Study of LPP to identify Optimal Production Mix in “Ready to Eat” Snacks Factory

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Abstract - This case is the practical implication of widely known LPP technique to produce optimum product mix for maximum profit. It analyzes the various process various time for different products, manufactured in the RTE snacks (namkeen) factory in Greater Noida, India. The research is about to know – how much of a specific product should be produced in a given production capacity to get maximum profits. Simulation software provided by “LINDO” is used to analyse the formulated problem and give the optimal solution for maximum profit in the organisation. The problem formulation were subjected to various input conditions in namkeen manufacturing process including peeling, boiling, dough making, mixing and frying to produce four basic items namely Nutmut Nimbu, Punjabi Pun, Aloo Bhujia and Crnhy Muchy with the reference variable as A, B, C and D respectively. The study and simulation identified that a production mix of 6.1% of Nutmut Nimbu, 2.5% of Punjabi Pun, 79.1% of Aloo Bhujia and 12.2% of Crnhy Muchy is to be produced for optimum profit of INR 1,41,128. The solution of the formulated problem suggested that we should produce 17 batches of Nutmut Nimbu, 7 batches of Punjabi Pun, 220 batches of Aloo Bhujia and 34 batches of Crnhy Muchy for optimum process production to give the optimum profits.

Key words – Linear programming, optimization, feasibility range, optimal solution, product mix.

I. INTRODUCTION
“Rate of production and amount of production to be produced is directly proportional to production efficiency. And production efficiency is a concern of every manufacturing unit.”

Production efficiency is defined as the ratio of output produces and per unit of inputs. But sometimes higher production efficiency does not lead to higher productivity. And the major concern of any company is the net gain of productivity. The most common measure of productivity is the “profit”, which shows the net production efficiency & productivity of any production system [1, 2].

It becomes really tough to identify the level of production of different products at varying demand. The choices of consumer vary significantly with time, taste, region and season. So it became necessary to meet the market demand keeping in mind the optimum production mix and schedule.

Also, in the real industry scenario of India, profit margins are proliferating because of the presence of large number of competitors and price discrimination. The profit margin of any company and the net price of product are very much influenced by the strategy of the competitors.

But, nevertheless, with high variation of market demands, availability of raw material and other resources, LPP plays a vital role in estimating the peripheral optimum production rate and product mix. This study gives the broader picture of “how much to produce” for the profit increment on different product mix.

In this study we have tried to identify the optimum production of different product items viz. Nutmut Nimbu, Punjabi Pun, Aloo Bhujia and Crnhy Muchy. So they can give the maximum profit to the company. The main aim of the study includes the forecasting of the optimum production mix per batch to maximise the profit and optimise the use of inputs.

II. DATA SOURCE AND VALIDATION
The source of data is the company from food industry known for its vibrant taste, and wide range of products. The company manufacture wide varieties of RTE snacks i.e. Namkeen. Company is available with 42 variant of namkeen but only four of them are chosen for study. These four products are Nutmut Nimbu, Punjabi Pun, Aloo Bhujia and Crnhy Muchy. These are the star product of the company which are being produced in bulk and uses the major portion of the factory resources.
The data collected has taken a lot of efforts, study and calculation to come with tangible figures. And this study becomes more difficult in food production industry, due to the presence of external factors.

The four products use five production machines for value addition and deliver the desire product. These machines are potato peeler, boiler, dough maker (malli-maker), mixer and fryer.

In factory Greater Noida, India, has a huge infrastructure to produce 70 tons of RTE snacks per day. The data collected is for one batch (60 kgs) whose processing time is calculated in seconds in most of the machines. The factory got multiple machines of same processing. Hence they add up to give a high production capacity.

Data collected from the factory shows that this plant have the capacity of 1,44,000 seconds of potato pilling, 72,000 seconds of boiling, 64,800 seconds for dough making (malli making), 1,44,000 seconds for mixing and 1,87,200 seconds for frying.

Now, information regarding the capacity utilized by each variant to produce one batch is given as:

a) The Nutmut Nimbu utilizes 260 seconds of potato peeling, 194 seconds of boiling, 15 sec of dough (malli) maker, 741 sec of fryers and 300 sec of mixing.

b) Punjabi Pun utilizes 234 seconds of potato peeling, 180 seconds of boiling, 15 sec of dough (malli) maker, 689 sec of frying and 240 sec of mixing.

c) Aloo Bhujia utilizes 222 seconds of potato peeling, 159 seconds of boiling, 60 sec of malli maker, 600 sec of frying and 300 sec of mixing.

d) Crnhy Muchy utilizes 251 seconds of potato peeling, 194 seconds of boiling, 15 sec of dough (malli) maker, 1099 sec of frying and 300 sec of mixing.

The expected profit from the batch of Nutmut Nimbu is INR 421, for Punjabi Pun is INR 397, Aloo Bhujia is INR 539 and Crnhy Muchy is INR 360.

Other then, this company has a policy to produce minimum number of batches of each product. So we need to produce at least 17 batches of Nutmut Nimbu, 7 batches of Punjabi Pun and 34 batches of Crnhy Muchy in a whole production day.

III. FORMULATION OF THE PROBLEM

The formulation of the problem is depicted by Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Potato peeler</th>
<th>Boiler</th>
<th>Dough Maker</th>
<th>Frying</th>
<th>Mixing</th>
<th>Profit (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutmut Nimbu</td>
<td>260 sec</td>
<td>195 sec</td>
<td>15 sec</td>
<td>742 sec</td>
<td>300 sec</td>
<td>421</td>
</tr>
<tr>
<td>Punjabi Pun</td>
<td>234 sec</td>
<td>181 sec</td>
<td>15 sec</td>
<td>689 sec</td>
<td>240 sec</td>
<td>397</td>
</tr>
<tr>
<td>Aloo Bhujia</td>
<td>222 sec</td>
<td>160 sec</td>
<td>60 sec</td>
<td>600 sec</td>
<td>300 sec</td>
<td>539</td>
</tr>
<tr>
<td>Crnhy Muchy</td>
<td>252 sec</td>
<td>194 sec</td>
<td>15 sec</td>
<td>1099 sec</td>
<td>300 sec</td>
<td>360</td>
</tr>
<tr>
<td>Total capacity</td>
<td>144000 sec</td>
<td>72000 sec</td>
<td>64800 sec</td>
<td>187200 sec</td>
<td>144000 sec</td>
<td></td>
</tr>
</tbody>
</table>

IV. MATERIAL & METHODS

The formulated problems aim the idea of giving the optimum product mix. The formulated problem is solved using simplex problem [3]: by considering A, B, C, D as non basic variables.

As the objective function is needed to maximize, so these variable are placed in objective function as:

Maximize \[ 421A + 397B + 539C + 360D \]

Where A signifies Nutmut Nimbu
B signifies Punjabi Pun
C signifies Aloo Bhujia
D signifies Crnhy Muchy

This objective function is subjected to:
260 A + 234 B + 222 C + 251 D <= 144000
194 A + 180 B + 159 C + 194 D <= 72000
15 A + 15 B + 60 C + 15 D <= 64800
300 A + 240 B + 300 C + 300 D <= 144000
741 A + 689 B + 300 C + 1099 D <= 187200
A >= 17
B >= 7
D >= 34
A, B, C, D >= 0

The software uses this equation with the other requisites like slack variables to eliminate inequalities and solve the problem.

V. SIMULATION

This problem is processed by the “Lindo” software.

About the software [4]-

Classic LINDO

Classic LINDO's simple interface and straightforward model expression style make it easy to learn and use. Classic LINDO is appropriate for building and solving moderately sized linear and integer models.

The syntax of the problem is shown in the screen shots shown by Fig. 1.

I. RESULT & DISCUSSION

Fig. 2 shows the recommended optimum product mix by the “Lindo” software.
The number of iteration required to solve the problem and give the optimum solution is 4.
The above screen shot shows that software has recommended the following product mix which is given in Table 2.

<table>
<thead>
<tr>
<th>Item</th>
<th>No. of batches</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17</td>
</tr>
<tr>
<td>B</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>220</td>
</tr>
<tr>
<td>D</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 2: Optimum Production Quantity

The analysis of above table shows that the factory should produce
17 batches of Nutmut Nimbu (NN) \((17 \times 60 = 1020 \text{ Kgs})\)
07 batches of Punjabi Pun (PP) \((7 \times 60 = 420 \text{ Kgs})\)
220 batches of Aloo Bhujia (AB) \((220 \times 60 = 13200 \text{ Kgs})\)
34 batches of Crnhy Muchy (CM) \((34 \times 60 = 2040 \text{ Kgs})\)

VI. CONCLUSION
We had tried to identify the optimum production of different product items viz. Nutmut Nimbu, Punjabi Pun, Aloo Bhujia and Crnhy Muchy so that they can give the maximum profit to the company. The main aim of the study includes the forecasting of the optimum production mix per batch to maximise the profit and optimise the use of inputs. This production mix will yield the maximum profit of Rs 1,41,128 per day.

VII. ASSUMPTIONS
1. The capacity of each process & machine is considered without any loss. We are considering that all processes will work without any major breakdown.
2. The profit margin is calculated on the basis of data provided by Sales & Accounting team which is subjected to variation.
3. The efficiency of the system is considered to be optimum enough to meet the above formulation.
4. The machines are considered to be used for production these four items only, and no other item is processes on these machines during a day.
5. The production system is considered to be free from the constraints of market demands & inventory needs.

VIII. REFERENCES