



# On Analyzing the Problems Encountered by Nestle Dealers in Nagore Area Using Fuzzy Matrices

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## ABSTRACT

Nestle is one of the world's largest and most prominent food companies. Headquartered in Vevey, Switzerland, it was established in 1866 by Henri Nestle. In this article the authors attempted to identify the various problems encountered by the Nestle dealer and to ascertain the group of (based on product variants) worst affected by such problems.

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## Introduction

Fuzzy relations and fuzzy relational equations have important applications in pattern classification, clustering, fuzzy information retrieval, preference and so on. In system models based on fuzzy sets, one often uses fuzzy matrices to define fuzzy relations. A fuzzy matrix is a matrix with elements having values in the fuzzy interval. In this article, the unit interval  $[0,1]$  and the interval  $[-1,1]$  are called fuzzy interval. Nestle launched in several countries such as France, United Kingdom and Russia. "Good Nutrition Programs" to help children adopt healthy nutrition habits as a component of a healthy lifestyle. Nestle's Products include *baby food, bottled water, breakfast cereals, coffee and tea, confectionery, dairy products, and snacks*. It is the largest food company in the world measured by revenues. The method based for this evaluation is followed by the one given by [1] and [4].

## Basic Definitions

### Definition 1

The characteristic function can be generalized such that the values assigned to the elements of the universal set fall within a specified range and indicate the membership grade of these elements in the set. Larger values denote higher degree of set membership. Such a function is called a membership function and the set defined by it a fuzzy set.

### Definition 2

An  $\alpha$ -cut of the fuzzy set A is a crisp set  $A_\alpha$  that contains all the elements of the universal set X that have a membership grade in A greater than or equal to the specified value of  $\alpha$ . It can be written as

$$A_\alpha = \{ x \in X \mid \mu_A(x) \geq \alpha \}$$

### Definition 3

When a fuzzy set A is a finite support its fuzzy cardinality  $|\tilde{A}|$  is a fuzzy set on N whose membership function is defined by

$$\mu_{|\tilde{A}|}(|A_\alpha|) = \alpha$$

for all  $\alpha$  in the level set of A.

### Definition 4

The Support of a fuzzy set A in the universal set X is the crisp set that contains all the elements of X that have a non-zero membership grade in A.

i.e., Support of fuzzy set in X are obtained by the function.

Supp :  $\tilde{p}(x) \rightarrow p(x)$

where  $\text{Supp } A = \{x \in X \mid \mu_A(x) > 0\}$ .

### Definition 5

The set of all levels  $\alpha \in [0,1]$  that represents distinct  $\alpha$ -cuts of a given fuzzy set A is called a level set of A. Formally,

$$\Lambda_A = \{ \alpha \mid \mu_A(x) = \alpha \}$$

where  $\Lambda_A$  denotes the level set of fuzzy A defined on X.

### Description of simple Fuzzy Matrix Model

Here we describe a simple fuzzy matrix model when we have a raw data in hand. The raw data is taken as a Average Time Dependent Data matrix (ATD). At the second stage, the average or mean and the Standard Deviation (S.D) of every column in the ATD matrix, are determined. Using the average  $\mu_j$  of each  $j^{\text{th}}$  column and  $\sigma_j$  the S.D of each  $j^{\text{th}}$  column, a parameter  $\alpha$  from the interval  $[0, 1]$  is chosen and the Refined Time Dependent Data matrix (RTD matrix) ( $e_{ij}$ ) is formed using the formula:

If  $a_{ij} \leq (u_j - \alpha * \sigma_j)$  then  $e_{ij} = -1$

else if  $a_{ij} \in (u_j - \alpha * \sigma_j, u_j + \alpha * \sigma_j)$  then  $e_{ij} = 0$

else if  $a_{ij} \geq (u_j + \alpha * \sigma_j)$  then  $e_{ij} = 1$ .

where  $a_{ij}$ 's are the entries of the ATD matrix.

The ATD matrix is thus converted into the Refined Time Dependent Data Matrix. This matrix is also at times termed as the fuzzy matrix as the entries are 1, 0, and  $-1$ .

### Analyzing the problems encountered by the Nestle dealer by using 4 x 6 matrices

In order to analyse the problems encountered by the Nestle dealer, an interview schedule was administered to 55 Nestle products in the town of Nagore, Tamil Nadu and were asked to respond each problem:

i. Cerelac items(13) ii. Lactogen items (4) iii. Nestum items(3)

iv. Tin items(3) v. Sauce items(4) vi. Sunrise items(7)

vii. Choclate items(16) viii. Maggi items(5). That is,

P<sub>1</sub> - Destruction of food products by rats and cockroaches.

P<sub>2</sub> - Labour shortage.

P<sub>3</sub> - High cost of labour.

P<sub>4</sub> - Storage problem.

- P<sub>5</sub> - First In First Out(FIFO) unable to follow.
  - P<sub>6</sub> - Low margin of profit.
- The list of problems encountered by them are as follows:
- P<sub>1</sub> - Pest attack and destruction by rats and cockroaches,cause damage to the product.
  - P<sub>2</sub> - Migration of labour force to urban centres results shortage of labour.
  - P<sub>3</sub> - Cost of labour increases due to shortage of labour. The price of food Products are always in the increasing trend.
  - P<sub>4</sub>- Sufficient storage place is needed to store the food products till it is sold.
  - P<sub>5</sub>- Gravity chute method storage not accessible in storage area.
  - P<sub>6</sub> -The difference between the sales revenue and production cost is marginal.

**Lactogen, Cerelac&Nestum Items**



**Maggi Items**



**Chocolate Items**



**Sauce Items**



**Sunrise Items**



**Tin Items**



Based on their land holding (Products Stockage) the respondents were grouped into four categories as detailed below:

By taking the above six categories as rows and the number of respondents suffering due to each of the ten problems as columns, 4 x 6 initial raw data matrix called Time Dependent Matrix (TD Matrix) [1] was formed.

The initial raw data matrix has been converted into the Average Time Dependent Matrix (ATD Matrix) [1] ( $a_{ij}$ ) by dividing each entry with the width of the respective class-interval.

**ATD Matrix**

The average ( $\mu_j$ ) and standard deviation ( $\sigma_j$ ) of every column were worked out as follows: Using the average ( $\mu_j$ ), Standard Deviation ( $\sigma_j$ ) and a parameter  $\alpha$  from the interval [0, 1], a fuzzy matrix called the Refined Time Dependent Data Matrix (RTD Matrix) [1] was formed. The RTD matrix with entries  $e_{ij}$ , where  $e_{ij} \in \{0, 1\}$ , was formed using the following formula [1] :

If  $a_{ij} \leq (u_j - \alpha * \sigma_j)$  then  $e_{ij} = -1$   
 else if  $a_{ij} \in (u_j - \alpha * \sigma_j, u_j + \alpha * \sigma_j)$  then  $e_{ij} = 0$   
 else if  $a_{ij} \geq (u_j + \alpha * \sigma_j)$  then  $e_{ij} = 1$ ,  
 where  $a_{ij}$ 's are entries of Average Time Dependent Matrix.

By varying the parameter [0, 1], any number of Refined Time Dependent Data Matrices can be obtained. Three of such matrices obtained were as follows:

**RTD matrix for  $\alpha = 0.10$**

**Row sum matrix**

1	0	-1	1	-1	0	0
-1	1	0	-1	0	-1	-2
0	-1	0	1	1	1	2
0	1	1	-1	0	-1	0

Products Stock age	Number of Respondents
1-2	9
3-4	12
5-6	14
7-8	14

Products Stock age	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>6</sub>
1-2	15	8	5	10	4	6
3-4	12	9	7	7	6	5
5-6	14	5	18	13	17	10
7-8	14	9	12	8	6	3

Products Stock age	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>6</sub>
1-2	7.5	4.0	2.5	5.0	2.0	3.0
3-4	6.0	4.5	3.5	3.5	3.0	2.5
5-6	7.0	2.5	4.0	6.5	3.5	5.0
7-8	7.0	4.5	6.0	4.0	3.0	1.5

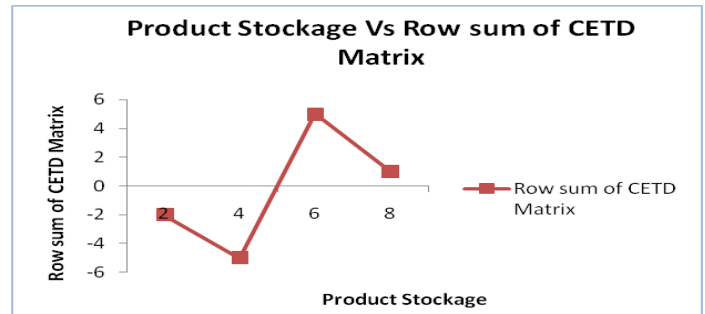
Average	6.875	3.87	4.0	4.75	2.87	3.0
Standard Deviation	0.6289	0.9464	1.4719	1.3228	0.6291	1.4719

**RTD matrix for  $\alpha = 0.20$**

**Row sum matrix**

1	0	-1	1	-1	0
-1	1	0	-1	1	0
1	-1	1	1	1	1
1	1	1	-1	1	-1

0
0
3
2



**RTD matrix for  $\alpha = 0.35$**

**Row sum matrix**

1	-1	-1	0	-1	0
-1	1	-1	-1	0	-1
0	-1	-1	1	-1	1
0	1	1	-1	-1	-1

-2
-3
-1
-1

**Conclusion**

From the graph it is observed that the Nestle Dealer holding product ranging between 3-4 were worst affected by such problems. Out of 55 products Nestum and Tin variety items have not sold much in twelve shops at Nagore area.

**Suggestion**

Based on the analysis survey conducted in this region to identify the root cause of the problem. The price of these two items are costly while compare with their competitive items. The same was communicated to Nestle zonal manager through this dealer for reasonable price reduction. Additionally we suggest them to introduce new attractive schemes to enhance this product sale. Zonal manager confirmed that it will be communicated to manufacturer in periodic regional meetings.

By combining all these three matrices, the Combined Effect Time Dependent Data Matrix (CETD Matrix) [ 1 ], which gives the cumulative effect of all these entries was obtained as follows

**CETD matrix**

**Row sum matrix**

3	-1	-3	2	-3	0
-3	3	-1	-3	1	-2
1	-3	0	3	1	3
1	3	3	-3	0	-3

-2
-5
5
1

The graph as shown below exhibited the group of respondents (based on product stockage) worst affected.

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