APPLICATION OF RCBD IN DETERMINING DEVIATION OF PRICES OF BASKET COMMODITIES IN SUPERMARKETS IN MOMBASA COUNTY

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ABSTRACT

This study reveals the significant deviation, correlation and statistical significance and variance on the prices of the commodities charged by the four supermarkets in Mombasa County. A statistical model, Randomized Completely Block Design has been used to ascertain the significance deviation with the sample size taken as twenty five basket commodities of each category, selected from four leading supermarkets in Mombasa. Coefficient of determination for drinks and beverages, food-stuff and non-foodstuff was: 50.3%, 78.2% and 84% respectively. Null hypothesis was rejected at 95% C.I, correlation coefficient was 0.987** at 99%, this showed significance in correlation and statistical significance.

Key words: Analysis of Variance, coefficient of determination, Randomized Complete Block design AND Confidence of Interval

1.0 Introduction:

 Competition in market viewed as essential healthy business external environment. A stiff competition has caused downfall of many business ventures. Since deviation on the price of commodities is very huge to the extent that, the consumers are forced to pay even more for the similar commodity in a different supermarket? For the business to survive in such situation a

number of businesses strategies are adopted these strategies included: price scheming, product differentiation and production strategy. Any of the strategy adopted created a burden passed on to the consumers who used the final product. Other factors which resulted in price adjustments are; Price wars, after sale service, strategic business location, car park, building occupied etc. as for the case of supermarkets, these factors influenced the price deviation.

This study focused on the prices charged on commodities by different supermarkets in Mombasa County. (Azad et al,2012) [1] Showed that in developing countries such as Kenya, consumers preferred shopping from supermarkets to small retail shops.

The anticipated change in commodities price gave a new notion to this study to find out the extent of deviation hence, fill the gap of knowledge on significance in prices deviation on similar commodities from four major supermarkets in Mombasa County. The supermarkets were: Tuskys; Budget; Uchumi and Nakumatt. The commodities sampled were termed as basket commodities. (Burt, Sparks,2003) [2], in his survey conducted in UK showed that there was variation in prices from one retail store to another and retailers had taken over value addition on goods such as branding. (Heil and Helsen, 2001) [3] in their overview of seventeen different price wars in diverse industries, identified many negative outcomes for their participants, ranging from eroded corporate image, unrealistic consumer reference prices, profit erosion, poor quality and the squeezing of smaller firms. However, for the individual firm and its management the outcome could be positive. In examining consumer behavior, when there was significant change in prices, consumers shopped around for fairer price and possibly shifted to a retail shop of less dearer prices.

2.0 Review of Literature

According to (Jehangir.R , 2003) [4], literature review provides framework that will establish the importance of the study and provide the results of publications from other scholars related to the research study.

According to (Martin Presendorfor,2015) [5], prices across supermarket chains show little relationship and price level is higher given that the past prices were higher than the present prices. Consumers demand on present high prices are affected by past prices though to a low degree. The consumers who shop on average low prices are likely to buy from competing supermarkets. However, significant in deviation was not discussed, therefore this study set to find out the significant in price deviation.

(Jacqueline de Figueiredo, 2010) [6], carried out research on comparison between farmers' market price and groceries stores prices and found out that, there is relationship between farmers' market prices and groceries store prices. In her conclusion, there was no significant relationship between farmers' market price and groceries store price.

(Alice O. N, Emi N, Leonard I. N, 2011) [7], conducted a study on grocery price Dynamics and concluded that, substantial variation on prices accounted for by differences across chain stores. In addition, a characteristic of the retail chain stores was too crucial in determining heterogeneity in price variation. (Cavallo's A. 2012) [8], presented facts on the prices charged by supermarkets from online stores in Agentina data used were extracted from the supermarket website. The findings were that supermarkets charged different prices, since they target high income earners.

In addition to Calvallo's finds, retailers use price wars as one of the top strategies to manage their business they initiate pricing as promotion of their products which includes everyday low pricing or high pricing this action of price wars result into prices variation.

(Grewal, Roggereen and Nordfalt, 2014) [10], showed that retailers were faced with competition Burden to the extent that they were obliged to lower their prices so as to fit in the prevailing market forces. The forces of demand and supply rule the market mostly in the developing countries where middle class earners form the bulk of consumers. They also noted that prices charged by supermarket depend on the price charged by immediate competitor supermarket.

(Miyuri Sharai, 2014) [11], depicted that prices charged depend on the quality and quantity of the commodities offered by the supermarkets. In addition to that consumers embrace the variation of prices in reference to the quality of the commodities in shops.

(Gomez Lobo, Jimenez.J Perdiguero.J, 2015) J.[12], found out that prices varies from supermarkets subject to some factors such as entrance of a new supermarket in the market when the new supermarket set its prices low, the existing supermarket will too adjust their prices so as to maintain their customers. Both supermarkets close to the new the entrance and even those far from entrance.

(Sathyamoorthi, Mburu, 2016) [13], on a study on price pattern by supermarkets, made a conclusion that prices within different branches of the supermarkets are the same for most of the products. There was no uniformity in prices by different supermarkets. Their study further

showed that, some supermarkets dropped their prices with higher margin at on set and at the end of promotion period. In the view of the above related work none of them has discussed significant in price deviation. Therefore, this study wish to determined if there is significance in price deviation to fill the gap of knowledge of significant deviation on the price variations from the supermarkets in Mombasa County?

3.1 Data Collection Instruments

Data for this study was collected by means of observation and recording using tables. Though there were no questionnaires provided to any supermarket management the method employed also concurred with assertion developed to address objectives, research question and defined hypothesis of study. This study used table showing names of commodities and respective supermarkets.

3.2 Data Analysis

The research objectives were investigated by collecting data from primary sources, the collected data was then cleaned, coded, edited, then analyzed. Analysis was done using statistical software called Statistical Package for Social Sciences (SPSS) this software provides detailed and well presented results on the table format and graphical presentation and good techniques for data analysis. The null hypothesis was analyzed by techniques of ANOVA, F- test and correlation and coefficient of determination. The significant of the deviation were determined by coefficient of determination (R^2). The model of this study derived from Randomized Complete Block Design (RCBD)

$Y_{ij} = \mu + T_i + \beta_j + \varepsilon_{ij}$ where; Y_{ij} = j th observation of the i th treatment

   μ = the population mean of items, T_i = treatment effects, β_j = the j replicate effects and ε_{ij} = is the random error.

4.1 Drinks and beverages

Analysis of variance for the for drinks and beverages from the SPSS output was presented on the table below

| Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	1735725.280[a]	4	433931.320	24.321	.000
drinks	1735725.280	4	433931.320	24.321	.000
Error	1712790.720	96	17841.570		
Total	3448516.000	100			
R Squared = .503 (Adjusted R Squared = .483)					

Table 4.1:prices of drinks and beverages

From table 4.1 the value of the Sig. column=0.000, this indicated that there was significance difference in the means; analysis was carried out at 95% confidence interval. This led to rejection of the claim that, the entire sample means were equal at 95% of confidence interval, the study therefore concluded that there was significant difference in the mean deviation. More illustration was shown in table 4.2 of the estimated mean. R square was 50.3% this explained variation in means was 50.3% and adjusted R= 48.3%, explained the statistical significance of the model of the drinks and beverages. Correlation coefficient was found by computing square root of $R^2 = 0.503$ square root= 0.7092. This value of square root hinted a strong relationship among the deviation in mean prices. Marginal mean estimate was presented as in the table below.

Drinks and beverages	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Nakumatt prices	131.840	26.714	78.812	184.868
Tuskeys prices	129.520	26.714	76.492	182.548
uchumi prices	132.560	26.714	79.532	185.588
Budget prices	133.040	26.714	80.012	186.068

Table 4.2: Price of drinks and beverages

Drinks and beverages mean prices depicted Budget was the dearest followed by

Uchumi ,Nakumat and Tuskeys was the cheapest the deviation was profound this could be

possibly explained by the fact that these are commodities whose prices were mostly set by the

manufactures so the retailers who dare set the prices above the kink demand cove could

certainly lose the customers' to their competitors. Ironically the highest deviation was observed between Tuskeys and Budget supermarkets the value was Ksh3.52. Factors which could influenced the price variation was electricity bill. Since the drinks were to kept cold for quick sale. The information above was presented on the graph as shown below.
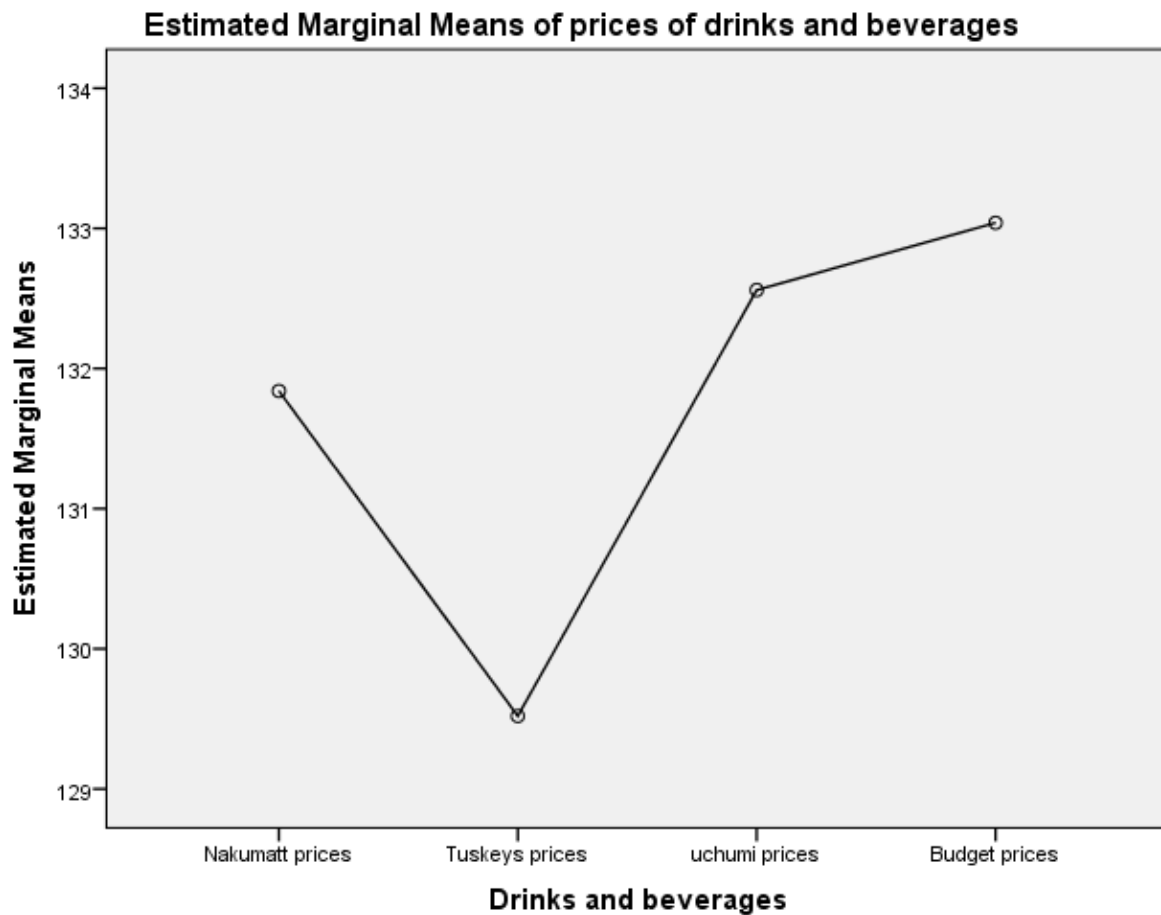
Graph 4.1 illustrate the variation deviation in mean prices of drinks and beverages

From the graph 4.1 above Budget led by a mean of Ksh133.04 followed by Uchumi Ksh132.56, Nakumatt Ksh131.84 and Tuskeys Ksh129.52

A bar graph showed the similar shape of the graph as viewed in graph 4.1 above

Bar graph 4.1.1 for drinks and beverages

The bar graph above confirmed the decision to reject the null hypothesis that all means are equal. For this category, Budget was the dearest with the mean of approximately 133, Uchumi became second, Nakumatt third and Tuskeys was the pocket friendly supermarket.

Significant Deviation and Prevalence

The question and objective was answered using the result from table 4.1. The analysis of Variance (ANOVA) revealed that deviation was significance, at 95% confidence interval the same decision was taken at 99% of C.I. from the ANOVA table the column headed sig=0.000 this was the p-value < 0.05. Since the p-value < 0.05, there was sufficient evidence to draw a credible conclusion that, there was significant on price deviation and statistical significance by use of RCBD model. Table 4.4 for non foodstuff, the results from these tables showed null hypothesis that all the mean of the prices deviation were equal was rejected since the p< 0.05, the sig column provided a strong evidence to reject the null hypothesis. Consequently variation in mean then translated that deviation was significant. 50.3% explained significance deviation for drinks and beverages category, 77.2% for foodstuff category and 84% for non-foodstuff category. The study therefore concluded that there was significant deviation. The percentages discussed above were coefficient of determination (R^2).

Results for non-foodstuff category from SPSS output, was presented in table of analysis of variance as shown below.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	3804983.600[a]	4	951245.900	126.137	.000
Non foodstuff	3804983.600	4	951245.900	126.137	.000
Error	723974.400	96	7541.400		
Total	4528958.000	100			
R Squared = .840 (Adjusted R Squared = .833)					

Table 4.3: SPSS output for non-foodstuff prices

ANOVA table 4.2 above R square = 84% and adjusted R = 83.3% these depicted well fit of non-foodstuff model as well as significance deviation of the prices and statistical significance of the deviation. Statistical significance also meant that the variation in prices was due to certain factors and did not happen by chance. Again the column headed Sig=0.000 this is the p-value, the value was by far less than alpha. Hence there was strong evidence against the claim that mean of the price deviation were equal. Thus null hypothesis rejected. From the

value of R square, if the square root was calculated then value of R=0.9165 was found and this is the correlation coefficient. This depicted that there was a strong correlation amongst the prices

Marginal mean of the prices deviation to justify the variation in the mean of the prices was presented on the as shown below

Estimate marginal mean				
Nonfood-stuff	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Nakumatt non foodstuff prices	200.040	17.368	165.564	234.516
Tuskeys non foodstuff prices	194.480	17.368	160.004	228.956
Uchumi non foodstuff prices	193.760	17.368	159.284	228.236
Budget non foodstuff prices	191.880	17.368	157.404	226.356

Table 4.4: non food-stuff prices

The column headed mean in the table 4.4 showed variations in the estimated mean this justified that there was difference in the mean. The estimated mean was represented on the graph 4.1 shown below. The graph also justified the variation on mean of the prices. From the graph Nakumatt was the highest with a mean of 200, Tuskeys was 194, Uchumi 193 and Budget was 191 this information showed prices of non foodstuff was dearer at Nakumat and cheaper at Budget. Many consumers could therefore shop for non foodstuff from budget since it charges the lowest prices. The mild variation was observed from Uchumi and Tuskeys. The slight deviation in the prices from Budget, Tuskeys and uchumi could be due to the fact that the three supermarkets are located in the same place thus sharing customers who have knowledge of their prices.
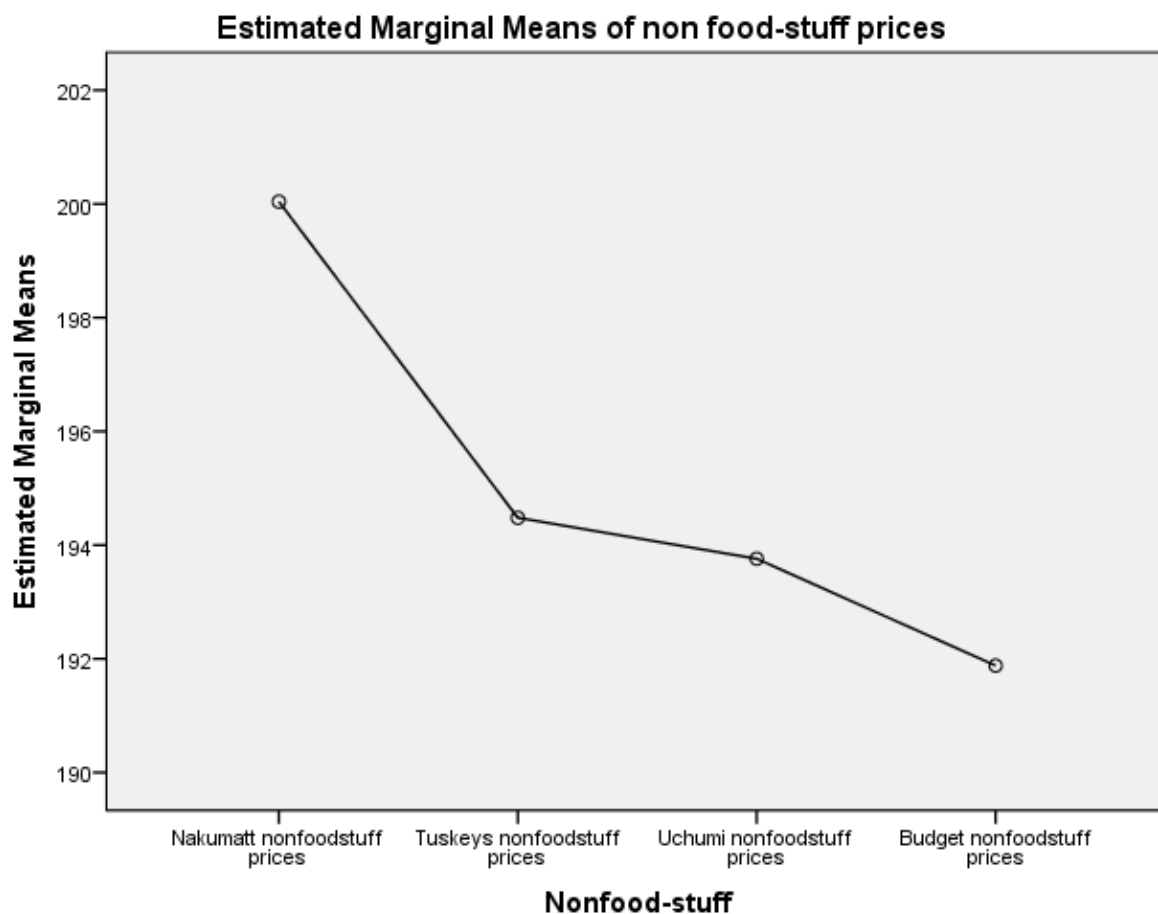
Graph 4.2 shows estimated marginal mean against non-foodstuff prices

Nakumatt charged highest prices of all the supermarkets. Pocket friendly supermarket was budget Similar information was represented on the bar graph on the next page

The graphical information showed that means of the supermarket price were not equal. There it was necessary to reject null hypothesis as depicted on the analysis of variance table 4.2

Graph 4.2.1 showing marginal mean deviation non-foodstuff

If a line is fitted on the mid-point of the bar, similar shape as one on graph 4.2 would be produced. This bar graph confirmed the result produced by SPSS software in graph 4.2.

4.2 Foodstuff

The SPSS results for analysis of variance for between subjects for the foodstuff category was presented on the table as shown below.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	5383926.320[a]	4	1345981.580	86.300	.000
Foodstuff	5383926.320	4	1345981.580	86.300	.000
Error	1497275.680	96	15596.622		
Total	6881202.000	100			

Table 4.4: ANOVA table: Prices of food-stuff R Squared = .782 (Adjusted R Squared = .773)

Output in ANOVA table 4.4 above for foodstuff category indicated that, there was significant difference in mean. Since, the p-value was less than alpha value; $p < 0.05$. Therefore, there was substantial evidence to reject the null hypothesis and conclude that, mean prices were significantly different at 95% confidence interval.

The value of R square = 78.2% and adjusted are = 77.3% the two values provided evidence of significance in deviation and statistical significance of the study as well as the goodness of fit of the model. Significance deviation was for the foodstuff was explained by 78.2%. The square root of $R^2 = (0.782)^{1/2} = 0.8843$ this value was very close to correlation coefficient of the foodstuff. A strong association among the prices variation was therefore evidenced. To justify the output in the ANOA table above estimated mean was produced by RCBD in SPSS as shown in table 4.5 below. The study therefore concluded that there was significance deviation and deviation was due to some factors and not by chance, hence there was statistical significance. Prevalence of variation was 78.2%, this value depicted high significance variation. The marginal mean estimate for the foodstuff was as shown below.

Food-stuff	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Nakumatt Prices of foodstuff	242.240	24.977	192.660	291.820
Tuskeys prices of foodstuff	227.760	24.977	178.180	277.340
Uchumi prices of foodstuff	225.000	24.977	175.420	274.580
Budget prices of foodstuff	232.760	24.977	183.180	282.340

Table 4.5 Estimated Marginal mean.

From the table above, it was illustrated that deviation between Uchumi prices and the and Tuskeys was Ksh 2.00 while that from Uchumi and Nakumatt was Ksh17.00 if one shop from tuskeys with respect to Nakumat they would pay Ksh 15.00 more while Buget and Uchumi Ksh 7.00 and budget and nakumatt one could pay Ksh 10.00 more . Nakumatt therefore become dear supermarket in foodstuff followed Budget, Tuskey and Uchumi being the cheapest of all.
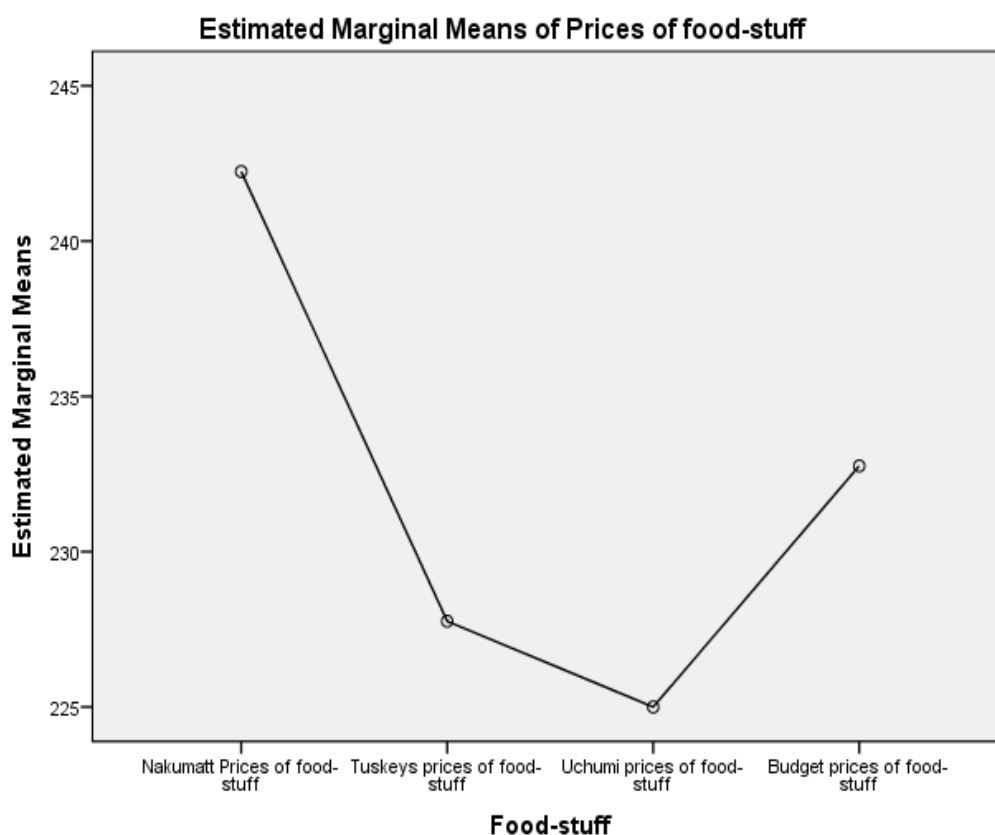
Graph 4.3 shows estimated marginal mean of foodstuff category

It is therefore conclude that Nakumatt is the dearest prices and Uchimi was the pocket friendly.

4.3 Correlation on the price deviation from the four supermarkets

The question was to determine correlation amongst the supermarket prices the study found out that there was a strong correlation amongst the supermarket prices and for all the categories of the commodities as the results displayed in the table below. The asterisk indicates significant in correlations and rejection of the null hypothesis

		Nakumatt prices of drinks and beverages	Tuskeys prices of drinks and Beverages	Uchumi prices of drinks and Beverages	Budget prices of drinks and Beverages
Nakumatt prices of drinks and beverages	Pearson Correlation	1	.998**	.994**	.997**
	Sig. (2-tailed)		.000	.000	.000
	N	25	25	25	25
Tuskeys prices of drinks and Beverages	Pearson Correlation	.998**	1	.995**	.996**
	Sig. (2-tailed)	.000		.000	.000
	N	25	25	25	25
Uchumi prices of drinks and Beverages	Pearson Correlation	.994**	.995**	1	.986**
	Sig. (2-tailed)	.000	.000		.000
	N	25	25	25	25
Budget prices of drinks and Beverages	Pearson Correlation	.997**	.996**	.986**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	25	25	25	25

Table 4.6: **. Correlation is significant at the 0.01 level (2-tailed).

From table 4.6 the correlations were flagged this depicted significant correlation and also signify rejection of the null hypothesis. The same scenario was similar across all the food categories. The row written Sig has p-value <0.01 the study therefore, concluded that, there was strong relationship amongst the supermarket prices, the double asterisk on the correlation coefficient was an evidence to reject null hypothesis and conclude that there was significance deviation and statistical significance.

4.4 Model

The study applied RCBD model to predict the price deviation from the three categories of commodities. The R squared values were: drinks and beverages= 50.3%, foodstuff= 74.5% and non-foodstuff= 84.0%. The figures suggested that model were appropriate for determining the deviation in prices. Graph4.4 below represents the three model summary this was done to justify the suitable model of the study. At a glance the best model was the one for non-foodstuff deviation since it had the highest value (84.0%).

In addition to the coefficient of determination, goodness of fit of the model could be determine by squaring the correlation for individual categories of commodities and then multiply by 100 to convert it to percentage. When that was done, significant of the model still observed in all the cases the criterion was taken at 95% and 99% confidence intervals

If commodities represent replicates, supermarket prices to be treatments, the model will be as shown below for food category:

$Y_{ij} = \mu + \intercal_i + \beta_j + \varepsilon_{ij}$ where; Y_{ij}= j th observation of the i th treatment

μ= the population mean of items, $\intercal_i$= treatment effects, β_j= the j replicate effects and ε_{ij}= is the random error. Grand mean=5909, treatment mean i=5908.5, mean of replicates j=236.44: Y_{ij} = (grand mean) + (treatment mean) + (replicate mean). Hence, Y_{ij} = 5909+ 5908.5+236.44. Note, summation of random error terms results into zero hence not included in the model. Model for drinks and beverages, $Y_{ij} = 3294 + 526.96 + 32.94$. Model for non foodstuff, $Y_{ij} = 4876 + 780.16 + 195.04$.
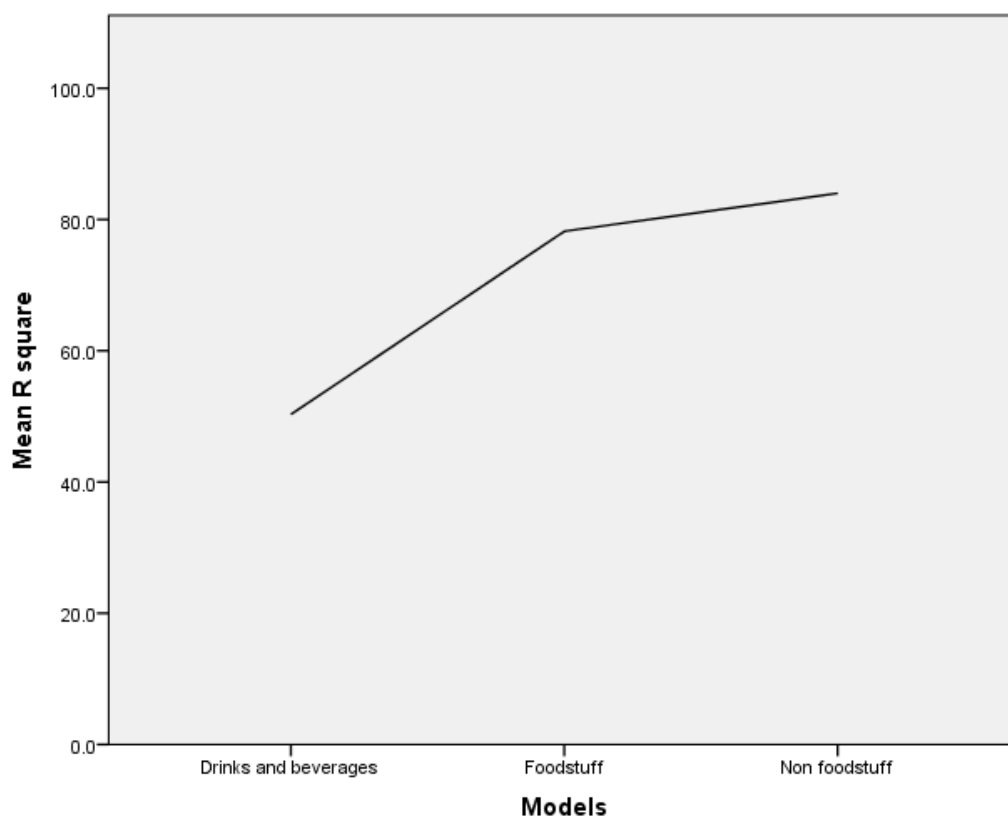
Graph 4.4 showing significance model

The graph above shows the three models, non-foodstuff was the best model to determine the price deviation since it has higher r square compared to the foodstuff and drink and beverages. In table 4.1.1 below indicated significance of the model since the intercept has p<0.05

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	3804060.160	1	3804060.160	12358.335	.000
	Error	923.440	3	307.813[a]		
Nonfood_stuff	Hypothesis	923.440	3	307.813	0.041	.981
	Error	723974.400	96	7541.400[b]		
Table 4.9: Non- foodstuff model table						
Since the p-value<0.05 for the non-foodstuff category model it there was enough evidence to conclude that, model had good fit hence significance.						

Bar graph 4.4.1 of the three food categories model

The bar graph above confirmed the validity of fitness of the model presented by the ANOVA table 4.9 above. The longest graph was that for non-foodstuff model followed by foodstuff and beverages and drinks was the shortest.

5.0 Conclusion and Summary

5.1 Significance in price deviation

From the analysis provided ANOVA tables for all categories of commodities, p-value< 0.05 for all the categories of commodities. This provided enough evidence to reject the null hypothesis and conclude that, price deviation was significant at 95% confidence of intervals. The decision was taken at 95% of confidence Intervals. The same decision would be similar at 99% of CI. The value of the coefficient of determination (R^2) explained the significance deviation, statistical significance and prevalence in variation. R^2 value for all the categories of commodities were: drinks and beverages $R^2 = 50.3\%$, foodstuff $R^2 = 78.5\%$ and non foodstuff $R^2 = 84\%$. Since the coefficient of determination for the RCBD model for food categories had the least adjusted R= 50.3% there was substantial evidence to conclude that there was significant deviation on supermarket price variations. This conclusion was supported by the evidence on coefficient of correlation.

5.2 Correlation

From tables 4.5, 4.6, and 4.7 the p<0.01 and the correlation are flagged. The study concluded that there was strong association of the supermarket prices the decision was taken at 99% of C.I and also at 95% CI as evidenced in tables 4.1, 4.2, and 4.3 respectively. Positive sign was an indication that prices linearly dependent and only follow upward trend. Similar significance was observed from the square root of the coefficient of determination. In addition to ANOVA table correlation provided evidence to reject null hypothesis and conclude that, price deviation was significance. Correlation coefficient was flagged by two asterisks (**) at margin error of 5% the asterisks is the evidence to reject null hypothesis and conclude that, there was statistical significance.

5. 3 Statistical Significance

The guidelines to answer this question were drawn from the coefficient of determination and ANOVA table. From the ANOVA table the p< 0.05. Since the p-value was less than the alpha value, the study found suitable evidence to conclude that there was statistical significance. The variation in prices did follow certain factors. Hence, deviation in prices did not happen by chance. It was also an indication that there existed a stiff completion among the supermarket and that none of the management could dare cap their prices above kink demand curve. The statistical significance was also explained by coefficient of determination (R^2). The values for R^2 were: 50.3%, 77.2% and 84% for drinks and beverages, food-stuff and non-food-stuff respectively.

5. 4 Prevalence of Variances

The variances of the study was explained by coefficient of determination, study revealed that, there was profound variation. From the ANOVA table of each category of the commodity coefficient of determination was computed at the bottom, significance column of the ANOVA table, p<0.05. Thus, there was enough evidence to conclude that, there was high prevalence variation.

Initially, in chapter three the study was to apply Mauchly's Test of Sphericity to analyze data and test null hypothesis on similarity of the variance of the price deviation, but Mauchly's test has several weakness in that it may lead to retaining of the null hypothesis when it is actually false. As a result, this study therefore decided to maintain test of variances by RCBD.

Being that this study dropped Mauchly's test, this doesn't hinder other researchers from applying the test in their studies.

5.5 Recommendations on future areas of study

The study recommend future study in the areas such: Trends on prices deviations from one supermarket to another, Significance factors influencing the price variations and Study on deviations compared to recommended consumer prices.

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