Optimization Model for Advertisement Decision

A Case of Cooperative Dairy

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The market trend, has a significant change over the years. The market is always fluctuating and industries need to put in continuous effort to sustain their position and dominate competition. For a product line industry it becomes more important to create brand awareness and gain loyalty of their customer to minimize threat of new entrants. Brand awareness also plays a vital role in expansion of the product line and building new customer. Advertisement modes hence are an essential tool that would help an industry to reach out to its existing and potential customers. This paper designs and builds an operational model for media mix determination for cooperative dairy. The recommended advertising plan is determined via optimization technique in order to balance the key issues of size-of-audience reached versus advertising budgets.

Keywords—Advertisement Decisions; Optimization; Media Mix

I. INTRODUCTION

The dairy market in India is very competitive with one major private brand having a major market share and this result in the other dairies striving hard to sustain. Similar is the case for this cooperative dairy. The study focuses on the dairy, which is facing challenge to increase its sale and build a brand image. In a research conducted by the authors a Quality Function Deployment (QFD) method was applied and it provided three very important areas like marketing strategies, collection-distribution time. The research concluded that dairy such as this have a comparative product but their incompetent marketing skills leads them into losing customer and declining value chain. The paper therefore stresses on uplifting the brand image of this dairy using advertising medium and incorporating optimization model to bring down annual marketing budget as well.

Advertising can be done through various media options available such as print media or electronic media. Planning for a suitable media is of prime concern for any marketing manager as it influences the use of time and space to achieve advertising objectives such as placing an advertising message at right place and at right time before a target audience. This involves selecting an appropriate advertising media and development and allocation of the suitable advertising budget to these media. On the other side, types of media, number of products to be advertised, expected customer increase rate of the company’s major products, the frequency of advertisements, etc. are various factors that determine the allocation of the firms’ advertising budget. Research in the field of media selection and allocation began with work of Bass & Lonsdale (1966) who explored the use of linear programming in media selection. In particular they examined the influence of various methods of weighing the audience data to be used in linear program [1]. Bass and Lonsdale (1966) provide operational details of the application of linear programming to advertising media selection. The influence of weighting systems used to adjust audience data and various restraint systems is examined with actual data as inputs [1]. Costa, et al. (2001) applied QFD for food industry and concluded that QFD (in its standard format) seems to be more suitable for
food ingredient and food packaging than for food manufacturer [2]. Costa, et al. aims to describe the use of QFD in context of food industry and to discuss its benefits, drawbacks and challenges for QFD’s application in food R&D industry [2]. A linear programming approach for determining optimal advertising policy was based on the seminal works done by Mesak and Zhang (2001). He proposes an advertising model which can capture the advertising wear out phenomenon. The aim was to derive an optimal pulsation advertising strategy. Mihiotis and Tsakiris (2004) reviewed the recent study related to advertising planning. The study discussed the best possible combination of placements of a commercial (channel, time, and frequency) with the goal of the highest rating subject to constrained advertising budgets. The objective is to maximize the expected number of customers while adhering to advertising budget. They also provide with the constraints that need to be considered when formulating the model [3]. U. K. Bhattacharya (2009) developed a chance constraints goal programming model for the advertising planning which has been designed to decide the number of advertisement in different advertising media and the optimal allocation of the budget assigned to the different media [4] Since the amount of available budget is limited and fixed, it is desired to spend the available budget judiciously so as to obtain maximum exposure for all the products that needs to be advertised in different market segments[5]. The research of Iha and Aggarwal (2012) helps in understanding multi-objective media planning model for multiple media under a segmented market [6]. Kuo Chun-Min, et al. (2014) used Kano model integrated with QFD and to analyze the quantitative data used the software Statistical Package for the Social Sciences (SPSS). They concluded that for health, food firms must pay attention to natural ingredients in products and provides safety tests and scientific proofs of effectiveness. Also the prices of products are closely associated with consumers’ economic capability [10]. The vast research in the field of advertisement budget allocation fails to prove solution in the case of this cooperative dairy as the major shortcoming of budget and fewer media option makes it a challenging problem to overcome. The paper therefore provides simple revenue generating advertisement model to meet the minimum budget constraint. Also it provides platform to further research wherein advertisement and revenue generation could go complement each other more effectively.

The aim of the research is to promote the cooperative dairy among masses that forms its potential customer. The research works are either theoretical concept based on certain hypothesis or in case of a pragmatic research the limitations are minimum and therefore it has liberty to exercise novel methods. The cooperative dairy under consideration in this paper has a lot of hurdles to initiate any new reforming action, advertising and promotion in this case. Considering the factors the model sole purpose is to create awareness about the cooperative dairy and uplift its degrading brand image. It doesn’t aim to benchmark or supersede competitions in market. The reason being that unlike the cooperative dairy, the other market leaders don’t have any resources shortcoming. The financial structure of company is poor and it is undergoing a terrible loss. Therefore only a limited budget is sanctioned for promotion. This means that only a selective mode of advertising could be used that are feasible under the given budget. The idea initiated behind the advertisement is to act locally. The company caters the demand of only nearby areas and therefore we aim to promote it to the same. This is done in order to prevent the over expenditure of budget. Also the consumer behavior and market segmentation is easy for the company to analyse utilizing minimum resources. Expanding the model to a bigger circle would involve high amount of risk that the dairy is not willing to take.

Being a government owned dairy the process of cash flow to meet advertising budget is complicated. To get approval the model must prove its value by depicting minimum cost expenditure and getting maximum exposure. This problem was initially solved by expert opinion it wherein it was suggested that the since areas of target customer and target market is a small town therefore only the traditional means of advertising should be used. This includes newspaper, pamphlets, billboard, camps and booths. Any technical advanced medium such as digital marketing will require large amount of investment and its success is highly doubtful. The optimization model used here is a practical possibility for the dairy as it meets all the internal challenge. One of the unique point in this model is that the possibility of having sales of specific product has also been considered to attain a twofold objective from a market segment vis-à-vis revenue generation and promotion Its success will lead into the next step of the research wherein the aim is to explore the market for meeting the competition and incorporating innovative methods of advertising such as digital marketing and mobile vehicle advertisement.

II. MODEL DEVELOPMENT

The following section develops and formulates a media planning model for multiple media in different market segments. The objective is to maximize the expected number of customers while adhering to advertising budget. The market data and advertisement cost of different channel was inquired and tabulated to understand an overview of market scenario. The different market segment is discussed below:
A. Malls

The city has 4 major malls that are situated at prime location. Based on the crowd attraction the mall situated in centre of city was preferred. This mall sees a footfall of an average 90,000 people per month. This data was extracted and approximated based on movie shows and entry tickets.

B. Ghats

The city has main attraction in Ghats which is also a tourist spot. The Ghat has a footfall of around 2.5 million people per month. This data was extracted and approximated based on Regional UP tourism office Varanasi.

C. Schools

A missionary school with a population of 8,000 was considered. The data was extracted from school website.

D. Hospitals

Government hospital situated in B.H.U is the largest public hospital that has a footfall of around 1,34,000 people per month. This data was extracted from hospital’s survey report published on its website and approximated.

E. Residential Compound

The Diesel Locomotive Works is a government plant that manufactures railway engines and in its campus has residential quarters to facilitate its employees. Around 15,000 residents are living in these quarters as per the information provided on DLW website. This data was extracted and approximated.

F. Railway Station

The Varanasi cantonment railway station is one of the busiest public places in the city. By conducting a pilot study at three different time of the day and counting the persons in the queue of ticket counter, the approximated static population was found as 1, 80,000 per month.

The prerequisite data that was collected is summarized as given in the table I. ** All cost is in Indian Rupees.

### TABLE I: DESCRIPTION OF DIFFERENT MARKET SEGMENTS AND THE ADVERTISING COST

<table>
<thead>
<tr>
<th></th>
<th>Malls</th>
<th>Ghats</th>
<th>School</th>
<th>Hospital</th>
<th>Residential Compound</th>
<th>Railway Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>[BLB]</td>
<td>8000</td>
<td>8000</td>
<td>8000</td>
<td>8000</td>
<td>8000</td>
<td>8000</td>
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<tr>
<td></td>
<td>[320/1000 exposure]</td>
<td>[114/1000 exposure]</td>
<td>[121/1000 exposure]</td>
<td>[120/1000 exposure]</td>
<td>[44/1000 exposure]</td>
<td></td>
</tr>
<tr>
<td>[NEW]</td>
<td></td>
<td></td>
<td></td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[182/1000 exposure]</td>
<td>[1200/1000 exposure]</td>
<td>[67/1000 exposure]</td>
</tr>
<tr>
<td>[PAMP]</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>[120/1000 exposure]</td>
<td>[43/1000 exposure]</td>
<td>[750/1000 exposure]</td>
<td>[45/1000 exposure]</td>
<td>[17/1000 exposure]</td>
<td></td>
</tr>
<tr>
<td>[CAMP]</td>
<td></td>
<td></td>
<td>10000</td>
<td>1000</td>
<td>1000</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[2500/1000 exposure]</td>
<td>[152/1000 exposure]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[BOOTH]</td>
<td>12000</td>
<td>5000</td>
<td>4000</td>
<td>6000</td>
<td>10000</td>
<td>5000</td>
</tr>
<tr>
<td></td>
<td>[480/1000 exposure]</td>
<td>[71/1000 exposure]</td>
<td></td>
<td></td>
<td>[28/1000 exposure]</td>
<td></td>
</tr>
<tr>
<td>Min Exp</td>
<td>2500</td>
<td>7000</td>
<td>4000</td>
<td>6000</td>
<td>10000</td>
<td>18000</td>
</tr>
<tr>
<td>Max Exp</td>
<td>120000</td>
<td>32000</td>
<td>8000</td>
<td>20000</td>
<td>15000</td>
<td>190000</td>
</tr>
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<td>Ad Cost</td>
<td>23000</td>
<td>16000</td>
<td>13000</td>
<td>23000</td>
<td>15000</td>
<td>28000</td>
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<tr>
<td>Revenue</td>
<td>7500</td>
<td>7000</td>
<td>12000</td>
<td>6600</td>
<td></td>
<td>18000</td>
</tr>
<tr>
<td>Final Adv Cost</td>
<td>15500</td>
<td>9000</td>
<td>1000</td>
<td>16400</td>
<td>15000</td>
<td>1000</td>
</tr>
</tbody>
</table>
The table shows the cost of each channel of advertisement at each market segment. The type of market determines the type of channels that would be effective. The possibility of having sales of specific product has also been considered with the assumption taken at minimum profit of 2 INR per sale and 5% of average exposure to be the total customers to avoid any misjudgments. The assumption was done by pilot study conducted on the booth vendors selling consumable goods and brainstorming session.

Notations

Decision Variables:

BLB$_i$ = cost of advertising via Billboard in market segment $i$; where $i=1,2,4,6$.

NEW$_i$ = cost of advertising via Newspaper in market segment $i$; where $i=4,5,6$.

PAMP$_i$ = cost of advertising via Pamphlets in market segment $i$; where $i=1,2,4,5,6$.

CAMP$_i$ = cost of advertising via Camps in market segment $i$; where $i=3,4$.

BOOTH$_i$ = cost of advertising via Booths in market segment $i$; where $i=1,2,6$.

UX$_i$ = useful exposure in market segment $i$; where $i=1,2,3,4,5,6$.

COST = total amount spent on advertising.

USEFULX = total useful exposures.

Budget Constraints:
The dairy has an annual budget of 400000 INR devoted towards advertising and promotional activities. Based on the advertisement cost and total modes of advertising a minimum cost of 130000 INR per month was fixed. This cost is at the lower threshold for advertising at six prime spots in the city. This cost is exclusive of the revenue generated by installing small outlets for selling products simultaneously.

III. METHODOLOGY

The model formulation must provide a satisfying mix of advertising media expenditures that meet the maximum useful exposure objective, while adhering to the limitations of media resource availability in a segmented market. The problem of maximizing the total advertising reach using different modes of advertising can be written as a multi-objective programming problem involving different modes of advertising under different market segments. There will be two main sets of constraints.

1. Exposures in a market $\geq$ minimum required + useful excess exposure beyond minimum.
2. Useful excess exposures in a market $\leq$ saturation level + minimum required.

Maximize:

$$Z= UX_1 + UX_2 + UX_3 + UX_4 + UX_5 + UX_6;$$

Subject to:

- $$COST \leq 130000; \sum_{i=1}^{2} BLB_i + BLB_4 + BLB_6 + \sum_{i=4}^{6} NEW_i + \sum_{i=1}^{6} PAMP_i + \sum_{i=3}^{6} CAMP_i + \sum_{i=1}^{2} BOOTH_i + BOOTH_6 = COST;$$
- $$UX_1 + UX_2 + UX_3 + UX_4 + UX_5 + UX_6 = USEFULX;$$
- $$320 * BLB_1 + 120 * PAMP_1 + 480 * BOOTH_1 - UX_1 \geq 25000;$$
- $$114 * BLB_2 + 43 * PAMP_2 + 71 * BOOTH_2 - UX_2 \geq 70000;$$
- $$750 * PAMP_3 + 2500 * CAMP_3 - UX_3 \geq 4000;$$
- $$121 * BLB_4 + 182 * NEW_4 + 45 * PAMP_4 + 152 * CAMP_4 - UX_4 \geq 66000;$$
- $$1200 * NEW_5 + 300 * PAMP_5 - UX_5 \geq 10000;$$
- $$44 * BLB_5 + 67 * NEW_5 + 17 * PAMP_5 + 28 * BOOTH_5 - UX_5 \geq 18000;$$
- $$BLB_1 + BLB_2 + BLB_3 + BLB_6 \leq 32000;$$
- $$NEW_4 + NEW_5 + NEW_6 \leq 36000;$$
- $$PAMP_1 + PAMP_2 + PAMP_3 + PAMP_4 + PAMP_5 + PAMP_6 \leq 18000;$$
- $$CAMP_3 + CAMP_4 \leq 20000;$$
- $$BOOTH_1 + BOOTH_2 + BOOTH_6 \leq 22000;$$
- $$UX_1 \leq 95000; UX_2 \leq 25000; UX_3 \leq 4000; UX_4 \leq 134000; UX_5 \leq 10000; UX_6 \leq 10000;$$
- $$BLB_1 > 0; BLB_2 > 0; BLB_4 > 0; BLB_6 > 0;$$
- $$NEW_4 > 0; NEW_5 > 0; NEW_6 > 0;$$
As depicted in the Table II for a cost expenditure of 72900 INR the products get an exposure of 278000 people. The advantage of this model is that the approximation of exposure and revenue generation is done at minimum level and therefore if correction is applied it will provide with an increased value of exposure and revenue generated. This will have two fold profit of increased viewership of the brand and lower cost expenditure. While this optimization has been done above only for two parameters of interest and one quarter, it could be undertaken for any/all of the parameters around which the model is built.

IV. CONCLUSION & FUTURE SCOPE

The purpose of the advertising portfolio model was to discover the optimal mix of media alternatives to maximize exposures and minimize the existing budget. The media sources used for this model were all sources with which the consumers of dairy products were already familiar. Further research could be done to investigate other media alternatives available in the area, including television, email, and direct mail advertising. It may also be worthwhile create model at more microscopic level with additional data. This could be for example a block wise advertisement and revenue generation model that would help in identifying the most profitable areas in city for the dairy industry [4]. Also incorporating questionnaire would give incite on type of product consumed for different demography and thereby help in assisting new product launch. Optimization modeling has seemingly endless potential for developing and solving models that can assist in making optimal business decisions [3]. The dairy industry being state governed industry has only begun to link its relatively recent open attitude regarding advertising with optimization techniques that can assist in promoting its brand. Yet the financial crunch and the complicated paper work and cash flow are major hurdles in the path. The idea of generating revenue at site of advertising is a hope that would persuade the decision makers to involve in such practices. Yet the consumer behavior is one thing that should be taken into account to evolve this practice on further levels. The ‘prognosis is good’ for a contributing role for advertising in this professional product line industry.

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