



Application of Taguchi's Method of Optimization in analysis and quantification of factors affecting the success of retail outlets

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Abstract: Nowadays, without knowing the consumer behaviour it is not possible for retail outlets to take appropriate measures to meet the consumer needs and demands. Three factors were selected: Product variety, Employee behaviour, pricing and way finding & check out speed. The present study provides the better understanding of the impact of factors affecting the success of retail stores. The empirical analysis is based on data obtained from consumer survey and data were analyzed using Taguchi method and analysis of variance (ANOVA). The study covers the population includes 200 consumers from Ujjain and Indore. Also, this study introduces the concept of Taguchi's method of optimization in analysis and quantification of factors affecting the success of retail outlets. For this L_9 orthogonal array, Signal to Noise ratio (S/N) and ANOVA was used. Interaction between these factors was not tested as it required the use of more complicated designs

Keywords: Retail outlets, Taguchi Method, Analysis of variance (ANOVA), Signal to noise ratios, orthogonal array

I. Introduction

In the present marketing era retail outlets, supermarkets and discount stores plays a dominating role in India. There is an increase in competition among the types of modern stores: grocery stores, supermarkets, discount stores, department stores, catalog showrooms; they are competing for the same customers [5]. Nowadays, customers are facing difficulty in making their decision to select from many types of stores such as grocery stores, supermarkets, discount stores, large mega stores and hypermarkets [7].

Many researches have been conducted on factors affecting the success of retail stores. Tinne [9] makes an attempt to find out the factors that affect consumer impulse buying behaviour at superstores in Bangladesh. The impact of various variables like discount offer, various scheme, promotional activities, retail store offer, display of product, behaviour of sales person, popularity of the product, influence of reference group, income level of customers and festival season, on consumer buying behaviour, has been analysed.

Ural [11] investigate the effect of store image and product attributes on consumer evaluations of store brands, in Turkey context. Three store image factors were identified: layout, merchandizing and service. Store image was found an important predictor of consumer attitude towards the store brand. Karbala and Wandebori [4] contributes about the factor that affect consumer to buy a product by looking several factors that can influence them such as product, price, place and promotion. The data were analyzed with cross tab analysis, Pearson correlation analysis, regression analysis and factor analysis. Anic [1] examines the differences in consumers' attitudes towards domestic and foreign retailers in Croatia. The empirical analysis is based on data obtained from consumer survey. The data were analyzed using t-test, chi-square test and ANOVA. It may be concluded that when designing retail strategy, managers should take into consideration both consumer attitudes and consumers segments. Chaiyasoonthorn and Suksa-ngiam [2] investigating what factors affect Thai customers purchasing goods and services from such types of retail stores in Bangkok, Thailand. 424 respondents were selected from 4 areas in Bangkok; correlations and multiple regressions statistical analyses were employed to estimate relationships between independent and dependent variables.

John and Christopher [3] investigates the relationship between branding dimensions and brand rating. The collected data were computed and analyzed using multiple regressions. Patel and Desai [6] tried to find out the factors which affecting to the customers satisfaction of organized retail stores. Result of factor analysis shown that five factors namely 'product Convenience', 'Employee Service', 'Shopping Convenience', 'Physical Features', and 'Pricing' have been lead to customer satisfaction of organized retail stores. To analyze the data, exploratory factor analysis, one sample test and multiple regression analysis have been applied. Taghizadeh and Fesghandis [10] identify and prioritize the factors affecting the consumer behaviour based on the product value. The Kolmogorov-Smirnov test was used to test the product value, and Friedman test for prioritizing the factors.

Raajpoot et al. [8] makes an important methodological and operational contributions to the retail service design literature. They uses a Taguchi design comprising of inner $L_8(2^7)$ and outer 2^2 arrays. Signal-to-noise (S/N) ratio was used to test design robustness. With all the view points above and reviewing the above literature, four

factors have been selected in this study which are product variety, employee behaviour, pricing and way finding & check out speed. These factors and their levels are shown in table 1.

II. Objective

The main objective of the study is to introduce the Taguchi method of optimization in finding out the factors, their analysis and quantification of factors affecting the success of retail outlets with the help of Taguchi's orthogonal array, Signal-to-noise (S/N) ratio and ANOVA. Another objective of the study is to find out the relative importance of identified factors on customer satisfaction. This study also gives an idea to the retail outlets companies about the factors that actually affect the customer satisfaction and also gives an idea on what major areas they have to put their efforts to improve their performance.

III. Research methodology

In this study, the number of respondents was 200 selected by considering non-probable convenience sampling method from two cities Ujjain and Indore (M.P.), India. Respondents were given a set of 9 cards with each card describing a particular condition of stores and asked them to arrange these cards in order of preferences. These cards represents the nine conditions of retail outlets based on Taguchi's L_9 orthogonal design which is shown in table 2. Rank one represents the best condition that a customer wants and the rank nine represents the worst condition that a customer does not want. Taguchi method and ANOVA have been used for analyzing of the data.

The factors used in this study are defined as:

Product variety: Product variety refers to the number of product brands and categories and it was divided into three categories low, medium and high.

Employee behaviour: Employee behaviour was classified into three categories which are rudeness, in between and friendly behaviour. These three categories are coded as low, medium and high respectively for rudeness, in between and friendly behaviour.

Pricing: Pricing are again categorised as low, medium and high price.

Way finding & check out speed: This was categorised as difficult, in between and fast way finding & check out speed. These three categories again coded as low, medium and high respectively for difficult, in between and fast way finding & check out speed.

Table 1. Selected factors and their levels

Factors	Factors Levels		
	1	2	3
Product variety (P V)	Low	Medium	High
Employee behaviour (E B)	Low (Rude)	Medium (In between)	High (Friendly)
Pricing (P)	Low	Medium	High
Way finding & check out speed (WF & CS)	Low (Difficult)	Medium (In between)	High (Fast)

Table 2. Cards with different situations based on L_9 orthogonal array

Card no.	Product Variety	Employee Behaviour	Pricing	Way Finding & Check out Speed
1	Low	Low	Low	Low
2	Low	Medium	Medium	Medium
3	Low	High	High	High
4	Medium	Low	Medium	High
5	Medium	Medium	High	Low
6	Medium	High	Low	Medium
7	High	Low	High	Medium
8	High	Medium	Low	High
9	High	High	Medium	Low

IV. Results and Discussions

Demographic profile of respondents:

Gender: Among the 200 respondents, 63% were females and 37% were males.

Age: In case of age group, 28% respondents were below 30 years of age, 38.5% respondents were between 30-45 years and 33.5% respondents were above 50 years of age.

Salary: In case of salary, 39% respondents having family income below Rs 30000 pm, 34.5% having family income in between Rs 30000 – 50000 pm and 26.5% having salary above Rs 50000 pm.

Analysis of factors:

To continue towards the main analysis, analysis of factors have been performed to identify the relative importance of identified factors on customer satisfaction while purchasing in retail outlets. For this average rank of each card have been calculated. After this signal to noise ratio have been calculated. Since, rank is a 'lower the better' type of quality characteristic (as rank 1 shows the best condition and rank 9 shows the bad condition), therefore, the S/N ratio for 'lower the better' type of response was used which is given by the following equation:

$$S/N = -10\log\left[\sum_{i=0}^n \frac{Y_i^2}{n}\right] \dots\dots\dots(1)$$

Here, n represents the trial conditions (here it is one) and $Y_1, Y_2, Y_3, \dots\dots\dots Y_n$ represents the values of responses (average of ranks) for quality characteristics. The signal to noise ratios were calculated using equation (1) for each of the nine cards and their values are also given in table 3.

Table 3. Average of ranks and S/N ratios

Card No.	Average of ranks	Signal to noise (S/N) ratio
1	6.86	-16.7265
2	5.60	-14.9638
3	7.50	-17.5012
4	7.80	-17.8419
5	7.15	-17.0861
6	4.55	-13.1602
7	8.15	-18.2232
8	2.05	-6.2351
9	4.25	-12.5678

The mean value of card ranks for each factors at different levels have been calculated. These average values of card ranks for each factors at levels 1, 2, 3 are given in table 4 and Fig.1. Similarly, the average values of S/N ratios of all the three factors at three levels were calculated and are shown in table 5 and Fig. 2.

Table 4. Response table for Mean

Level	Product variety	Employee behaviour	Pricing	Way finding & Check out speed
1	6.653	7.603	4.487	6.087
2	6.500	4.933	5.883	6.100
3	4.817	5.433	7.600	5.783
Delta	1.837	2.670	3.113	0.317
Rank	3	2	1	4

Table 5. Response table for S/N Ratios

Level	Product variety	Employee behaviour	Pricing	Way finding & Check out speed
1	-16.40	-17.60	-12.04	-15.46
2	-16.03	-12.76	-15.12	-15.45
3	-12.34	-14.41	-17.60	-13.86
Delta	4.06	4.84	5.56	1.6
Rank	3	2	1	4

Fig. 1 Main effects plot for means

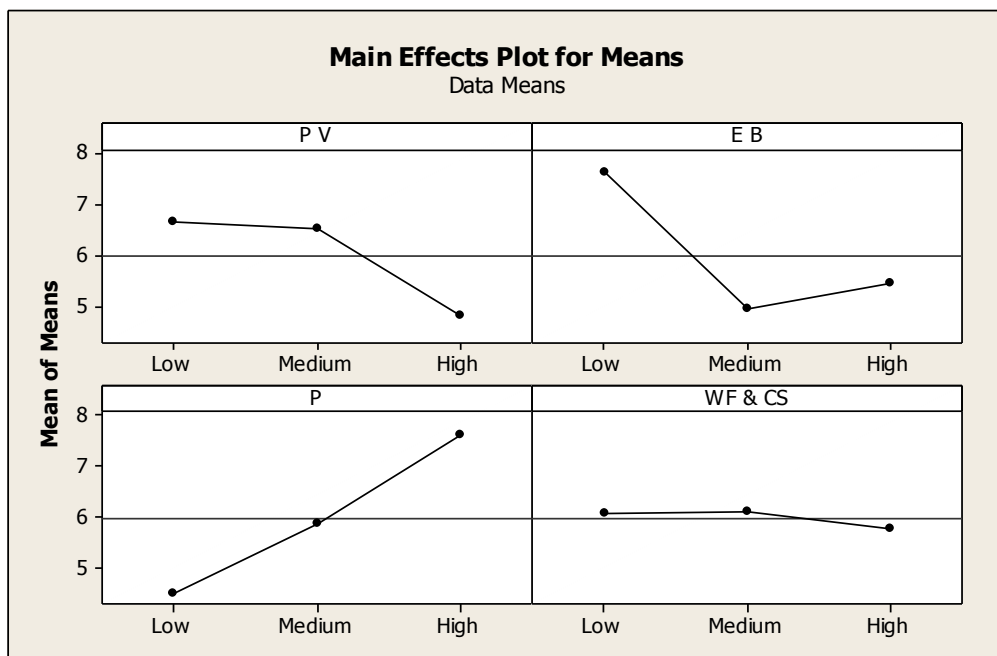
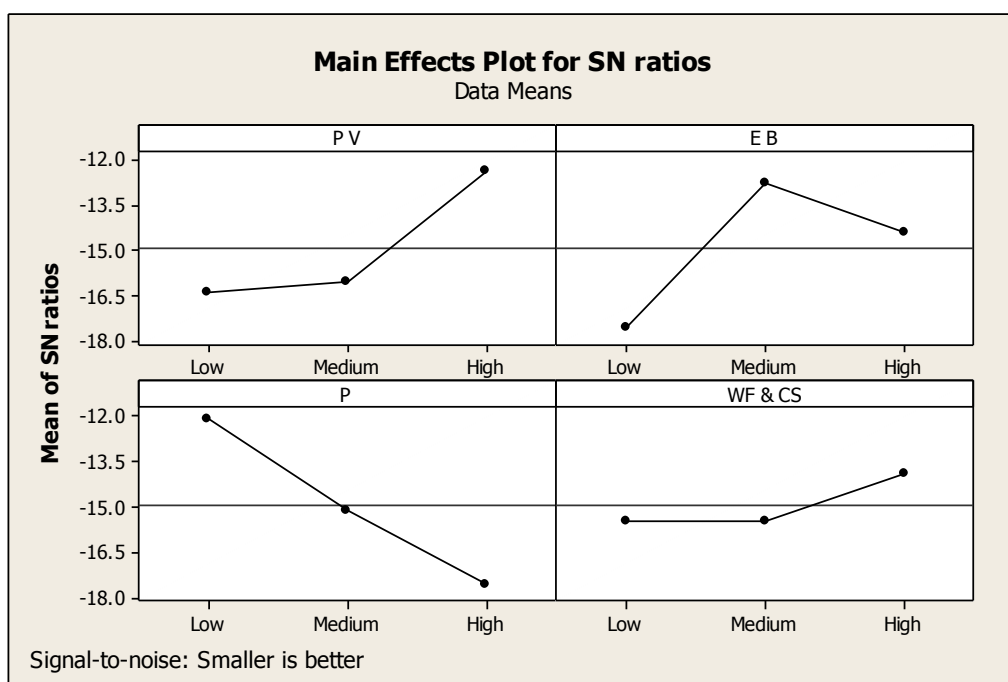


Fig. 2 Main effects plot for S/N ratios



It is clear from table 4 and Fig. 1 that card rank is minimum at 3rd level of product variety, 2nd level of employee behaviour, 1st level of pricing and 3rd level of way finding & check out speed. The S/N ratio analysis from table 5 and Fig. 2 also shows that the same results.

The present study used ANOVA to determine the percentage contribution and optimum combination of factors. The results of ANOVA of the raw data or mean of card rank is given in table 6 and the results of ANOVA of S/N ratios is given table 7. It is evident from these tables that the pricing is the most important factor followed by employee behaviour and product variety and way finding & check out speed has minimum percentage contribution in card ranking i.e. success of retail outlets. The percentage contributions all the factors are quantified under the last column of both the tables.

Table 6. Analysis of Variance for mean

Source	Degree of Freedom	Sum of Squares	Mean Square	% Contribution
Product variety	2	6.2305	3.1152	18.823
Employee behaviour	2	12.0878	6.0439	36.532
Pricing	2	14.5905	7.2952	44.078
Way finding& check out speed	2	0.1925	0.0962	0.5815
Error	0	*	*	
Total	8	33.1012		

Table 7. Analysis of Variance for S/N Ratios

Source	Degree of Freedom	Sum of Squares	Mean Square	% Contribution
Product variety	2	30.177	15.083	25.546
Employee behaviour	2	36.258	18.129	30.694
Pricing	2	46.602	23.301	39.451
Way finding& check out speed	2	5.089	2.545	4.308
Error	0	*	*	
Total	8	118.126		

V. Conclusions

In today's scenario, retail stores have involved in very aggressive competition. In such a case it is necessary for retailers to know the consumer behaviour as well as the preference of the customers. This study draws the following conclusions:

- This paper makes an important to the retail service design literature.
- This study shows that the application of Taguchi method is not limited to the manufacturing sector but it can also be effectively used with other sectors like retail.
- The Taguchi's method of optimization can be easily and effectively applied in finding out the factors affecting the success of retail outlets.
- All the analysis (response table for means, response table for S/N ratios, ANOVA for means and ANOVA for S/N ratios) shows that pricing is the most important factor followed by employee behaviour, product variety and way finding & check out speed in the success of retail outlets.
- It is evident from ANOVA for S/N ratios that percentage contribution of product variety is 25.54%, employee behaviour is 30.69%, pricing is 39.45 and way finding & check out speed is 4.3%.
- From the analysis of the selected sample, it has been concluded that pricing, employee behaviour and product variety are the most important factors in the success of retail outlets. So, retailers have maximum focus on these factors for achieving desired success.

References

- [1] Anic I D (2010), "Attitudes and purchasing behaviour of consumers in domestic and foreign food retailers in Croatia", Zb. Rad. Ekon. Fak. Rij., Vol.28, No.1, pp 113-133.

- [2] Chaityasoonthorn W and Suksa-ngiam W (2011), "Factors affecting customers using modern retail stores in Bangkok", IPEDR, Vol.16, pp 108-112.
- [3] John S F and Christopher J A (2012), "A study on factors affecting sales of branded product in retail sector", International Journal of Scientific and Research Publications, Vol. 2, Issue 9, pp 1-5.
- [4] Karbala A and Wandebori H, S. T (2012), "Analyzing the factors that affecting consumer's purchase intention in Toimoi store, Indonesia", 2nd International Conference on Business, Economics, Management and Behavioral Sciences, pp 80-83, Oct. 13-14, 2012 Bali (Indonesia).
- [5] Kotler P and Keller K L (2006), Marketing Management, 12th ed., Upper Saddle River: Pearson Education, Inc.
- [6] Patel B S and Desai A K (2013), "Factors affecting customer satisfaction in organized retail stores: a study of Surat city", Indian Journal of Applied Research, Vol. 3, Issue 5, pp 106-108.
- [7] Popkowski Leszczyc P T L, Sinha A and Sahgal A (2004), "The effect of multi-purpose shopping on pricing and location strategy for grocery stores", Journal of Retailing, Vol.80, no.2, pp.85-99.
- [8] Raajpoot N, Javed R and Koh K (2008), "Application of Taguchi design to retail service", International Journal of Commerce and Management, Vol.18, No.2, pp 184-199.
- [9] Tinne W S (2011), "Factors affecting impulse buying behaviour of consumers at superstores in Bangladesh", ASA University Review, Vol.5, No.1, January-June, pp 209-220.
- [10] Taghizadeh H and Fesghandis G S (2011), "Identifying and prioritizing factors affecting consumer behaviour based on product value", World Academy of Science, Engineering and Technology, Vol. 60, pp 680-683.
- [11] Ural T. (2008), "Factors affecting the success of store brands in Turkish retailing market", Innovative marketing, Vol.4, Issue 2, pp 33-41.