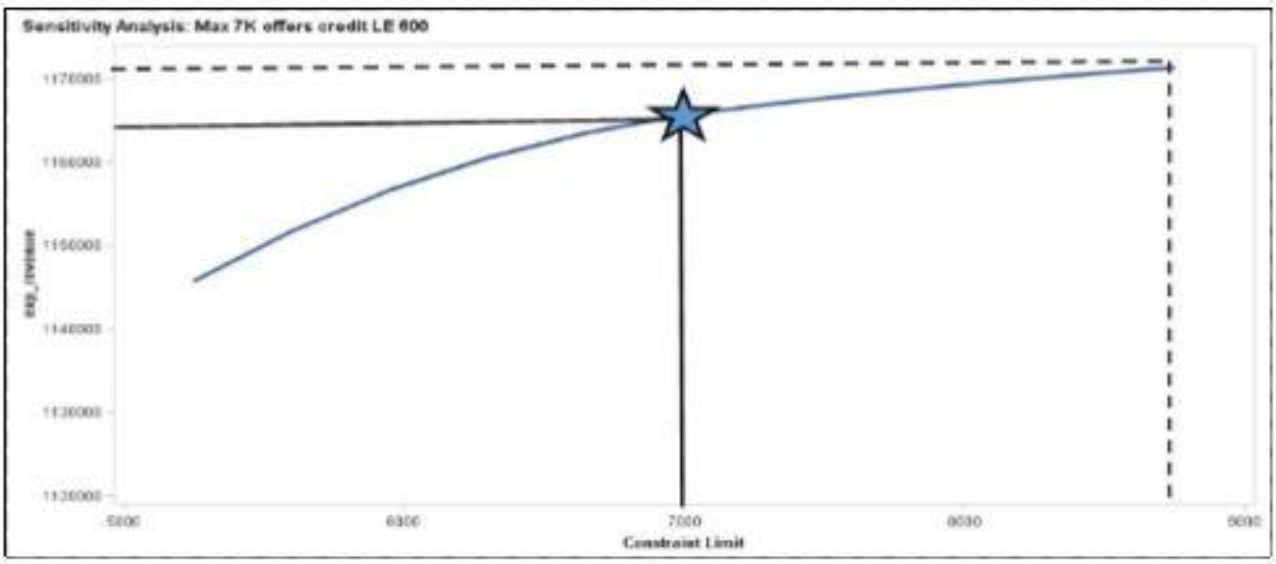
The sensitivity analysis graphs the relationship between a constraint and the objective. Display 5 shows out of the box functionality for the sensitivity analysis graph.



Display 6. Adjust Max Budget to Maximize Expected Revenue (Objective)

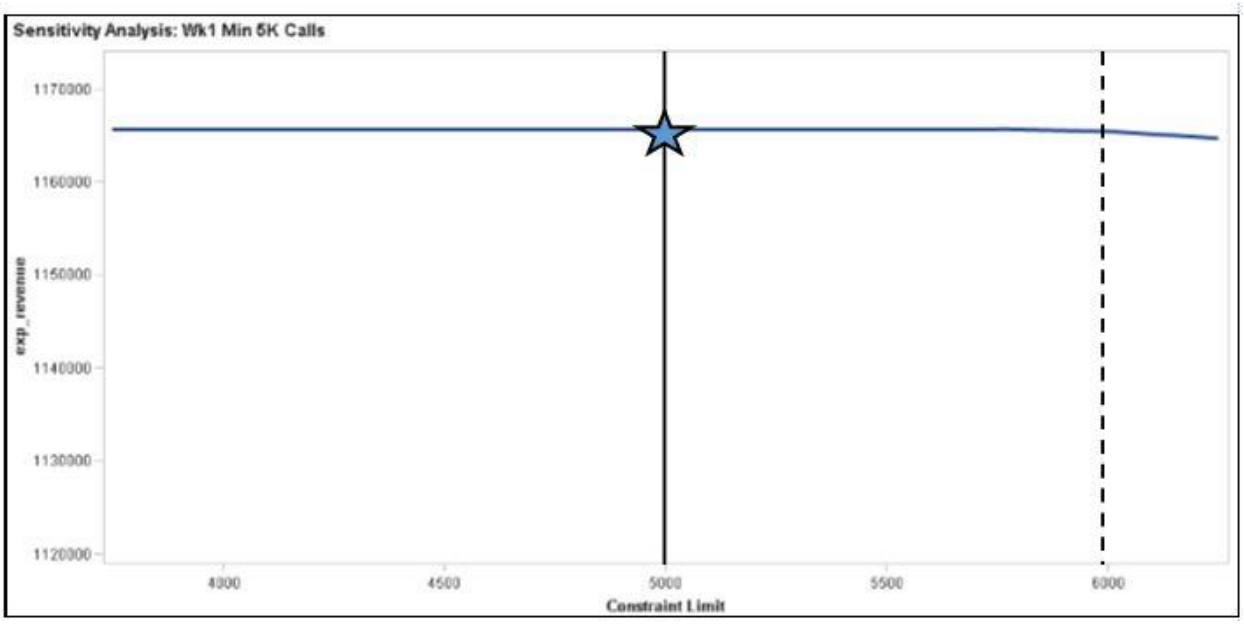
In Display 6, the additional solid lines indicate the current, existing constraint of a maximum budget of $50k. The dotted line indicates that an increase in budget to $68.5k would increase revenue from $116.5 to $117.2.

Note: This is a REVENUE objective, so profit and ROI might actually decline if the increase in budget causes each unit, or dollar, to be less productive. Depending on campaign goals, this might or might not be desired.



Display 7. Max 7k Offers Credit Score Less Than or Equal to 600 – Increase to 8.8k for Increased Expected Revenue (Objective)

Another example of a positive sloping sensitivity analysis, Display 7, indicates a modest revenue increase of approximately $6,000 (from 1,165,000 to 1,171,000) from when you increase the number of offers made to customers with a credit score of less than 600 from 7k to 8.8k offers. At this point, it becomes more of a business decision. You should consider if it is worth the risk incurred by taking on more low credit customers versus the relatively small increase in revenue by making the additional offers. There will be times that you choose to not adjust even though there is some opportunity to improve your objective.



Display 8. Week 1 Min 5k Calls Zero Opportunity Cost and Negative >6K

No slope, or a negative slope, as seen in Display 8, shows that the objective has low sensitivity to the constraint. In this example, the number of calls in Week 1 has no impact on revenue until you exceed 6,300 calls, at which point, revenue declines slightly.

Opportunity cost can be negative with the corresponding sensitivity analysis showing a negative slope as you can see in Display 9 and Display 10. Display 9 Constraint Summary indicates that for each additional Disability DM offer, expected PROFIT declines by approximately $29.84 across the entire scenario. This indicates that the most profitable number of Disability DM offers to make is less than 15k.

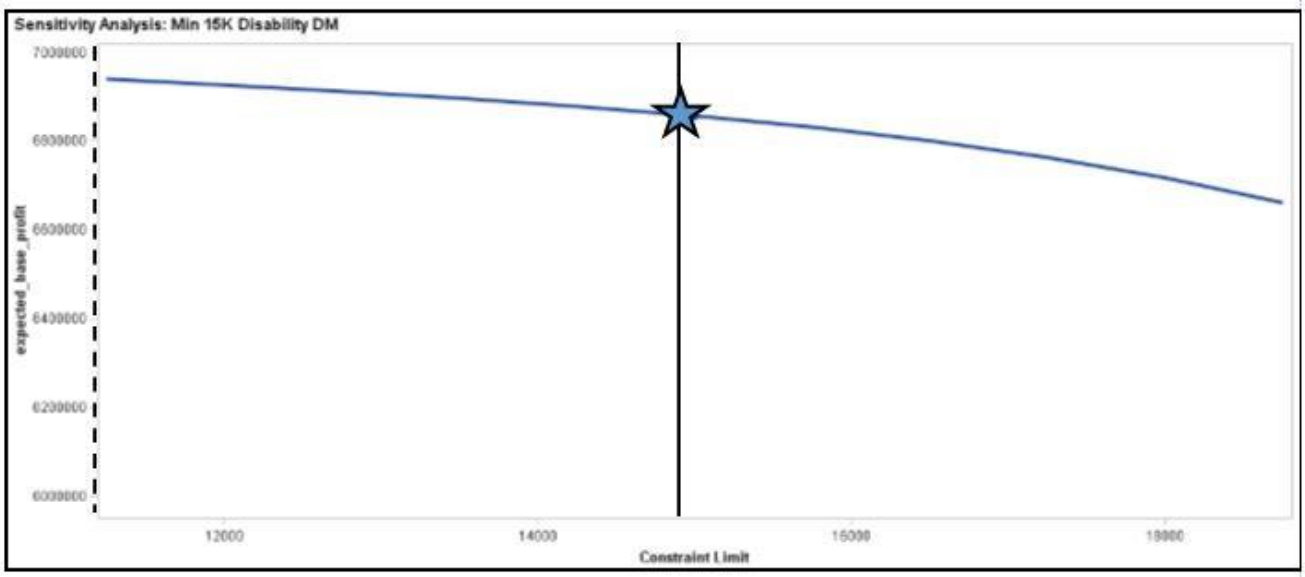
By looking at the Sensitivity Analysis in Display 10, you will be able to determine a good level of Disability DM offers to make. Consider re-running the scenario with a limit of 11k Disability DM offers to determine the approximate impact.

Constraint Summary

Number of rows: 7

Type	Name	Operator	Limit	Value	Opportunity Cost
Budget	Max $175K	At most	175,000.00	174,999.05	15.74
Budget	Max $22K for Wellness Camp	At most	22,000.00	22,001.10	8.33
Budget	Max $25K for ho xsell 1K ded DM	At most	25,000.00	10,367.50	0.00
Cellsize	Min 15K Disability DM	At least	15,000.00	15,001.00	-29.84
Channel	Wk10 CallCenter 20K	At most	20,000.00	19,999.00	16.90
Channel	Wk11 CallCenter 18.5K	At most	18,500.00	0.00	0.00
Channel	Wk12 CallCenter 15K	At most	15,000.00	0.00	0.00

Display 9. Negative Opportunity Cost



Display 10. Corresponding Negatively Sloped Sensitivity Analysis

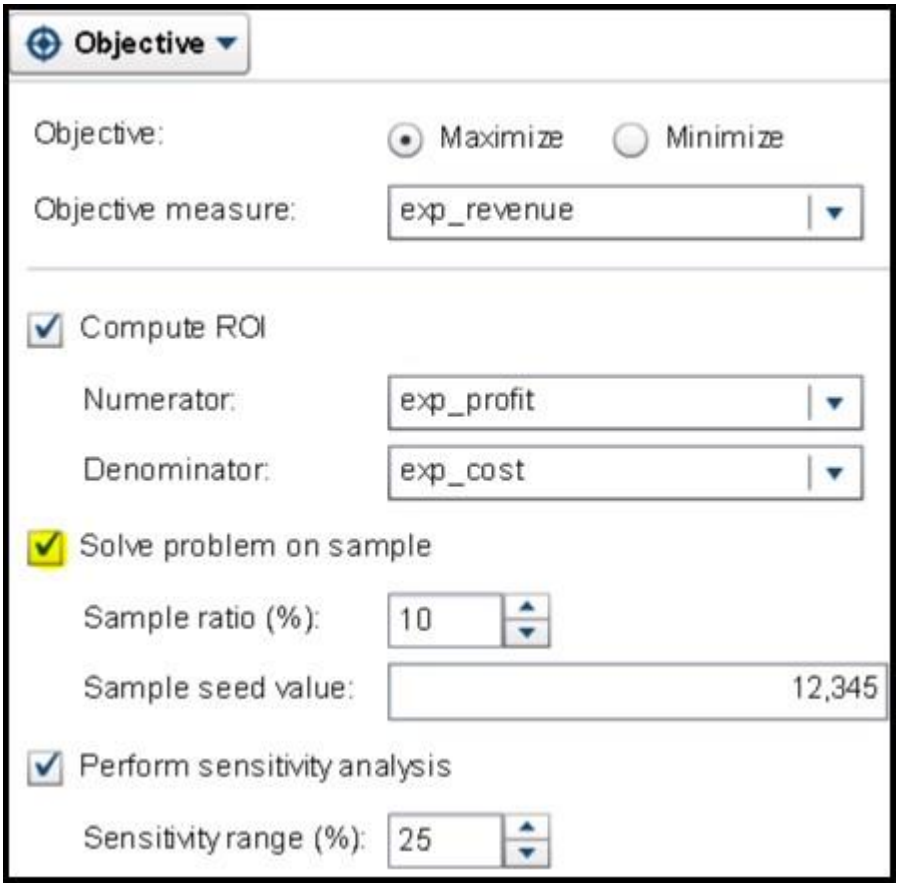
Opportunity cost calculations are calculated by default for all scenarios. Sensitivity analysis is an advanced feature that requires that you set it on the Objective page (Display 11) and place flags on the Constraint Page (Display 12). Running sensitivity analysis will increase your run time, with the incremental time varying by scenario complexity and the number of constraints on which you run the sensitivity analysis.

RUNNING WHAT IF SCENARIOS AND COMPARING SCENARIOS

How do you use all this information to improve your results? The best way is to establish a Best Practices protocol, giving yourself time in your process to leverage SAS Marketing Optimization as a test lab by running multiple *What If* scenarios.

SOLVE ON A SAMPLE

On the Objective page, flag **Solve problem on a sample**, as in Display 11. This will facilitate your testing by allowing your scenarios to run at a fraction of the time. You can also set a random seed value.



Display 11. Solve Problem on Sample to Run *"What Ifs"*

The percentage of the original customer file that you choose to use can vary based on the size of your data set. Often, your set is large enough that a 10% sample is adequate. If in doubt about the sample size you are using, increase your sample ratio (%), keeping in mind, the larger the data set, the longer it will take to run your test scenarios. You can also always get a reality check by running a sample size calculator as well.

Note: If you use a sample to solve your scenario, as in Display 11, please be sure to un-flag this feature prior to finalizing and promoting your scenario.

REPORT ONLY CONSTRAINTS

In addition to constraints used in your optimization, you can also include ***Report Only Constraints*** in order to better understand the expected business impacts of various scenarios. They are built on the Constraints page, shown in Display 12, based on calculations made on existing measurements and appear in the ***Results.***

Display 12. Creating "Report Only" Constraints

As you can see in Display 13, you must flag to use the constraint in the optimization. Processing time increases for each constraint selected. ***Report Only Constraints*** have no impact on the optimization itself, but you are able to see the estimated impact of them based on the calculations and decisions of the optimization.

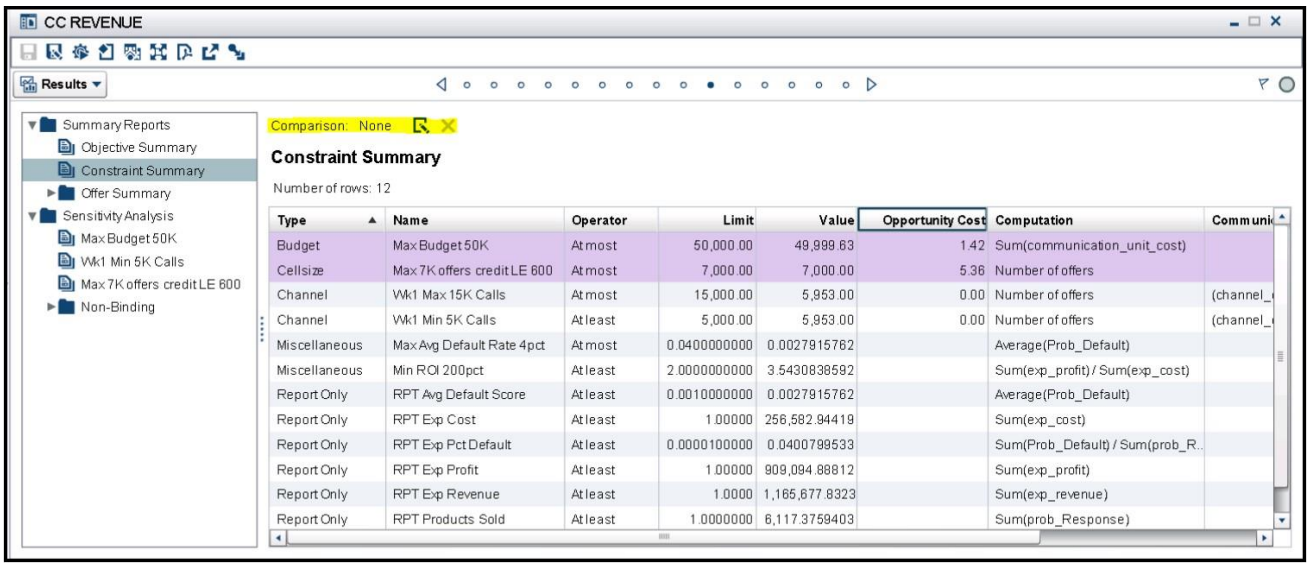
Name	Prepopulated	Type	Operator	Limit	Level	Sensitivity Analysis
Max Budget 50K	No	Budget	At most	50,000	Aggregate	☑
Wk1 Max 15K Calls	No	Channel	At most	15,000	Aggregate	☑
Wk1 Min 5K Calls	No	Channel	At least	5,000	Aggregate	☑
RPT Products Sold	No	Report only	At least	1	Aggregate	
RPT Avg Default Score	No	Report only	At least	0.001	Aggregate	
RPT Exp Revenue	No	Report only	At least	1	Aggregate	
RPT Exp Cost	No	Report only	At least	1	Aggregate	
RPT Exp Profit	No	Report only	At least	1	Aggregate	
RPT Exp Pct Default	No	Report only	At least	0.00001	Aggregate	
Max 7K offers credit LE 6...	No	Cellsize	At most	7,000	Aggregate	☑

Display 13. Add "Report Only" Constraints

Note***: Report Only Constraints*** are not available for Sensitivity Analysis. This makes sense when you consider that they have no impact on the optimization of the objective.

COMPARING MULTIPLE SCENARIOS

Within SAS Marketing Optimization, you can compare any scenarios you have built and optimized. Within any scenario that you would like to compare, after running the optimization, you can go to the Results page. At the top is a small edit box for Comparison: Multiple as shown in Display 14. When you select this, you get a list of all scenarios available for comparison as seen in Display 15. The default listing shows any scenarios that are built on the same input files. You can also select ***Show all scenarios*** to compare any scenarios within the same business context, regardless of their input files.



Type	Name	Operator	Limit	Value	Opportunity Cost	Computation	Communi
Budget	Max Budget 50K	At most	50,000.00	49,999.63	1.42	Sum(communication_unit_cost)	
Cellsize	Max 7K offers credit LE 600	At most	7,000.00	7,000.00	5.36	Number of offers	
Channel	Wk1 Max 15K Calls	At most	15,000.00	5,953.00	0.00	Number of offers	(channel_
Channel	Wk1 Min 5K Calls	At least	5,000.00	5,953.00	0.00	Number of offers	(channel_
Miscellaneous	Max Avg Default Rate 4pct	At most	0.0400000000	0.0027915762		Average(Prob_Default)	
Miscellaneous	Min ROI 200pct	At least	2.0000000000	3.5430838592		Sum(exp_profit) / Sum(exp_cost)	
Report Only	RPT Avg Default Score	At least	0.0010000000	0.0027915762		Average(Prob_Default)	
Report Only	RPT Exp Cost	At least	1.00000	256,582.94419		Sum(exp_cost)	
Report Only	RPT Exp Pct Default	At least	0.0000100000	0.0400799533		Sum(Prob_Default) / Sum(prob_R..	
Report Only	RPT Exp Profit	At least	1.00000	909,094.88812		Sum(exp_profit)	
Report Only	RPT Exp Revenue	At least	1.0000	1,165,677.8323		Sum(exp_revenue)	
Report Only	RPT Products Sold	At least	1.0000000	6,117.3759403		Sum(prob_Response)	

Display 14. "Comparison: Multiple" Flag

Type: Optimized Scenarios

Select scenarios to compare:

	Name	Folder	Input Data
☑	CC PROFIT	Optimization/Scenarios/AP SEMINAR DEMOS	Banking Credit Card Upsell
☑	CC SALES	Optimization/Scenarios/AP SEMINAR DEMOS	Banking Credit Card Upsell
☐	Max Prod Sold 50K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Prod Sold 60K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Profit 50K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Profit 50K risk roi const	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Profit 60K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Rev 50K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Rev 50K risk roi const	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell
☐	Max Rev 60K Budget	Optimization/Scenarios/Credit Card Upsell	Banking Credit Card Upsell

Display 15. "Comparison: Multiple" – Selecting Scenarios

By selecting Constraint Comparisons, you can view, side by side, the results of multiple scenarios. In Display 16, you can compare scenarios with primary objectives of Sales, Revenue, and Profit. You can also see the usefulness of the Report Only constraints in understanding the business relationships between the various objectives.

Tip: Using short scenario names helps to view constraint limits, optimization values and opportunity costs in Display 16 in one view without the need to scroll.

Comparison: Multiple

Constraint Comparison

Number of rows: 12

			Limit			Value			Opportunity Cost		
Type	Name	Operator	CC PROFIT	CC REVENUE	CC SALES	CC PROFIT	CC REVENUE	CC SALES	CC PROFIT	CC REVENUE	CC SALES
Budget	Max Budget 50K	At most	50,000.00	50,000.00	50,000.00	50,000.12	49,999.63	49,999.76	0.34	1.42	0.02
Cellsize	Max 7K offers credit LE 600	At most	7,000.00	7,000.00		7,000.00	7,000.00		4.39	5.36	
Channel	Wk1 Max 15K Calls	At most	15,000.00	15,000.00	15,000.00	5,990.00	5,953.00	5,000.00	0.00	0.00	0.00
Channel	Wk1 Min 5K Calls	At least	5,000.00	5,000.00	5,000.00	5,990.00	5,953.00	5,000.00	0.00	0.00	0.00
Miscellaneous	Max Avg Default Rate 4pct	At most	0.0400000000	0.0400000000		0.0018065682	0.0027915762				
Miscellaneous	Min ROI 200pct	At least	2.0000000000	2.0000000000		5.0366591867	3.5430838592				
Report Only	RPT Avg Default Score	At least	0.0010000000	0.0010000000	0.0010000000	0.0018065682	0.0027915762	0.0029876457			
Report Only	RPT Exp Cost	At least	1.00000	1.00000	1.00000	187,622.39205	256,582.94419	271,655.61349			
Report Only	RPT Exp Pct Default	At least	0.0000100000	0.0000100000	0.0000100000	0.0270367281	0.0400799533	0.0410933169			
Report Only	RPT Exp Profit	At least	1.00000	1.00000	1.00000	944,990.04458	909,094.88812	868,816.06582			
Report Only	RPT Exp Revenue	At least	1.0000	1.0000	1.0000	1,132,612.4366	1,165,677.8323	1,140,471.6793			
Report Only	RPT Products Sold	At least	1.00000	1.0000000	1.0000000	5,831.83199	6,117.3759403	6,958.5658823			

Display 16. Sales, Profit, and Revenue Scenario Comparisons

The view in Display 16 offers a wealth of information. This is a good snapshot to use if you need to communicate with others in your organization about alternative approaches you are considering for your final campaign constraints to promote. Information contained includes opportunity costs, budget, offer quantities, as well as expected cost, % default, sales, revenue, and profit.

CONCLUSION

SAS Marketing Optimization offers a wealth of profitability indicators and built in functionality to increase the impact your campaigns have on your KPIs. By building and testing your scenarios with this in mind, you will get the best results out of your optimized campaigns. It is critical that you select the optimal objective that will produce the highest impact on your KPIs. Across your campaigns, you can choose to vary the objective function to drive a variety of KPIs and achieve various business results. Keep in mind that SAS Marketing Optimization prioritizes the objective you give it, sometimes at the expense of other

metrics. SAS Marketing Optimization is extremely powerful and becomes increasingly so, as you learn more about how to use it for pre-testing as a decision management tool. ***What If Scenarios*** can also be invaluable tools for communicating within the organization. For example, you can use scenario approximations to make a case to increase or decrease operational constraints like budget, credit lines, agent distribution, or offer timing just to name a few. By using all of these built in features, you will be able to modify your scenarios to achieve the optimal impact.

REFERENCES

SAS Institute Inc. 2016. *SAS Marketing Optimization 6.5: User's Guide.* Cary, NC: SAS Institute Inc.

CONTACT INFORMATION

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