



Optimization Project 1

Report on:

**Marketing Budget Allocation Analysis**

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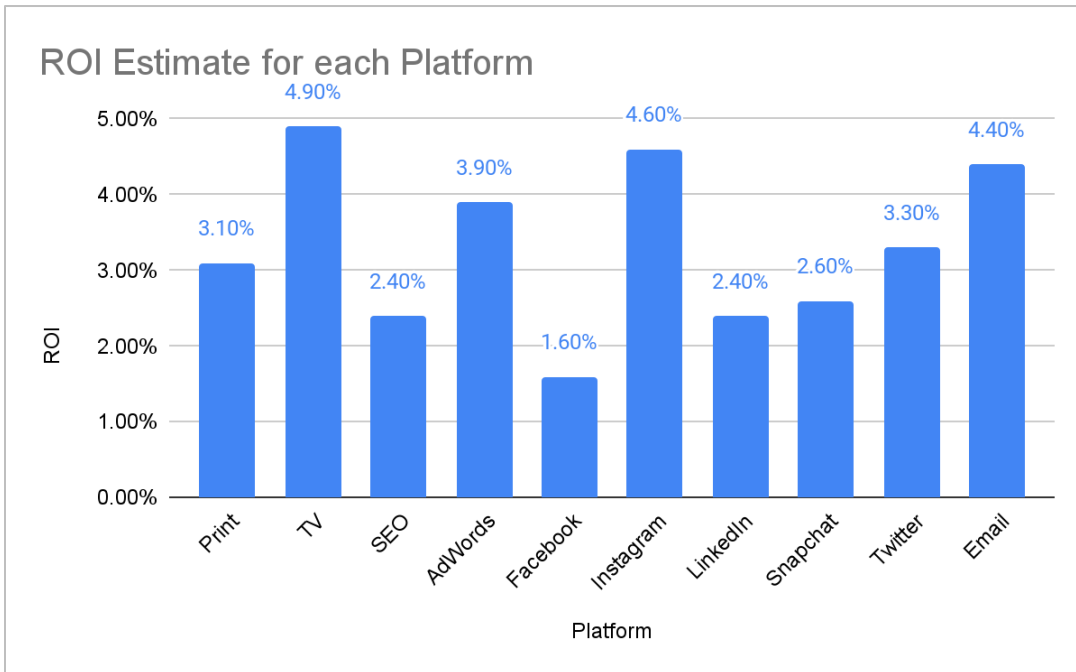
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## Objective:

As the budget season is approaching, we undertook an analysis of how to spend our marketing budget on different mediums. We had a budget of \$10M, which was to be distributed among the 10 potential channels. This study aimed to maximize the ROI received from the expenditure.

## Approach:

To begin, we hired a consulting firm to conduct a study on the projected ROIs for these channels for the next year. The results of the study were as follows:



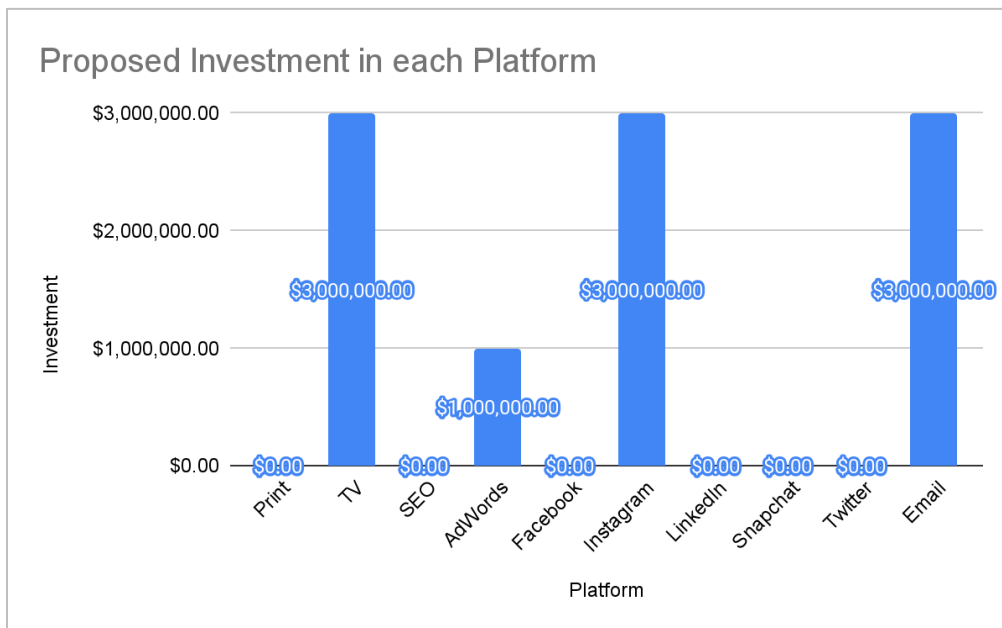
It is clear from the data that TV, Instagram, and Email are the most lucrative options for us. On top of this, we utilized the expertise of our CMO to come up with some constraints based on their domain knowledge, which were as follows:

1. The amount invested in print and TV should be no more than the amount spent on Facebook and Email. Surprisingly, email seems to be a great channel for reaching real people.
2. The total amount used in social media (Facebook, LinkedIn, Instagram, Snapchat, and Twitter) should be at least twice of SEO and AdWords.
3. For each platform, the amount invested should be no more than \$3M.

With this data and domain knowledge in hand, we designed an Optimization model with the objective of maximizing our ROI. The results were as follows:

## Results:

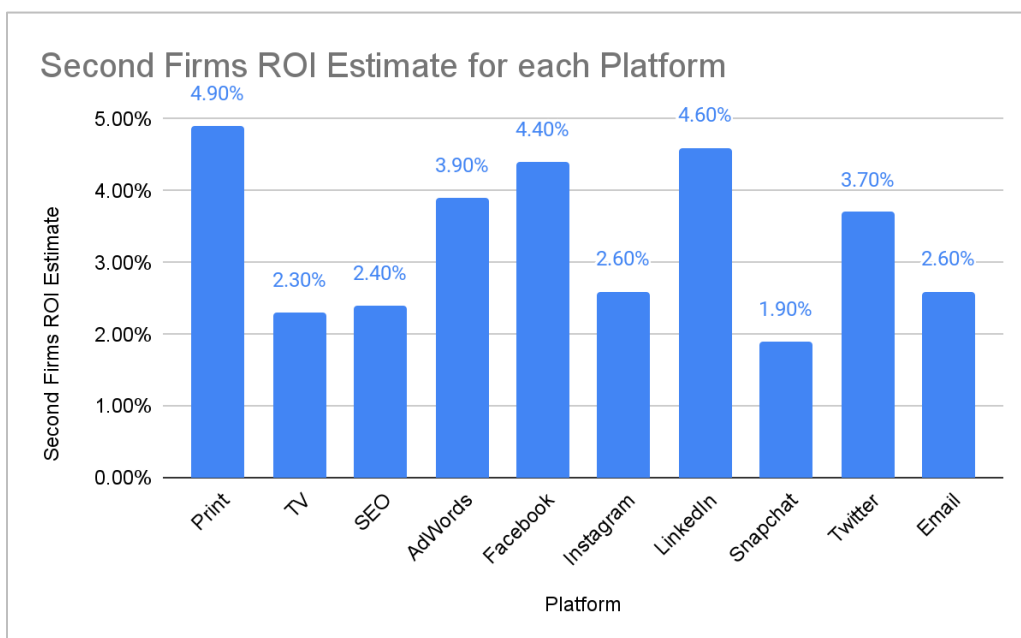
### First Firm's Estimates



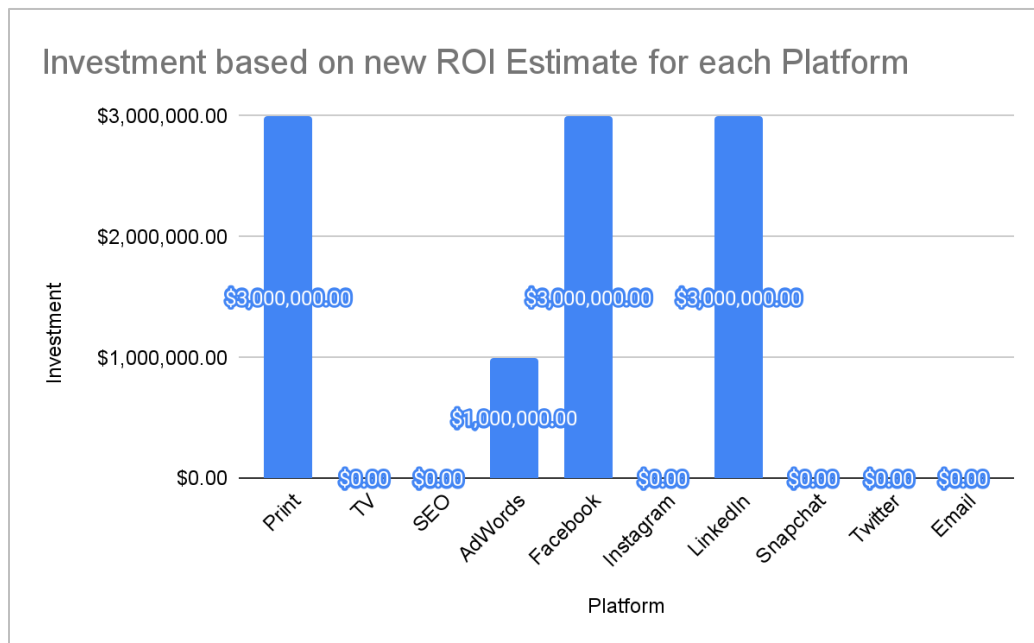
This allocation was made according to the constraints present, and it maximizes our ROI to a value of \$456,000. We can see the optimal solution is skewed with TV, Instagram, and Email being allotted the majority share of the budget.

### Second Firm's Estimates

One should gather wisdom from many sources as wisdom gained from only one source can become stale, and our CMO had exactly that thought when he sought a second consulting firm to conduct another ROI study for the same set of channels. The second firm came back to us with these results:



These results were clearly disparate from the number reported by the first firm, therefore we decided to repeat the optimization process with these ROIs to see the change that could happen in our allocation and objective. The results of the second run were as follows:



Surprisingly, this new allocation also resulted in an ROI of \$456,000. Results were skewed again but the majority budget in this estimate was allotted to different platforms in Print, Facebook, and LinkedIn.

#### First Allocation v/s Second Allocation

We had a new concern on our hands, we had two possible allocations we could use and there was a possibility that the market would follow the allocation that we didn't choose. To help us understand this effect we conducted an analysis of what our results would look like if we followed on allocation but got the returns based on other allocations' ROI estimates. So, there is a high risk involved.

Returns	First Allocation	Second Allocation
First ROI Estimate	\$456,000	\$252,000
Second ROI Estimate	\$264,000	\$456,000
Difference	\$192,000	\$204,000

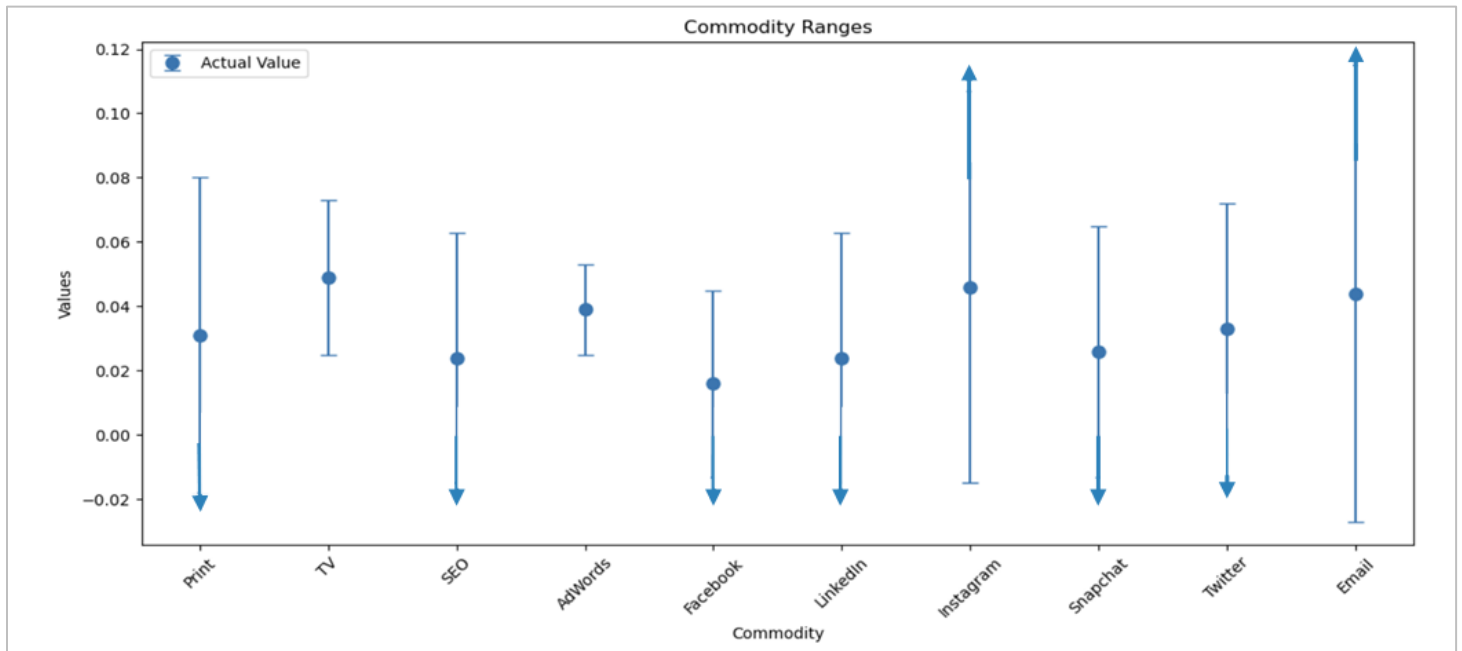
#### CMO's recommended constraint

The risk involved in budget allocation also brings to light the third constraint that our CMO provided us, i.e. each platform can be allotted a maximum budget of \$3M. If we ignore that constraint and rerun our optimization model, we can potentially increase our returns by \$9,000 in both cases, but in case our chosen ROI estimate proves to be wrong, we will have returns fall by at least an additional \$26,000.

The third constraint is helping us diversify our investment and is therefore mitigating the potential risk in case our ROI estimates prove to be wrong. From a qualitative point of view, marketing through different platforms provides intangible benefits of maintaining a varied brand presence and targeting a more demographic audience.

## Sensitivity Analysis:

To explore the changes in allocation further, we performed a sensitivity analysis on our original ROIs from the first consulting company to see how our optimal allocation would change based on changes in the ROI data. From that analysis, we acquired the following results:

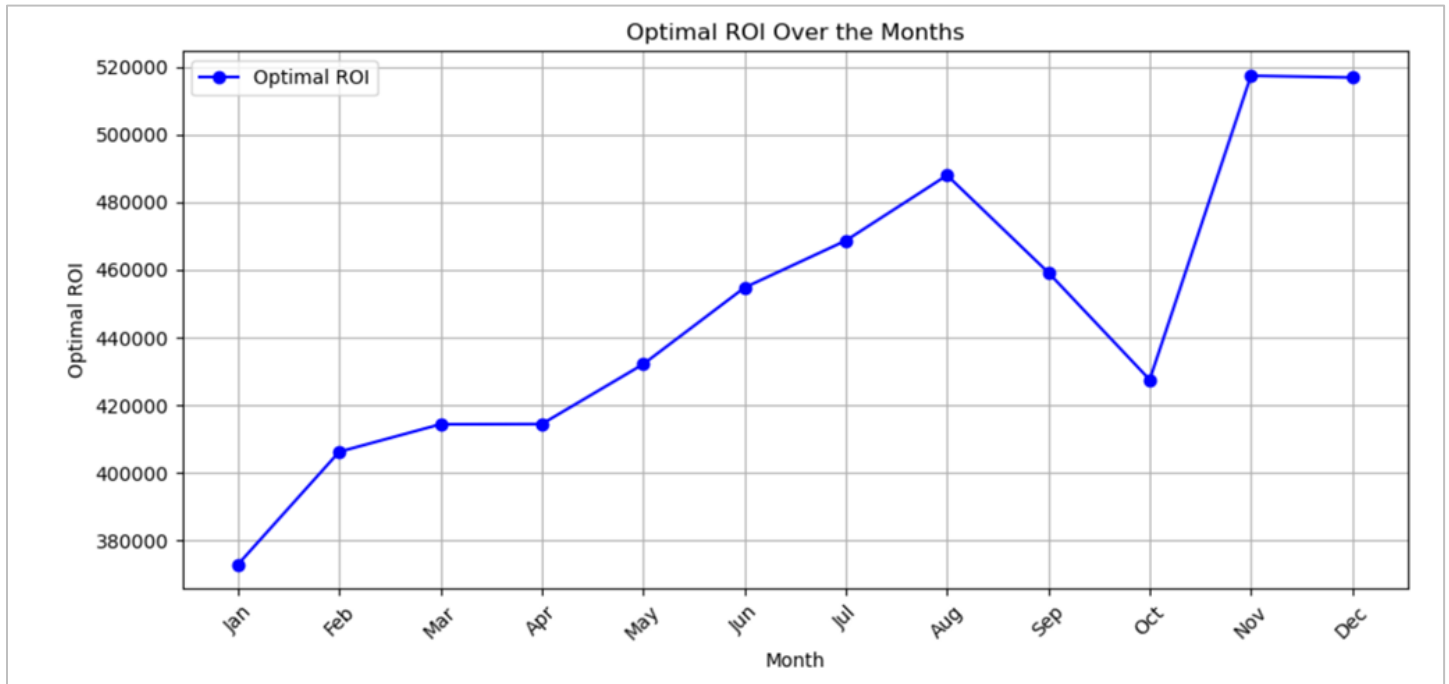


This graph shows for each advertising medium the amount of ROI that can be increased or decreased before the optimal solution changes (the arrows indicate infinity). When the allowable increase and decrease range is large, this means that the platform is not very sensitive, and small changes to their ROI values won't impact the optimal allocation.

However, for platforms like TV or AdWords, there is a very narrow range for ROIs that will not affect the optimal solution. This indicates that these platforms are crucial determinants of the distribution of the budget for the optimal solution.

## Reinvesting Returns:

Now that we also have permission to reinvest half of the returns for each month, we have implemented another optimization model that will tell us the most effective spending strategy for each platform each month. With those strategies in place, we get the following ROIs over the months:



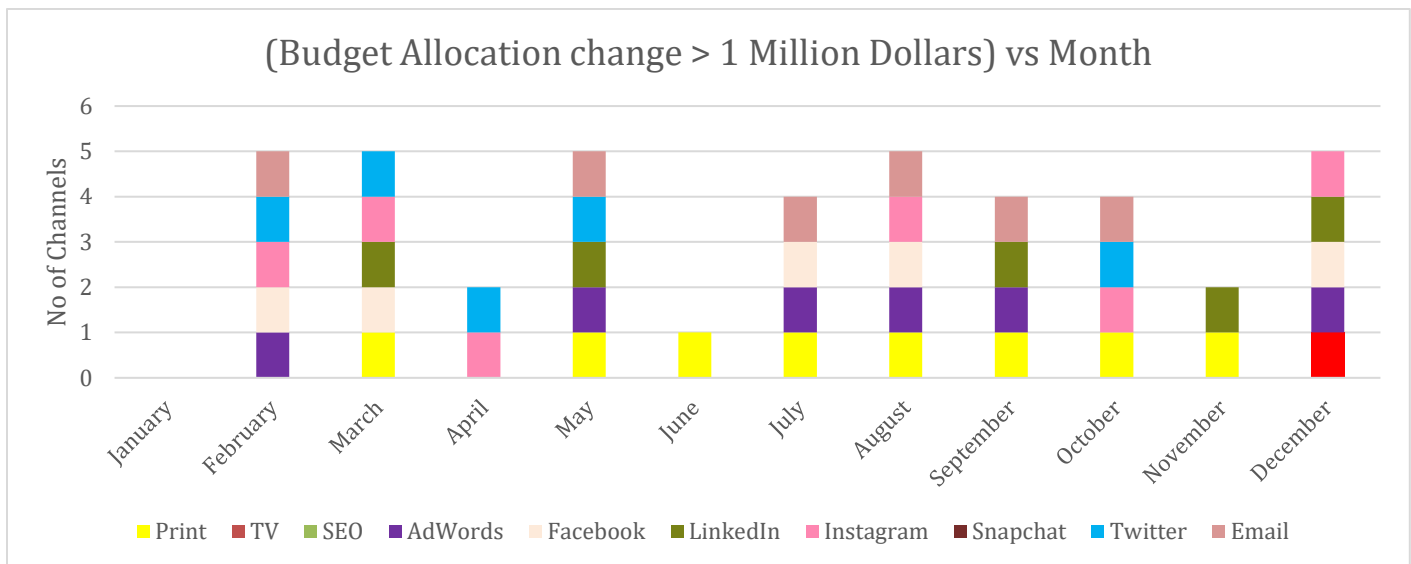
As you can see, the general trend is that the ROI increases over the months. This data indicates that over the span of one year, reinvesting half of the ROI each month would benefit the company. By reinvesting half of the ROI into the budget for next month, we are able to increase the budget, improving the quantity, quality, and reach of our advertisements on each platform, which then in turn generally increases our ROI.

## Budget Stability:

Platform	Print	TV	SEO	AdWords	Facebook	LinkedIn	Instagram	Snapchat	Twitter	Email	Optimal ROI
January	\$ 3,000,000	\$ -	\$ -	\$ 1,333,333	\$ -	\$ -	\$ 2,666,667	\$ -	\$ -	\$ 3,000,000	\$ 373,000
February	\$ 3,000,000	\$ -	\$ -	\$ 2,395,500	\$ 3,000,000	\$ -	\$ -	\$ -	\$ 1,791,000	\$ -	\$ 406,296
March	\$ -	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ 1,389,648	\$ -	\$ 3,000,000	\$ -	\$ 414,417
April	\$ -	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ 3,000,000	\$ -	\$ 1,596,856	\$ -	\$ 414,487
May	\$ 1,804,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ 3,000,000	\$ 432,144
June	\$ 3,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 2,020,172	\$ 3,000,000	\$ 454,767
July	\$ -	\$ -	\$ -	\$ 3,000,000	\$ 2,247,555	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ -	\$ 468,655
August	\$ 3,000,000	\$ -	\$ -	\$ 1,827,294	\$ -	\$ 654,588	\$ -	\$ -	\$ 3,000,000	\$ 3,000,000	\$ 487,966
September	\$ 1,362,933	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ -	\$ -	\$ 3,000,000	\$ 1,362,933	\$ 459,220
October	\$ -	\$ -	\$ -	\$ 3,000,000	\$ -	\$ 3,000,000	\$ 3,000,000	\$ -	\$ -	\$ 2,955,475	\$ 427,575
November	\$ 3,000,000	\$ -	\$ -	\$ 2,056,421	\$ -	\$ 1,112,842	\$ 3,000,000	\$ -	\$ -	\$ 3,000,000	\$ 517,376
December	\$ 3,000,000	\$ 3,000,000	\$ -	\$ 427,951	\$ 3,000,000	\$ -	\$ -	\$ -	\$ -	\$ 3,000,000	\$ 516,834

However, there may be a problem with the stability of this budget, as indicated by the above table and the following graph. The table depicts the actual budget allocation for each platform based on given ROI estimates for each month.

The graph illustrates the change in spending of more than \$1M for each platform channel every month. We can see that for most of the months, there is a high fluctuation (> \$1M) in the budget for channels indicating instability in budget allocation. To correct this in our model, we may add another constraint that does not allow the allocated spending for each platform to change beyond the \$1M limit for every month.



## Conclusion:

In conclusion, adopting a logical approach through optimization modeling while incorporating the marketing experience of our CMO in our budget allocation will generate the overall best results which will help escalate our brand presence across various ad channels while also yielding healthy returns.