Case 2 - Intel Asia-Pacific

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Intel Asia-Pacific (Intel AP) use Facebook ads to promote marketing activities

- Intel Asia Pacific will target 6 countries: Indonesia, Korea, Malaysia, Pakistan, Philippines and Singapore.
- Facebook advertisements include *Marketplace Ads*, *Premium Ads* and *Mobile Ads*.
- *Premium Ads* and *Mobile Ads* can induce Earned Media.
- The total budget is $95,000 while 9% of the budget has already been used for the initial media purchasing plan, so the actual budget is 91%*$95,000=$86,450.

Intel AP is looking to...

- Maximize clickthrough within budget
- Or alternatively maximize clickthrough/total impression

Our goal is find the optimal marketing plan that reaches out to the most customers. We will compare the results obtained from the two approaches and decide which model is more desirable in terms of total clickthrough, total impression, and budget.

Assumptions of Intel AP Purchase Plan

- The given cost per 1,000 impressions, click-through rates and social impression multipliers are fixed throughout the entire time span of the marketing activities.
- For each ad type/country combination, the number of impressions should not fall below 75% of the number of impressions in the preliminary plan.
- For each country, the total number of impressions should be no more than 125% of the total number of impressions in the preliminary plan.
- If there are multiple purchasing plans to achieve the same maximum click-throughs, we choose the one with max proportion of click-throughs/impressions.

Model Development

We developed a linear program with

- Decision variables X_{ij} where *i* stands for country (1=Indonesia, 2=Korea, 3=Malaysia, 4=Pakistan, 5= Philippines, 6=Singapore) and *j* stands for ad type (1=marketplace, 2=premium, 3=mobile ads). There is no X_{23}.
- objective function that calculates calculates the total clickthrough
- the 75% and 125% constraints
- the total budget constraint
- nonnegativity constraint

Model Development

$$\begin{aligned}\text{Max}\ \ & 0.09\%x_{11} + 0.08\%x_{21} + 0.11\%x_{31} + 0.12\%x_{41} + 0.11\%x_{51} + 0.12\%x_{61} + \\ & 0.43\% * (1 + 25.28\%)x_{12} + 0.23\% * (1 + 98.23\%)x_{22} + 0.32\% * (1 + 38.95\%)x_{32} + \\ & 0.59\% * (1 + 69.96\%)x_{42} + 0.48\% * (1 + 58.64\%)x_{52} + 0.34\% * (1 + 37.70\%)x_{62} + \\ & 0.05\% * ((1 + 25.28\%)x_{13} + (1 + 38.95\%)x_{33} + (1 + 69.96\%)x_{43} + (1 + 58.64\%)x_{53} + \\ & (1 + 37.70\%)x_{63})\end{aligned}$$

s.t.

$$\begin{aligned}\frac{1}{1000}\big(&0.53x_{11} + 0.88x_{21} + 0.60x_{31} + 0.57x_{41} + 0.56x_{51} + 0.71x_{61} + 4.41x_{12} + 5.25x_{22} + 3.22x_{32} \\ &+ 4.41x_{42} + 3.85x_{52} + 5.60x_{62} + 0.40(x_{13} + x_{33} + x_{43} + x_{53} + x_{63})\big) \le 86450\end{aligned}$$

$$-x_{11} \le -4500000$$

$$-x_{21} \le -4500000$$

$$-x_{31} \le -4500000$$

$$-x_{41} \le -750000$$

$$-x_{51} \le -4500000$$

$$-x_{61} \le -1500000$$

$$-x_{12} \le -2625000$$

$$-x_{22} \le -2775000$$

$$-x_{32} \le -2775000$$

$$-x_{42} \le -525000$$

Model Development (cont'd)

$$-x_{52} \leq -2775000$$

$$-x_{62} \leq -1012500$$

$$-x_{13} \leq -2250000$$

$$-x_{33} \leq -2250000$$

$$-x_{43} \leq -2250000$$

$$-x_{53} \leq -2250000$$

$$-x_{63} \leq -2250000$$

$$x_{11} + x_{12} + x_{13} \leq 15625000$$

$$x_{21} + x_{22} \leq 12125000$$

$$x_{31} + x_{32} + x_{33} \leq 15875000$$

$$x_{41} + x_{42} + x_{43} \leq 5875000$$

$$x_{51} + x_{52} + x_{53} \leq 15875000$$

$$x_{61} + x_{62} + x_{63} \leq 7937500$$

All variables ≥ 0

Model Explanation

As for *Premium*/*Mobile Ads*, people who click-through the ad will appear on their friends' news feed, and their friends can subsequently click-through the ad as well.

Using Total Premium/Mobile CTR = Premium/Mobile CTR + (Premium/Mobile CTR * Social Impression Multiplier * Social CTR).

Total CTRs are calculated and listed below:

Market	Indonesia	Korea	Malaysia	Pakistan	Philippines	Singapore
Marketplace	0.09%	0.08%	0.11%	0.12%	0.11%	0.12%
Premium	0.54%	0.46%	0.44%	1.00%	0.76%	0.47%
Mobile	0.06%	0.10%	0.07%	0.08%	0.08%	0.07%

Base Solution

- Total click-through would be 131,593.
- Pakistan and Philippines ads reach the 125% maximum.
- Indonesia, Korea, Malaysia, and Singapore reach 75% minimum in all types of advertisement.
- All *Marketplace Ads* reach 75% minimum.
- All budgets has been spent.

Model 2: maximize total clickthrough/total impression

- Non-linear model (Solved by GRG nonlinear solver)
- Same set of decision variables and constraints
- Different objective function
- Results:

	Original Model	Model 2
Total CT	131593	131534
CT/total impression	2.79E-3	2.24E-3

- The two models have similar Total CT, yet Model 2 has a notably higher CT/total impression value. However, having less total impressions also means that the cost of impression is higher, which is pointless in maximizing clickthroughs. So we will still go with the original model.

Sensitivity Analysis

The mobile ad CTR is estimated to be 0.05%, which is described as being “conservative”. We re-ran the model with 0.06%, 0.07%, and 0.08% mobile ad CTR.

	Original (0.05%)	0.06%	0.07%	0.08%
Total CT	131,593	134,728	138,901	141,127

At 0.07% mobile ad CTR, all countries except Korea, where mobile ads are unavailable, reach the 125% maximum for the optimal solution. In other words, a slight increase in mobile ad CTR could result in a different optimal solution which has a higher marketing emphasis on mobile ads (75% minimum for all marketplace and premium ads).

Conclusion

According to our analysis, Intel AP should implement the following marketing strategy to achieve maximum click-through:

- 75% impressions in all *Marketplace Ads*
- 75% impressions in all Indonesia, Korea, Malaysia, and Singapore ads
- 2,875,000 impressions in Pakistan Premium and 2,250,000 impressions in Pakistan *Mobile ads*
- 3,424,130 impressions in Philippines Premium and 7,950,870 impressions in Philippines *Mobile ads*

The optimal result would be 131,593. Under the original budget and the preliminary marketing plan, the total click-through would be 131,965. However, since we are given less budget, we would not be able to reach 131,965 anyways.