CHAPTER - IX

MARKET SEGMENTATION DECISION SYSTEM-V : RETAIL OUTLET LOCATION MODEL

9.1 INTRODUCTION

The retail outlet location is a dominant factor in the success or failure of the company in any market segments. The retail outlet location involves a commitment of resources and services to a long-range plan for particular market segment. Location of retail outlet decision involves greater significance, because these plans represents the basic strategy for assessing market segments and have significant impact in revenue, costs, and service levels to the customers satisfaction. The good location decision for retail outlet will have competitive advantage to others. The decision criteria for the location of retail outlet depends on availability of land, building, equipment, products, transportation facility, labour, and other utilities. Most important decision is to acquire new customers and to penetrate into existing market segments from location. If decision is not done considering such factors then there would be substantial loss of customers and heavy location cost of the retail outlet. The location decision depends upon customers paying capacity i.e., income level and usage rate of particular product in that market segment. And customer satisfaction level is utmost important decision to be considered in particular market segment for location site. The customer satisfaction depends on availability of wide variety of product and price range, easy availability, nearness to customers, credit facility and many more. In current situation of competitive market condition, it is not only essential the to produce right things but also it is important that the product to be available to consumers in their own locality easily. The retail outlet location problems for dairy products can be formulated with the criteria of maximising revenue and customer satisfaction level at minimum cost.

The present study is based on the dairy products market in Keonjhar district of Orissa state [India]. The study is about to make decision for location of new retail outlet for dairy products in each market segment and its viability. In dairy product retail outlet the standardised milk is the chief product for sale and therefore, requires daily distribution and be available close to locality of customers. Whereas other dairy products such as butter, ghee, milk powder, cheese, yogurt don’t require daily distribution and can be available in some distant retail out locations. Storage facility are utmost essential for milk and its products due to perishability or semi-perishability nature. Depending upon market potentiality in any segment, location of retail outlet is to be set up. In Keonjhar district dairy product retail outlet location are set up without any analysis or research of location problems. The present research points out that, firstly, market in any particular geographic segment is divided into customer zones i.e., market segments. Then grouping of customer has to be made on
basis of income level and usage rate of dairy products in relation to the location problem. The customer segments are formed for convenient has to identify the number of likely customer to new retail outlet. The existing competitive sites in the trade area are then identified along with their market sizes and customer preferences to each site to every customer market estimating of the number of customers served by each location site. Using the model, we select the market segment a new retail outlet to be located which could estimate the number of customers, revenue generation, cost involved and also level of satisfaction by customer etc..

9.2 RESEARCH METHODOLOGY

9.2.1 Research Purpose & Objective:

The present research is to determine which location site for retail outlet will be the best sales centre for dairy product in particular market segment. Considering the consumers to differ in one market segment, formation of certain market segments basing similarity in their characteristics such as income level, and usage rate is done. The market segments formed by customers attributes are incorporated for study of location site preferences. The retail outlet decision objective are defined by gathering information regarding location sites advantages and disadvantages and also market segment customer attributes combined with organisation's objectives. The primary objective of market segmentation based on retail outlet location is to increase the sales of dairy products. After deciding on location site the marketing managers should determine some acceptable levels of profits which may satisfy the organisation's objectives and also increase customer satisfaction from the retail outlet. And the third objective for location decision is to minimise the sum of all costs affected by location. In attempting to minimise costs, we should think not only of today's costs, but of long-run costs as well. The three objectives of the organisation are related to location site i.e., profit maximisation, cost minimisation and customer satisfaction maximisation to draw which location sites are best to the given market segments.

9.2.2 Information Collected

1. Milk and milk products available in Keonjhar district.
2. Number of retail outlets for dairy products available in Keonjhar district.
3. Types of dairy products available in retail outlet in particular market segments.
4. Number of competitors in the market segments for marketing of dairy products.
5. Cost associated with the location sites.
6. Customer satisfaction level from the location site for new retail outlet.
7. Revenue generation from different location site in different market segments.
8. Types of consumers and their characteristics such as income level and usage rate in particular market segment.
9. Size and characteristics of market and market environment.

9.3 MARKET SEGMENTATION BASED ON RETAIL OUTLET LOCATION

In the present study seven products are considered, which are sold to the same customer groups and marketed through the same channels. The seven items in product-line segments are as follows: fluid milk classified into three segments depending upon contents of fat and snf viz., double tone milk (1.5% fat and 9.0% snf), tone milk (3.0% fat and 5% snf) and whole milk (4.0% fat and 8.0 snf) and milk products considered are ghee, butter, flavoured milk and yogurt. Product-line makes the most sense when the each item performances its own sales and makes profits in their line and compares with competitors' product-lines.

The data collected from the district has been divided into two distinct geographic segments i.e., Rural and Urban. In the present context marketing mixes of milk and milk products greatly vary in rural and urban areas. Marketing channels is considered to be more significant in the marketing mix of milk and milk products and have greater distinction in rural and urban market segments. Most of the fluid milk is procured from rural areas and demand for fluid milk and milk products is largely (in terms of sales) in urban market comparison to rural market. The geographic segments selected by judgmental sampling after considering the geographic location, milk potential and transportation facilities.

For this study, further assumption are made regarding income groups in the Indian condition, segmenting the market on basis of level of income of consumers carries an outstanding significance as it varies with change in the regions or places. The income level of the households are assumed as Low Income Group (LIG) whose income is below or equal to Rs. 6000/- per month; Middle Income Group (MIG) whose income is between Rs. 6001/- to Rs. 12000/- per month and Higher Income Group (HIG) whose income is above Rs. 12001/- per month. The household size segment are on the basis of small household size having 1 to 2 persons, medium household size having 7 or more persons. The market segmented according to household usage rate as heavy users, medium users and light users according to average usage rate of household per month depicted in Table 9.1.
Table 9.1: Dimensions of households usage rate segments.

<table>
<thead>
<tr>
<th>Type of household usage segment</th>
<th>Fluid milk (double tone, whole milk)</th>
<th>Ghee</th>
<th>Butter</th>
<th>Flavoured milk</th>
<th>Yogurt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy</td>
<td>50 litres or more or more</td>
<td>5 kgs or more or more</td>
<td>2 kgs or more or more</td>
<td>20 litres or more or more</td>
<td>10 kgs or more or more</td>
</tr>
<tr>
<td>Medium</td>
<td>20 to 50 litres</td>
<td>2 to 5 kgs</td>
<td>1 to 2 kgs</td>
<td>10 to 20 litres</td>
<td>5 to 10 kgs</td>
</tr>
<tr>
<td>Light</td>
<td>less than 20 litres</td>
<td>less than 2 kgs</td>
<td>less than 1 kg</td>
<td>less than 10 litres</td>
<td>less than 10 kgs</td>
</tr>
</tbody>
</table>

In this segmentation approach following assumption are considered for marketing of milk and milk products. Raw milk supply in particular geographic segment will strongly be seasonal- there is more production of milk in summer than in winter. The daily orders do not vary much except periodic fluctuations in demand and supply of milk and milk products due to seasonal variation and during fairs and festivals seasons whose effect are easily predictable. The major factor for seasonal variations in milk production is due to incidences of calving of milch animals (Cow's and buffalo's) during different months. In present study seasonal variation marketing mix of milk and milk products has considerable effect and a year has been divided into half year and then into four quarters of seasons viz., spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). The study intends to collect data for demand and supply variation in different seasons basing on different geographic segments. Total Keonjhar market is divided into four different zones of markets called market segments such as North, South, East and West. And each market segment a new retail outlet location site is considered along with already existing retail outlets. For application aspect construction of the segmentation tree are done on a priori segmentation basis for retail outlet location shown in Fig. 9.1.

9.4 ALGORITHM

STEP 1 : Solve m linear programming problems of maximisation type stated as

Max \[ G_i(X) ; i = 1 \ldots m \]

Subject to

\[ A_j (\bar{X}) \leq b_j \]

\[ \bar{X} \in \{0,1\} \]

(9.1)
Let $X^i$ be the optimum solution which maximises the $i^{th}$ objective $G_i(X)$ given $g_i$ as its optimal value. The pay-offs on the other objectives at $X^i$ can be denoted by $g_{ji}$ signifying the value of $j^{th}$ objective $G_j(X)$ of the optimal point $X^i$ of the $i^{th}$ objective.

**STEP 2**: Construct a pay-off matrix $G$ given by

$$G = \begin{bmatrix}
g_{11} & g_{12} & g_{13} & \cdots & \cdots & g_{1m} \\
g_{21} & g_{22} & g_{23} & \cdots & \cdots & g_{2m} \\
\vdots & \vdots & \vdots & \ddots & \ddots & \vdots \\
g_{m1} & g_{m2} & g_{m3} & \cdots & \cdots & g_{mm}
\end{bmatrix} \quad (9.2)$$

Where the matrix can be referred to as decision matrix. The $k$ tuple $(g_{11}, g_{22}, \ldots, g_{mm})$ comprising the diagonal element of the matrix $G$ is the ideal point in the $m$ dimensional criterion space. Due to the conflicting nature of the objectives, this point usually does not lie in the feasible criterion space. Denote this point by $g^* = (g^*_1, g^*_2, \ldots, g^*_m)$ after replacing $g_i$ by $g^*_i$. The boundary point for the objective $G_j(X)$ can be obtained by taking the minimum of all $g_{ji}$ for $i \neq j$, $i = 1, \ldots, m$. Hence, for all $G_j(X)$, their boundary point can be taken as $g^*$.

**STEP 3**: 

1. Specify $P_{i}$ for each $G_i(X)$ : $i=1, 2, \ldots, m$.
2. Assign the maximum possible overall satisfaction $\beta_j \in [0,1]$, such that $1 = \beta_0 \geq \beta_1 \geq \beta_2 \geq \ldots \geq \beta_n = 0$.

Considering the objective $G_i(X) > b_i$ with tolerance $P_i$ for $G_i(X)$, divide the interval $[P_i, b_i]$ into sub-intervals $[q_{ij-1}, q_{ij}]$, $j=1,2,\ldots,N$, such that $P_i = q_{i0} \leq q_{i1} \leq \ldots \leq Q_{iN} = b_i$.

Construct a piecewise linear approximation $\mu_{G_i}(X)$ for the $i^{th}$ objective such that,

$$\mu_{G_i}(X) = \begin{cases} 
0 & \text{if } G_i(X) \leq q_{i,N} = P_i \\
\beta_j + [(\beta_j - \beta_{j-1})/(q_{i,j-1} - q_{i,j})](G_i(X) - q_{i,j}) & \text{if } q_{i,j-1} \leq Z_i(X) \leq q_{i,j} \\
1 & \text{if } G_i(X) \geq b_i \end{cases} \quad (9.3)$$
4. As it is needed to maximise the overall satisfaction, using the membership functions, using Zadeh's min-operator for aggregating the objectives; the problem can be modelled as:

Maximise \( \lambda = \frac{1}{2} \lambda_1 + \frac{1}{4} \lambda_2 + \frac{1}{8} \lambda_3 + \frac{1}{16} \lambda_4 + \frac{1}{32} \lambda_5 \)

S.t
\[
\begin{align*}
\mu_{Gi}(X) & \leq \beta_{j} \quad : \ i = 1, 2, \ldots m \\
A_i(X) & \leq b_j, \ j = 1, 2, \ldots l \\
X, \lambda_k & \geq 0 \quad : \ k = 1, 2, \ldots 5 \quad \ldots \quad (9.4)
\end{align*}
\]

(i) Determine the outputs using any appropriate algorithm or computer code.

9. The solution vector \( X^* \) associated with this computation stage in the final solution.

Numerical Example:

Let the Multi-Criteria Decision System involves 3 objectives which are conflicting and non-commensurable and at the same time are bounded by 6 rigid constraints. Mathematically, it may be given as:

Max A. \( 50x_1 + 70x_2 + 30x_3 + 75x_4 + 65x_5 + 40x_6 + 80x_7 + 70x_8 \)
Max B. \( 5000x_1 + 5000x_2 + 5000x_3 + 5000x_4 + 7000x_5 + 7000x_6 + 7000x_7 + 7000x_8 \)
Max C. \( 57.6x_1 + 99x_2 + 243x_3 + 205.8x_4 + 84x_5 + 128.7x_6 + 207.9x_7 + 205.8x_8 \)

S.t.
\[
\begin{align*}
1. & \quad x_1 + x_5 \leq 1 \\
2. & \quad x_2 + x_6 \leq 1 \\
3. & \quad x_3 + x_7 \leq 1 \\
4. & \quad x_4 + x_8 \leq 1 \\
5. & \quad x_1 + x_2 + c_3 + x_4 - x_5 - x_6 - x_7 - x_8 \leq 0 \\
6. & \quad x_1 + x_2 + c_3 + x_4 + x_5 + x_6 + x_7 + x_8 \geq 0 \\
7. & \quad x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 \in \{0,1\}
\end{align*}
\]

Now, all these objectives are kept at the same priority level. The maximum and the corresponding minimum for each of the objectives can be obtained from \( P_j \).

\[
P_j = \begin{bmatrix} 290 & 70 & 210 \\ 24000 & 7000 & 24000 \\ 596.7 & 205.8 & 661.5 \end{bmatrix}
\]

Now, basing on the points, we obtain the following set of piecewise linear membership functions as:

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\[ \mu_1 (Z_1) = 0 + \frac{50x_1 + 70x_2 + 30x_3 + 75x_4 + 65x_5 + 40x_6 + 80x_7 + 70x_8 - 70}{202 - 70} \]
\[ \mu_{11} (Z_1) = 0.6 + \frac{50x_1 + 70x_2 + 30x_3 + 75x_4 + 65x_5 + 40x_6 + 80x_7 + 70x_8 - 202}{290 - 202} \]
\[ \mu_2 (Z_2) = 0 + \frac{5000x_1 + 5000x_2 + 5000x_3 + 5000x_4 + 7000x_5 + 7000x_6}{17200 - 7000} \]
\[ \mu_{22} (Z_2) = 0.6 + \frac{5000x_1 + 5000x_2 + 5000x_3 + 5000x_4 + 7000x_5 + 7000x_6 + 7000x_7 + 7000x_8 - 17200}{24000 - 17200} \]
\[ \mu_3 (Z_3) = 0 + \frac{57.6x_1 + 99x_2 + 243x_3 + 205.8x_4 + 84x_5 + 128.7x_6}{479.2 - 205.8} \]
\[ \mu_{33} (Z_3) = 0.6 + \frac{57.6x_1 + 99x_2 + 243x_3 + 205.8x_4 + 84x_5 + 128.7x_6 + 207.9x_7 + 205.8x_8 - 479.2}{661.5 - 479.2} \]

The problem can be transformed into:

Max \[ \lambda = \frac{1}{2} \lambda_1 + \frac{1}{4} \lambda_2 + \frac{1}{8} \lambda_3 + \frac{1}{16} \lambda_4 + \frac{1}{32} \lambda_5 \]
S.t.  \[ \lambda \leq \mu_1 (Z_1), \mu_1 (Z_1) \leq 0.6, \]
\[ \lambda \leq \mu_{11} (Z_1), \mu_{11} (Z_1) \leq 1, \]
\[ \lambda \leq \mu_2 (Z_2), \mu_2 (Z_2) \leq 0.6, \]
\[ \lambda \leq \mu_{22} (Z_2), \mu_{22} (Z_2) \leq 1, \]
\[ \lambda \leq \mu_3 (Z_3), \mu_3 (Z_3) \leq 0.6, \]
\[ \lambda \leq \mu_{33} (Z_3), \mu_{33} (Z_3) \leq 1, \]
\[ x_1 + x_5 \leq 1 \]
\[ x_2 + x_6 \leq 1 \]
\[ x_3 + x_7 \leq 1 \]
\[ x_4 + x_8 \leq 1 \]
\[ x_1 + x_2 + c_3 + x_4 - x_5 - x_6 - x_7 - x_8 \leq 0 \]
\[ x_1 + x_2 + c_3 + x_4 + x_5 + x_6 + x_7 + x_8 \geq 0 \]
\[ x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 \in \{0, 1\} \]

The final solution:

\[ \lambda = 0.36 \]
\[ x = (0, 0, 0, 0, 0, 1, 1) \]
\[ G = (150, 14000, 413.7) \]
9.5 MODEL FORMULATION

9.5.1 Decision variables, constants and symbols:

The model consists of a number of decision variables, constants and symbols. These are discussed below. All the values and variables unless otherwise specified refer to the particular time period.

\( p \) : 1, 2, 3 ..., 7 for product line segments of dairy products viz., Double Tone Milk, Tone Milk, Whole Milk, Ghee, Butter, Flavoured Milk and Yogurt.

\( g \) : 1, 2, 3, 4 for geographic segments viz., Keonjhar, Barbil, Harichandanpur and Saharpada.

\( i \) : 1, 2, 3 for income level segments viz., Higher income group, Middle income group and Lower income group.

\( q \) : 1, 2, 3, 4 for seasonal variation segments viz., Autumn, Summer, Winter and Spring.

\( j \) : 1, 2, 3 for product usage segment viz., Heavy, Medium and Light.

\( m \) : 1, 2, 3, 4 for market segments in the particular geographic segments viz., North, South, East and West.

\( l \) : 1, 2, ..., \( n \) for potential location site for retail outlet in particular market segment.

\( y(f) \) : 1, 2, 3 ..., \( n \) referring an ordered set \( (p, g, i, q) \) for particular \( p \)th product considered in \( g \)th geographic segment in \( i \)th income group distributed in \( q \)th Here, \( y(f) \) represents the segment type, viz., 1, 2, ..., \( n \) for the set of segments \( Z \), where

\[
Z = \{ z : z = (p, g, i, q) \\
\quad \text{and} \quad p = 1, 2, 3, ..., 7; \\
\quad g = 1, 2, 3, 4; \\
\quad i = 1, 2, 3; \\
\quad q = 1, 2, 3; \}
\]

\((y(f),j,m,l)\) Type of segment for \( p \) product obtained by segmenting the market based on \( y(f) \) and \( j \)th usage rate segment and for \( i \)th retail outlet location site in \( m \)th market segment.

\( X_{y(f),j,m,l} \) : Location site variables for \((y(f),j,m,l)\).

\( P_{y(f)} \) : Profit incurred by the Location site variables for \((y(f),j,m,l)\).

\( C_{y(f)} \) : Cost incurred by the Location site variables for \((y(f),j,m,l)\).

\( S_{y(f)} \) : Satisfaction by the Location site variables for \((y(f),j,m,l)\).
9.5.2 System Constraints:

(i) Budgetary Constraint:

Budget is a financial forecasting of the expenses on various functional heads for a fixed period of time. Every organisation sets its own budget in order to assist in allocating resources and predict performance of management. The present study for dairy industries in the study area needs well planned and designed budget to match the product with the market. For deciding retail outlet location decision for dairy product, market requires costs for land, establishing building and equipment, which should be within certain budgeting limit for the organisation. This constraint is to restrict the cost decision variable for retail outlet location to be less than or equal to certain amount of total budget in rupees, mathematically it can be put as:

$$\sum_{y(f)} \sum_{j} \sum_{m} \sum_{I} C_{jml} y(f) X_{y(f)} \leq B \text{ for all } y(f), j, m, l.$$  

(ii) Exclusive Retail Outlet Market Segment constraint:

This constraint ensures that no two new retail outlet are located in the same market segments. This constraint allows possibility of associating new retail outlet location or not associating a retail outlet in a particular market segment at all. This states that one new retail outlet for each market segment. This constraint ensures atleast one number of new retail outlet located in each market segment, mathematically it can be put as:

$$\sum_{y(f)} \sum_{j} \sum_{I} C_{jml} y(f) \geq 1 \text{ for all } m$$

(iii) Retail Out Limitation Constraint:

This constraint ensure that only a predetermined number of retail outlets available for particular market segment. For marketing of dairy products, this constraints specifies the exact number of retail outlets for particular market segment. This constraint restrict decision variable to be less than or equal to the
number of total retail outlets in a market segment, mathematically it can be put as:

\[ \sum_{j} \sum_{m} C_{jml} \leq R \text{ for all } m \]

(iv) **Geographic Constraint**:

This constraint specifies the geographic area coverage of retail outlet in a particular market segment and cannot exceed the total available area for the retail outlet catering of dairy products market. So, coverage for marketing of dairy product is confined to geographic area. This constraint limits the decision variable for retail outlet location to be less than or equal to total geographic area covered and which can be expressed as:

\[ \sum_{j} \sum_{m} \sum_{y(f)} C_{jml} \geq G \text{ for all } y(f) \]

(v) **Market Share Constraint**:

Market share refers to that part of a total market controlled by one firm’s product. It is expressed as the sales of a particular product/brand or line of products in relation to total industry sales and is commonly computed as a percentage. In case of marketing of dairy products based on retail outlets should be sufficiently above certain limit of market share. Hence, this model is to have market share within certain accepted limits based on retail outlet location in different market segments expressed as:

\[ \sum_{j} \sum_{m} \sum_{y(f)} M_{jml} \geq M \text{ for all } y(f), j, m, l. \]

(vi) **Minimum Selectivity and Competitive Advantage Constraint**:

Certain locations for retail outlet are already accepted by market segments. Based on this marketers has to decide and take advantage of locating the retail outlet as to serve the established market segment. This would not only ensure a competitive parity at present. This constraint ensures that in each market segment at least one retail outlet is selected, mathematically it can be put as:

\[ \sum_{j} \sum_{m} X_{jml} \geq 1 \text{ for all } j, m. \]
(vii) **Customer Satisfaction Constraint:**

In order to satisfy customers, the location of retail outlets should be such that it is easily accessible to the customer than competitors outlet, availability of quality and variety of product ranges, standard price, good customer dealing, credit facility, and many more. And in each market segment, the retail outlet location should have a minimum level of satisfaction to that customer. This can be stated as:

\[
\sum_{y(f)} \sum_{j} \sum_{m} S_{y(f)} X_{y(f)} \geq S \text{ for all } l.
\]

(vii) **Revenue Generating Constraint:**

In order to have retail outlets in good location sites in particular market segments, which should produce minimum amounts of revenue to withstand market conditions. This constraint indicates that minimum amounts of profit should be generated after establishing a retail outlet in specified location. Mathematically, this constraint can be stated as:

\[
\sum_{y(f)} \sum_{j} \sum_{m} p_{y(f)} X_{y(f)} \geq P \text{ for all } l.
\]

9.5.3 **System Objectives:**

(i) **Profit Objective:**

The good retail outlet location may be a significant decision as it acquires new market potentials and penetrated into existing market segments. It increases the sales area and maximizes the total sum of the expected profit obtained from the new retail outlets to the existing area. Profit contribution is defined as the difference between the total revenue generated by the sales of goods and total cost incurred. The profit contribution as model objective should be maximized and it can be expressed as follows:

\[
\text{Max } \sum_{y(f)} \sum_{j} \sum_{m} \sum_{l} p_{y(f)} X_{y(f)} \text{ for all } y(f), j, m, l
\]

(ii) **Cost Objective:**

In the retail outlet location, the objective is to minimize the sum of all costs affected by location. In attempting to minimize costs, we should think not only of today's costs, but of long-run costs. In order to have potential location sites for retail outlets, there are some costs incurred such as land, building equipment costs, transportation costs, material costs, labour costs, utilities costs,
taxes and insurance costs etc.. In this model, the objective is to minimise the costs incurred by acquiring potential retail outlet location site in particular market segment for dairy products. Mathematically, it can be put as:

\[
\text{Min } \sum_{y(f)} \sum_{j} \sum_{m} \sum_{l} C_{jml} X_{y(f)jml} \text{ for all } y(f), j, m, l
\]

(iii) **Customer Satisfaction Objective**

The marketing concept proposes that customer satisfaction is the means to achieve long-run profits. Satisfying consumer needs and wants is utmost important to any organisation which markets its product. Customer satisfaction for deciding the retail outlet location depends upon customer’s utilities such as nearness to locality, convenient time, availability of variety of products and price ranges, credit facility and location proximity to competitors retail outlet location. It is also necessary that organisation should enter those segments where customers are highly satisfied to the location site. We can determine value of customer satisfaction by the desired needs and wants of retail outlet location decision attributes on subjective judgement and negotiation on 1-10 scale. The objective function of maximising customer satisfaction can be mathematically expressed as:

\[
\text{Max } \sum_{y(f)} \sum_{j} \sum_{m} \sum_{l} S_{jml} X_{y(f)jml} \text{ for all } y(f), j, m, l
\]

7.5.4 (0,1) Restriction:

Each decision variable has to take 0 or 1 as its solution. Mathematically, it can be represented as:

\[
X_{y(f)jml} \in \{0,1\} \text{ for each } y(f), j, m, l
\]

9.6 **APPLICATION**
9.6.1 **Decision Variables, Constants and Symbols**:

- \(p\) : 1, 2 for product line segments of dairy products i.e., Milk and Ghee respectively.
- \(g\) : 1 for geographic segments viz., Keonjhar.
- \(q\) : 1, 2, 3, 4 for seasonal variation segments viz., Autumn, Summer, Winter and Spring.
- \(i\) : 1, 2 for income level segments viz., Higher income group, Middle income group respectively.
\( j \) : 1, 2 for product usage segment viz., Heavy users and light users respectively.

\( m \) : 1,2,3,4 for market segments in the particular geographic segments viz., North, South, East and West.

\( l \) : 1 for potential location site for retail outlet in particular market segment.

\( y(f) \) : 1, 2 for particular \( p^{th} \) product considered in \( g^{th} \) geographic segment in the \( i^{th} \) income group distributed through \( q^{th} \) season.

Where \( f \in z \),

\[
z = \{ z : z = p \times g \times i \times q \}
\]

Where \( p = 1, 2; \)

\( g = 1; \)

\( i = 1, 2; \) and

\( q = 1; \)

\((y(f), j, m, l)\) : Type of segment for \( p \) product obtained by segmenting the market based on \( y(f) \) and \( j^{th} \) usage rate segment and for \( i^{th} \) retail outlet location site in \( m^{th} \) market segment.

\( X \) : Location site variables for \((y(f), j, m, l)\).

\( P \) : Profit incurred by the Location site variables for \((y(f), j, m, l)\).

\( C \) : Cost incurred by the Location site variables for \((y(f), j, m, l)\).

\( S \) : Satisfaction by the Location site variables for \((y(f), j, m, l)\).

\( M \) : Market share from the Location site variables for \((y(f), j, m, l)\).

\( B \) : Total budget in rupees.

\( R \) : Total number of retail outlets.

\( M \) : Minimum allowable market share in any market segment.

\( S \) : Minimum allowable customer satisfaction in any market segment.

\( G \) : Total geographic area covered.

\( P \) : Minimum Profit in rupees.

### 9.6.2 System Constraints:

#### (i) Budgetary Constraint:

\[
\sum_{y(f)} \sum_{j} \sum_{m} \sum_{l} C \cdot X_{y(f), j, m, l} \leq B \quad \text{for all } y(f), j, m, l.
\]
(ii) Exclusive Retail Outlet Market Segment constraint:

\[ \sum_{j} \sum_{m} \sum_{l} C_{jml} \leq 1 \text{ for all } m \]

(iii) Retail Out Limitation Constraint:

\[ \sum_{j} \sum_{l} C_{jml} \leq R \text{ for all } m \]

(iv) Geographic Constraint:

\[ \sum_{j} \sum_{m} \sum_{l} C_{jml} \geq G \text{ for all } y(f) \]

(v) Market Share Constraint:

\[ \sum_{j} \sum_{m} \sum_{l} M_{jml} X_{jml} \geq M \text{ for all } y(f), j, m, l. \]

(vi) Minimum Selectivity and Competitive Advantage Constraint:

\[ \sum_{j} \sum_{l} X_{jml} \geq 1 \text{ for all } j, m. \]

(vii) Customer Satisfaction Constraint:

\[ \sum_{j} \sum_{m} \sum_{l} S_{jml} X_{jml} \geq S \text{ for all } l. \]

(vii) Revenue Generating Constraint:

\[ \sum_{j} \sum_{m} \sum_{l} P_{jml} X_{jml} \geq P \text{ for all } l. \]

9.6.3 System Objectives:

(i) Profit Objective:

\[ \text{Max} \sum_{j} \sum_{m} \sum_{l} P_{jml} X_{jml} \text{ for all } y(f), j, m, l \]
(ii) **Cost Objective:**

\[
\begin{align*}
\text{Min} & \sum \sum \sum \sum_{\text{y}(f)jml} C_{\text{y}(f)jml} X_{\text{y}(f)jml} \\
\text{for all y(f), j, m, l}
\end{align*}
\]

(iii) **Customer Satisfaction Objective**

\[
\begin{align*}
\text{Max} & \sum \sum \sum \sum_{\text{y}(f)jml} S_{\text{y}(f)jml} X_{\text{y}(f)jml} \\
\text{for all y(f), j, m, l}
\end{align*}
\]

9.7 **ANALYSIS AND INTERPRETATION OF RESULTS**

The problem has been solved by the algorithm for a solution in 0-1 format as described in section 9.4 and by utilising Lindo software in a pentium PC at Department of Business Administration, Utkal University, Vani Vihar, Bhubaneswar. The final result obtained is presented in table 9.3 which depicts the new retail outlet location site to be viable to particular market segment (based on geographic, income and usage rate). This is to decide on the new location site to the target market segment with maximum ability to fulfil the objectives of the organisation and customer in a given market segment. The Keonjhar town has been divided in four market segments (viz., north, south, east and west). And each market segment has to select a new location site besides existing retail outlets. These new retail outlet would serve customer in each market segment. The original data sheet of profit, cost and customer satisfaction from the new retail outlet location with associated dimensions, application and the consumer market segment are given in tables 9.2. The initial profit maximisation, cost minimisation and customer satisfaction maximisation solutions are given in table 9.3. The maximum value of total profit is in the presence of other two objectives determined to be Rs. 189,449,00/- and the minimum value for total profit is determined to be Rs. 881,1300/- (table 9.3). Similarly the maximum value for total cost is Rs. 172,494,100/- and the corresponding minimum value of cost is Rs. 821,279,000/- (table 9.3) in the presence of other two objectives. In the same manner, the maximum and minimum values for customer satisfaction is 75,927 thousand and 41,380 thousands respectively (table 9.3). After construction of piece-wise linear membership functions and the final solution obtained is given in table 9.4. The final solution on values for profit, cost and customer satisfaction are Rs. 140,060,700/-, Rs. 122,996,400/- and 44,427 thousands respectively (table 9.4). The final solution received becomes totally acceptable and within the given limits. The individual values of the final outcome to MSDS-5 are observed in zero-one format i.e., rejection-selection format. Actually the model accepts or rejects specific new retail outlet with all associated customer segment attributes (such as income level and usage rate segments). Hence, firstly, the specification of the various dimensions of new retail outlet location and characteristics of the consumer groups are combined and market segments are formed. The study is done for geographic segment i.e., Keonjhar town and season considered is winter.
$x_1$ to $x_8$ represent for geographic segment - Keonjhar market segment is for north and a new retail outlet location for dairy products - milk and ghee sales. $x_1$ is selected which represent customer segment from higher income group segment with heavy usage rate of milk is north market segment in Keonjhar town. $x_6$ is selected which represent customer segment from higher income group segment with medium usage rate segment of ghee product in north market segment in Keonjhar town. $x_9$ to $x_{16}$ represent for geographic segment - Keonjhar, market segment is for south and a new retail outlet location for dairy products - milk and ghee sales. $x_9$ is selected which represent customer segment from higher income group segment with heavy usage rate of milk in south market segment in Keonjhar town. $x_{13}$ is selected which represent customer from higher income group segment with heavy usage rate of ghee product in south market segment in Keonjhar town. $x_{17}$ to $x_{24}$ represent for geographic segment Keonjhar, market segment is for east and a new retail outlet location for dairy products - milk and ghee sales. $x_{18}$ is selected which represent customer segment from higher income group segment with medium usage rate of milk in east market segment in Keonjhar town. $x_{21}$ is selected which represent customer segment from higher income group segment with heavy usage rate of ghee product in east market segment in Keonjhar town. $x_{25}$ to $x_{32}$ represent for geographic segment Keonjhar, market segment is for west and a new retail outlet location for dairy products - milk and ghee sales. $x_{25}$ is selected which represent customer segment from higher income group segment with heavy usage rate of milk in west market segment in Keonjhar town. $x_{29}$ is selected which represent customer segment from higher income group segment with heavy usage rate of ghee product in west market segment in Keonjhar town. Profit, cost and customer satisfaction from the new retail outlet location at west market segment in Keonjhar town are (Rs. 209630, Rs. 2703470, 74260) respectively.

The marketing manager can identify the practical retail outlet location for dairy product with above result and understand the model output. The retail outlet location problem of dairy products can be solved by using the algorithm and model formulation technique of segmenting market according to its utility the profitable site as well as cost minimised location site could be found. With behaviour factor of customer segments regarding customer satisfaction from the location site, the new retail outlet potential location site which is most critical decision factor to any marketing manager can be solved by this proposed technique.
<table>
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<tr>
<th>Segment type</th>
<th>Profit (in Rs.) '00</th>
<th>Cost in Rs. '00</th>
<th>Customer satisfaction '00</th>
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Fig. 9.1: Dairy product retail outlet location and usage rate segmentation tree plan.

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<tr>
<th>Geographic Segment</th>
<th>Season</th>
<th>For Market Segment</th>
<th>Potential site for Retail outlet</th>
<th>Product</th>
<th>Income level Segment #1 (HIG)</th>
<th>Income level Segment #2 (MIG)</th>
<th>Usage rate #1 (Heavy users)</th>
<th>Usage rate #2 (Medium users)</th>
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<td>Usage rate #1 (Heavy users)</td>
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<td>#2 South</td>
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<td>Product #2 (Ghee)</td>
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<td>#3 (For market segment #3)</td>
<td>Product #1 (Milk)</td>
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### Table 9.3
Alternate plan

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### Table 9.4

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