

## Case Project

### Optimization of Decisions for Amber India Restaurants



#### Background

Amber India restaurants are award-winning restaurants with five locations across the San Francisco Bay Area (San Jose, Mountain View, Los Altos, Milpitas, and San Francisco). The restaurants serve both classic and contemporary Indian cuisine. The Amber group of award-winning Restaurants offers a class of distinctive and innovative culinary dishes.



Amber India: San Francisco

The owner, Vijay Bist, is a well-known restaurateur and entrepreneur in Silicon Valley. His noteworthy success, Amber India, represents Indian cuisine at its finest level and on par with other global standouts. In addition to overseeing the restaurants, Vijay devotes his time to continually study and engage in the innovations in Indian cuisine, with the objective of articulation in North America and elsewhere. Vijay received his early culinary education in India. This was followed by advanced education in Switzerland, Germany, and France, and an MBA degree in the US.



Vijay Bist, the owner of Amber India Group

Among the five locations, Amber India San Jose is particularly notable. It is located in Santa Row, one of Silicon Valley's premier destinations for shopping, dining, living, and more. With over 70 shops, 20 restaurants, and 9 spas and salons, there's something for everyone at the Row. The restaurant is surrounded by vibrant restaurants, bars, movie theaters, and fancy shopping outlets.



Santana Row, San Jose



Amber India Entrance, Santana Row



Amber India Restaurant in Santana Row, Silicon Valley

Amber restaurants offer modern elegance and comfort, and have an air of sophistication. The decor gives the customers the feel of an art gallery as it has artworks of many well-known artists spread out over three dining areas. Each of these dining areas has its own unique feel to it.

The menu boasts of both traditional and contemporary Indian dishes made with the freshest Californian produce.



## **Part I: Maximizing The Number of Exposures of Ads**

Amber has recently faced quite a reduced number of customers due to the Corona pandemic. Vijay has decided to develop a promotional campaign for Amber restaurants to address this issue. Amber's dishes have a lot going for it. They have great taste, nutritious and some of the dishes such as Amber's famous "Dahi Kebab" are quite crispy! Dahi Kebab is a vegetarian dish made from hung yogurt, fresh cheese, cashew, and green papaya relish. Overall, Amber's meals have the makings of a winning promotional campaign..



Amber's famous Dahi Kebab

Vijay has employed a San Francisco-based marketing firm, BayCreative, to help design a promotional ad campaign to achieve Amber, the largest possible exposure to customers in Northern California during a one-year period. Amber will pay BayCreative a fee based on services performed (not to exceed \$1 million) and has also allocated \$4 million for advertising expenses.

BayCreative has identified three effective advertising media for promoting Amber's restaurants:

- **Medium 1:** Television commercials on Bay-Area based TV stations.
- **Medium 2:** Advertisements in food and family-oriented magazines.
- **Medium 3:** Advertisements in major newspapers.

The problem now is to determine which levels should be chosen for these advertising activities to obtain the highest number of ad exposures to customers.

To determine the best mix of advertising activity levels, it is necessary to identify the overall performance measure for the problem and then the contribution of each activity toward this measure. Vijay's ultimate goal is to maximize Amber's profits, but making a direct connection between advertising exposure and profits is not an easy task. Therefore, as a proxy, Vijay decides to use the expected number of exposures as the overall measure of performance, where each viewing of an advertisement by some individual counts as one exposure. By Vijay's

request, BayCreative has come up with preliminary plans for advertisements in the three media. It has also estimated the expected number of exposures for each advertisement in each medium, as given in the bottom row of Table 1.

| Table 1: Cost and exposure data |                    |                  |                   |
|---------------------------------|--------------------|------------------|-------------------|
| Cost Category                   | Each TV Commercial | Each Magazine Ad | Each Newspaper Ad |
| Advertising costs for one year  | \$300,000          | \$150,000        | \$100,000         |
| Planning costs                  | \$90,000           | \$30,000         | \$40,000          |
| Expected number of exposures    | 1,300,000          | 600,000          | 500,000           |

The total number of ads through the different media is restricted by both the allocated advertising budget (a limit of \$4 million) and the planning budget (a limit of \$1 million for the fee to BayCreative). Another restriction is that there are only five commercial spots available in major Bay Area TV stations during the next year (medium 1). The other two media have an ample number of spots available.

Consequently, the three limited resources for this problem are

- **Resource 1:** Advertising budget (\$4 million),
- **Resource 2:** Planning budget (\$1 million),
- **Resource 3:** TV commercial spots available (5).

Table 1 shows how much of the advertising budget and the planning budget would be used by each advertisement in the respective media:

- The first row gives the cost per ad in each medium. (The cost of using only a fraction of an advertising spot is assumed to be that fraction of the cost given in the table.)
- The second row shows BayCreative's estimates of its total cost (including overhead and profit) to design and develop each advertisement for the respective media.
- The last row then gives the expected number of exposures per advertisement.

Since the promotional campaign is for Amber's award-winning restaurants with distinctive dishes and a modern environment, they have special appeal to young people (whose age range is between 18- 30 years old) and middle-aged people (whose age range is between 30-55 years old). Vijay feels that these two distinct customer segments should be targeted separately. Consequently, he has established two requirements for the campaign.

- **Requirement 1:** During the next year, the advertising of one type or another should be shown at least 5 million times to Bay Area residents whose age range is between 18- 30 years old (young people segment).
- **Requirement 2:** During the next year, the advertising of one type or another should be shown at least 5 million times to Bay Area residents whose age range is between 30- 55 years old (middle-aged people segment).

In effect, these two requirements are minimum acceptable levels for two special benefits to be achieved by the advertising activities.

- **Benefit 1:** Promoting Amber to the young people segment.
- **Benefit 2:** Promoting Amber to the middle-aged people segment.

Because of the way the requirements have been articulated, the level of each of these benefits is measured by the number of people in the specified category that are reached by the advertising.

To enable the construction of the corresponding benefit constraints, Vijay asks CreativeBay to estimate how much each advertisement in each of the media will contribute to each benefit, as measured by the number of people reached in the specified category. These estimates are given in Table 2.

| <b>Table 2: Number reached in each audience segment</b> |                           |                         |                          |                                 |
|---|---------------------------|-------------------------|--------------------------|---------------------------------|
| <b>Audience Segment</b>                                 | <b>Each TV Commercial</b> | <b>Each Magazine Ad</b> | <b>Each Newspaper Ad</b> | <b>Minimum Acceptable Level</b> |
| Young People  | 1.2 million               | 0.2 million             | 0 million                | 5 million                       |
| Middle-Aged People                                      | 0.5 million               | 0.2 million             | 0.2 million              | 5 million                       |

Vijay has one more consideration that he wants to incorporate into the model. He is a strong believer in the use of discount coupons. So, He always earmarks a significant portion of Amber's annual marketing budget for offering these coupons. Vijay still has \$1,490,000 left from this year's allotment for discount coupons and has decided to use the entire \$1,490,000 for offering discount coupons. Both medium 2 (advertisements in food and family-oriented magazines) and medium 3 (advertisements in major newspapers) will feature discount coupons. The estimates of the amount of coupon redemption per advertisement in each of these media are given in Table 3.

| <b>Table 3: Contribution toward the required amount</b> |                           |                         |                          |                                 |
|---|---------------------------|-------------------------|--------------------------|---------------------------------|
| <b>Requirement</b>                                      | <b>Each TV Commercial</b> | <b>Each Magazine Ad</b> | <b>Each Newspaper Ad</b> | <b>Minimum Acceptable Level</b> |
| Coupon Redemption                                       | \$0                       | \$40,000                | \$120,000                | \$1,490,000                     |

Vijay has asked for help from your team! for the planning of his promotional campaign.

## **YOUR MISSION!**

- Determine the decision variables
- Formulate the optimization model with all the constraints
- Coding in R, find the optimal number of advertisements to run in each media that maximize the expected number of exposures while satisfying all the constraints.
  - What is the optimal profit value?
  - What are the optimal values for the variables?

## **Part II: Maximizing The Profits**

The advertising campaign's ultimate goal is to maximize Amber's profits from sales. However, it is not easy to make a direct connection between advertising exposure and profits. Therefore, Vijay chose the expected number of exposures as a rough approximation for profit. Having done this, Vijay is uneasy. He realizes that the total profit may not be proportional to the total number of exposures of ads. So, his approximation might be only rough. The most important reason for it is that running too many advertisements in any of the media passes a saturation level beyond which the effect of one more advertisement in convincing a customer to visit Amber is substantially reduced.

Nevertheless, when the objective function is the expected number of exposures, having an individual see the advertisement one more time after being saturated adds the same amount to the objective function as seeing the advertisement for the first time. To check the results obtained in Part I, Vijay decides to define profit as the overall performance measure to be incorporated directly into the objective function.

He carefully defines profit as the total profit obtained from the number of first-time customer visits for dinner/lunch because of the advertising campaign. This excludes profits from impulse visits by customers who have seen no ads, since these visits have no relevance for evaluating the ad campaign. Repeat visits are also excluded from consideration because these depend mainly on customers' reactions to their first experience at Amber instead of the ad campaign. Vijay asks BayCreative to develop estimates of the number of first-time customer visits that should result from various numbers of advertisements in each of the media. BayCreative estimates based on some past data are given below.

- The estimated relationship between the number of TV commercials ( $TV$ ) on the number of first-time customer visits (millions) ( $S$ ) (either lunch or dinner) per year to all Amber restaurants:

$$S = -0.1TV^2 + 1.13TV - 0.04$$

- The estimated relationship between the number of magazine ads ( $M$ ) on the number of first-time customer visits (millions) ( $S$ ) (either lunch or dinner) per year to all Amber restaurants:

$$S = -0.002M^2 + 0.124M + 0.14$$

- The estimated relationship between the number of newspaper ads ( $N$ ) on the number of first-time customer visits (millions) ( $S$ ) (either lunch or dinner) per year to all Amber restaurants:

$$S = -0.0321N^2 + 0.706N - 0.09$$

BayCreative also reports that it is reasonable to assume that the sales that result from advertising in one of the media are not substantially affected by the amount of advertising in the other media since the audiences for the different media are usually different. It is estimated that the company's profit from serving each customer (either for lunch or dinner) will be, on average, \$5 per customer. This profit includes the price of dishes charged minus the various costs for preparing the dish and the service. However, this profit excludes the advertising costs and

planning costs specified in Part I for the advertising campaign. Therefore, Vijay wants to include these costs in his definition of the total profit that should be considered for determining the best advertising mix.

Vijay has asked again for your consulting teams help!

### **YOUR MISSION!**

- Using your results from Part I, formulate the total profit (as defined by Vijay).
- Use R (or any other language) to determine the optimal number of ads to run in each medium to maximize the total profit while satisfying all the constraints in Part I.
  - What is the optimal profit value?
  - What are the optimal values for the variables?
  - Based on your calculation, what can you conclude about the accuracy of Vjay's approximation in Part I (i.e., finding the optimal variables by using the expected number of exposures)?

### **Part III: Managing Demand for Amour du jour**

To better address the lower number of customers, Vijay also wishes to optimize Amber restaurants' ordering decisions. In particular, Vijay has focused on Amber's most popular drink, "Amour du jour"—a blend of Ketel One Citron, Pomegranate, Hibiscus, Goji Berry, and Lime.



Each cup of Amour du jour is 5.12 ounces and is sold for \$12 at Amber

Weekly customer demand for Amour du jour at a typical Amber restaurant is uniformly distributed between 200 gallons and 500 gallons. An Amber restaurant spends \$75 per gallon to purchase the main raw materials needed for making Amour du jour from a local third-party supplier. It also charges 12 dollars per customer order's glass. The size of the glass for each order is 5.12 ounces or 0.04 gallons. So, Amber can serve 25 customer orders with one gallon of Amour du jour.



Any purchased raw materials that are not used to make Amour du jour by the end of the week will perish and must be thrown away. Vijay wants to help its restaurants that are split between two opposing decisions:

- Ordering raw materials for making more gallons of Amour du jour can lead to more sales, but it can become costly due to the spoilage of the unused materials.
- Ordering raw materials for making a lower number of gallons of Amour du jour can prevent some costs due to materials spoilage, but it can lead to stockout and lost profits.

Vijay asks for help from your team with determining the orders for ingredients for the optimal number of gallons of Amour du jour per week.

### **YOUR MISSION!**

- Formulate the profit function for Vijay's ordering problem.
- What is the decision variable?
- Determine the optimal number of gallons of Amour du jour for which Amber must order raw materials each week to maximize the restaurant's profit. What is the optimal profit?