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Operational Research Techniques for Revenue Management

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Abstract:- Linear Programming (LP) is the mathematical technique for best allocation of scarcity of resources, such as labour, material, machine, capital, energy and so on, to manage revenue among several regular activities, such as items to produce, services to produce such items, jobs, latest equipments, projects, and so on, on the basis of a given situation of optimality. For the developments and application of specific operational research techniques to capture high revenue among several options of action available, which will include numerical values, linear programming as a tool of operations research which may be used where there is a need to formulate a mathematical model to represent the problem. This paper is an insight into how LP can be made use of in the production industry too, where the demand has been so much in India. A typicaloptimization case has been tried to solve and obtain an optimal solution for revenue management in anPackage Drinking Water Production Industry.

***Keywords:-*Revenue Management, Operational Research (LPP), Simplex PHP, Matlab Mathematics Subject Classification (2013):-Primary: 90B50, Secondary: 90C05.**

I. INTRODUCTION

Industries or companies focus on implementing successful operational techniques in order to optimize their efficiency which helps to increase profitability. Revenue Management is such a technique that helps big or small firms and medium production companies to achieve highest profits by correctly identifying need of the customer that the company has to serve, keeping the right quantity of products and services as well as setting up the optimal prices to be offered to these customers. Therefore, this paper attempts to bridge this gap by explaining the steps necessary to undertake for the Revenue Management implementation, together with overview the risks involved in the process of the implementation of RM. The following research questions were formulated in order to identify how Revenue Management can be implemented using operational research (OR). Finally, developments in the field of Revenue Management will continue as long as the technology develops further and it is important to follow constantly and carefully this developments to keep our self up to date.[1] Without applying new ideas and without facing risks behind new ideas, no company would be able to achieve anything or make a profit. This statement motivates our paper, as it also applies to Revenue Management (RM) systems. This paper provides an overview of uncertainties and risks affecting RM. So we propose a new approach for a methodical allocation of these topics that is Operational Research (OR) for Revenue Management (RM). Revenue management aims to maximize a company's revenue by optimally allocating customer requests to a limited capacity. The airline industry strives to perfect this technology and still constitutes RM's most important application area. Therefore, the overall structure of this paper follows the process of revenue management of industry producing package drinking water. The approaches proposed are considered as applying to OR, although some research contributions and applied methods are related to other industries.[2]

II. PURPOSE BEHIND THE PAPER

The need behind this study is to help managers and management team of the firms to develop maximum effectiveness in their present and future work for revenue management. It also means that revenue management in industry is a going on process so it needs some extra help of techniques from operational research, which provide a report that how Ashirvad Beverages apply linear programming techniques to manage its revenue. The basic question arises during application of OR (Operational Research on RM (Revenue Management).

1. Is the current method which we use for revenue management gives optimal output?

2. Is the resource available with us for applying linear programming is sufficient for revenue management?

III. WHY SUCH CONCEPT INITIATED (LITERATURE REVIEW)

If we consider meaning for Revenue Management is Yield Management. This name is the traditional airline term. However, there are some differences between Revenue and Yield Management. One of these differences is that Revenue Management is more logical and Yield Management is more practical. Another difference is that Revenue Management is applicable in a wide area, Yield Management is not as much as in demand compare to Revenue Management.[1] Let's see

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the history of RM and some of the basic concepts. Most of the people say correctly that there is nothing new about revenue management. Anyone selling his or her regular product knows that you need to flex your pricing in accordance with demand, lead time, competitors and a host of other factors. Hotel rooms, airplane seats, advertising time, fresh produce and winter clothing are all come under the concept of revenue management tactics. Revenue management as a formal discipline has its origins in the domestic American airline industry of the 1970s. Established, regulated airlines were threatened by unregulated charter competitors. American Airlines (AA), led by the legendary Bob Crandall, sought to cut the charters off at the pass. AA did so successfully with advance purchase restrictions on deeply discounted fares. Thus was born yield management (YM), the precursor to today's revenue management. AA and other airlines refined and extended their YM capabilities during the early years of deregulation, ultimately giving them the ability to price every seat on every flight for maximum value, selling low cost seats to price-sensitive travelers (usually the leisure segment) and high-cost seats to time-sensitive travelers (usually on business). The impact and benefit of these capabilities became transparent to all observers by the end of 1985, when AA reported 48 percent profit growth on 14.5 percent revenue growth, while low-cost competitor People'sExpresswas regular customers and cash. These financial results and the overwhelming competitive advantage attracted a great deal of attention from many industries. Cruise lines, car rental agencies and hotel companies started to evaluate the benefits of adopting YM as a business strategy. Early adopters in the hotel space included Marriott International, Holiday Inns Worldwide (now InterContinental Hotels Group), Hilton Hotels Corporation and ITT Sheraton. Organizations with centralized information systems and management structures adopted centralized systems. More decentralized organizations sought property-based systems.[4] Operations Research (OR) is a mathematical approach to analyzeany problems and making decisions. OR professionals aim to provide core bases for decision-making by understanding the depth of situation and prepare models for tough situations, and to use such models to predict system behavior and improve system performance. Such models can give rid of risk arising from work based on guess. Hence, any manager, while taking decisions, considers all aspects in addition to economic aspect, to make his solutions useful in every respect. Management problems can also be solved using quality as well as quantitative approach and such approach requires that problem has to properly defined and thoroughly study. Such procedure includes collecting data, information and then solving the problem ina systematic way, based on analysis rather on random guess work, or using trial and error methods. Operations research is primarily concerned with helping managers and executives to arrive at better decisions. [5]

IV. METHOD TO BE APPLIED

A typical mathematical problem consists of a single objective function, representing either profits to be maximized or costs to be minimized, and a set of constraints that describe the decision variables. In case of a linear program (LP), the objective function and constraints are linear functions of the decision variables.

Objective Function (Maximize or Minimize)

$$Z=C_1X_1 + C_2X_2 + \cdots \ldots \ldots \ldots . + C_nX_n$$

Non-Negative Linear Constraints

$$a_{11}X_1 + a_{12}X_2 + \cdots \ldots \ldots . + a_{1n}X_n (\leq or \geq) b_1$$

$$a_{21}X_1 + a_{22}X_2 + \cdots \ldots \ldots + a_{2n}X_n (\leq or \geq) b_2$$

$$a_{m1}X_1 + a_{m2}X_2 + \cdots \ldots \ldots . + a_{mn}X_n (\leq or \geq) b_m$$

Linear programming is widely used in mathematical model that can solve various problems with thousands of variables. Generally, the feasible values of the decision variables are limited base on a set of constraints that are described by mathematical functions of the decision variables. For a linear program, the objective functions and constraints are required to be linearly related to the variables of the problem.[7]

DECISION VARAIBLES:-Are products called 20 liters water cans, 1 1litre water bottles and 250ml water pouches which has to be produced by Ashirwad Beverages. It is represented by C, B, and S. respectively. These variables are used in the model formulated, to calculate optimum number of batches that has to be produced to maximize the profit.

OBJECTIVE FUNCTION:- In anykind of business set up , the main aim is to minimize the cost or maximize the profit and in this case, it is a problem of maximizing the profit because the cost of production of all the above mentioned products includes worker's salary, raw material etc.So our main objective is to obtain optimum number of batches to be produced of each product mentioned above so that we can maximize profit and can manage our revenue.

CONSTRAINTS:-As per given situation constraints are employee P's, Q's, R's working hours, raw material to produce minimum batches of cans and pouch and less

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profit from production of bottle. Maximize: Z =C_1C+ $C_2B + C_3S$, whereC_1, C_2 and C_3 is profit in rupees per batch made by company on selling it and it is 600rs, 120rs and 320rs for 20ltrs. Water cans 1ltr. Water bottle and 250ml water pouch respectively.

V. ASSUMPTIONS FOR THE MODEL

Assume that the manager of Ashirwad Beverages that sells three types of water containers: 20ltrs. cans, 1ltr. bottles and 250ml pouch. In company three groups of an employee are working P, Q, and R, each group contains 5 members .Making one batch of 20ltrs. cans require 2hrs. of an employee P's time, 3hrs. of an employee Q's time and 1hr. of employee R's time. . Making one batch of 1ltr. bottles require 1hr. of an employee P's time, 2hrs. of an employee Q's time and 3hrs. of employee R's time. Making one batch of 250ml pouch require 3hrs. of an employee P's time, 1hr. of an employee Q's time and 2hrs. of employee R's time Employee P, Q and R works 10 hours a day. There is a lots of demand of 20ltrs. cans and 250ml pouch , so company has also decided to keep inventory of raw material for both products in such a way that at least 4 batches of 20ltrs. cans and 2 batches of 250ml pouch has to be produced per day and company is not earning much profit on per batch of 1ltr.bottle so sometimes it is not necessary to produce batches of bottles. Let us denote 20ltrs cans by C, 1ltr. Bottle by B and 250ml pouch by S.[6]

VI. REASERCH MODEL

Maximize: Z =$600C$ + 120B+ $320S$

Subject to constraints:

$2C+3B + S \leq 10(Employee\ P's\ time)$

$C+2B + 3S \leq 10(Employee\ Q's time)$

$3C+B + 2S \leq 10(Employee\ R's\ time)$

$C \geq 4(Raw\ material for\ 20ltrs\ cans)$

$B \leq 2(\text{Less Profit})$

$S \geq 2(Raw\ material for\ 250ml\ pouch)$

$C \geq 0, B \geq 0, S \geq 0$

VII. OUTCOME OF MATLAB

```
f = [600; 120; 320]
A = [2 3 1
     1 2 3
     3 1 2
     -1 0 0
     0 1 0
     0 0 -1 ]
b = [10; 10; 10; -4 ; 2; -2]
lb = zeros(3,1)
linprog(f,A,b,[],[],lb)
 A =

    2    3    1
    1    2    3
    3    1    2
   -1    0    0
    0    1    0
    0    0   -1
b =

   10
   10
   10
   -4
    2
   -2
lb =

    0
    0
    0

ans =

    3.9634
    0.0000
    1.9817
```

VIII. RESULTS

The model was analyzed using computer software MATLAB (R2009a-32 bit). The results are in the form of an integer optimum solution. The integer optimum solution is obtained because of more calculations of decision variables so we rounded off to get fix number of batches. The results from this model shows that the optimumnumber of batches for 20ltrs cans, 1ltr bottle and 250ml pouch are 4, 0 and 2 respectively, sometimes we can get many solutions but we have considered one of them which resulted optimum value Z=3040rs.[6]

IX. CONCLUSION

The objective of this study is to apply the operational research techniques for revenue management at Ashirwad Beverages. Following research uses the different kind of variables in the form of employee's time, different kind of water containers and analysis was carried out using computer software MATLAB (R2009a-32 bit).Same model with minor changes can be used for further reference. Results that we obtained by using other LPP methods are not unique for above model, then also this model can be adjusted to give an optimum solution by increasing or decreasing numbers of conditions for production to achieve the desired objective.

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