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An Analysis of Covariance in Evaluating the Effects of Marketing Strategies

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Abstract

Marketing strategies in the wake of the 21st century is confronted with several challenges that even the giant Companies like Coca-Cola are keen at knowing the best market strategies that will boost its scope to survive competition from sister brands. This study aimed at evaluating the effects of 4pics market strategies in boosting sales of Coca-Cola products across the major depots. The results of the analysis showed Promotion mix, Brand mix, and Place mix met the assumptions of the model with a p-value of 0.334 which were not statistically significant thereby, meeting the conditions of independence and homogeneity of regression. The tables of analysis showed that the various sales at the three depots are significant with a p-value of 0.016 and squared partial Eta of 0.068 account for 1.6% chance that this result happened to random error alone. Also, the between subject effects for Place mix increased from 0.016 to 0.011 which signifies that when Promo and Brand mix are held constant in the model, the number of Coca-Cola soft drinks sold at each depot were significantly different. In conclusion, the company need to invest more on the three 3pics market strategies.

Keywords

Market Strategies, ANOVA, ANCOVA, Coca-Cola, 4pics

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1. Introduction

Most companies in the wake of the 21st century is confronted with diverse challenges especially in a developing country like Nigeria with series of diversity in the marketing strategies. The Coca-Cola Company have made remarkable success as one of the earliest soft drink Companies that penetrated the heart of the most populous black African nation in the globe. [1] stated that one of the guiding principle of any business organization is to maximize profit and any other reason is added. Thus, for any business to be carried out the firm would undergo a strong business research to know the strategies that it will employed to run a successful business in a given society. In addition, it is generally known that several organizations adopt different market sale strategies such as promotion and experimental design to boost its influences and surviving the market competition. Experimental design as a branch of statistics mainly involves the arrangement and procedures adopted in an experimental study. This arrangement has an analysis of covariance as a method used to boost the precision of an experiment in special cases. Analysis of covariance usually features and become vital to adopt when an experiment originally with response variable Y has an explanatory variable say X, where the variable Y is linearly related to the independent variable X but not wholly dependent on it. If the X variable can only be observed along with Y but cannot be subjected to the experimenter's control, then such a variable (x) is called a covariate or concomitant variable [2]. Therefore, analysis of covariance basically encapsulates the adjustment of the observed response variable in other to account for the uncontrollable variables that may arises during experimentation. In most experiments where such

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adjustment is required but it is ignored, the concomitant variable could inflate the error mean square and make the true differences in the response the treatment hard to detect [3], thereby limiting the possibilities of rejecting the null hypothesis. [4] opined that analysis of covariance is a method of adjusting the observed response variable *(Y)* for the effect of an uncontrollable nuisance variance *(X)*. In the light of this, one can see that there are several factors that may affect sales of certain product from a company, some of these factors may results to poor sales and bankruptcy of a firm.

1.1. Statement of the Problem

Coca-Cola have gained enormous ground in the Nigerian market as one of the most favourite carbonate soft drinks consumed by Nigerians and worldwide. The Coca-Cola bottling company in Nigeria have disclosed recently that in 2016 its net profit was GBP 344 million compared to GBP 280.7 million in 2015. However, the company stated that its revenue in Nigeria fell by 6% to GBP 583.3 million compared to GBP 621 million in 2015 and according to the 2013 annual financial report, the company have decided to adopt several market strategies to boost sales across the depots in the Country. Though several measures have been put in place to determine the effective market campaigning strategies, the company is keen at minimizing wastage therefore wanting to evaluate the actual 4pics in the Market strategies in each state that can maximise profit sales from its products However, some of the depots have witnessed a drastic decline in the sales of her stocked products to retailer and wholesalers which have grieved the company, hindering its target and realization of sales most of targeted areas. To evaluate some of the marketing 4pics strategies adopted by the company that may have interactions with the number of sales in some depots of the company in Benue state, Nigeria, the Analysis of Covariance approach is adopted to determine the 4pics market strategies (factors) that may have affected the sales of Coca-Cola brands in some depots across the state.

1.2. Research Questions and Hypotheses

To address the issues confronting sales of coca cola soft drinks across some depots in Benue state, there are need for this research to address certain questions that create insight to the formulation of the aim and objectives of the study, some of which include:

1. What are they market strategies adopted by Coca-Cola in the sale of soft drinks across target depots in Benue state?
2. Does sales varies across the depots in the state?
3. Which of the market strategies adopted affects sales of products across the depots?
4. The research hypotheses for this study are stated in their null form:
5. There is no significant difference in the market strategies adopted by coca cola in the sale of soft drinks across target depots in Benue state.
6. There is no significant difference among the sales output from different depot in the state during the promotion campaign.

1.3. Aim and Objectives of the Study

In accordance to the issues set to address by this study, the overall aim of the study was to evaluate the effects of the 4pics market strategies on sale of Coca-Cola soft drinks. This was achieved through the following specific objectives:

1. To determine which of the 4pics market strategies affects sales of Coca-Cola soft drinks across the targeted distribution depots
2. To determine the sales across the targeted depots without the effects of the covariates
3. To include the factors (covariates) that affects market sales across the depots in the model

This study created insight to understanding the effects of the 4pics market strategies in boosting the sales and distribution of soft drinks like Coca-Cola, study some of the factors that have posed setbacks in certain localities and give more rooms for further market research and strategies that will boost income revenue of the company. Considering the scope of this study, there are many reasons why a particular market strategy exercise may thrive or fail in certain areas of interest, however, this study shall narrow its interest in considering the market strategies that the company have employed in the past and present to boost its sales across the states in Nigeria, also three main depots across the three geo-senatorial zones of the state were considered instead of the entire twenty-three local government and ward districts of the state.

2. Literature Review

The Coca-Cola soft drink company initially started by John S Pemberton in 1886 and served at Jacob's Pharmacy, ever since then the company's products are consumed across every household all over the globe. The Nigerian Bottling Company Ltd (NBC) was incorporated in November 1951, as a subsidiary of the A. G. Leventis Group with the franchise to bottle and sell products of Coca-Cola Company in Nigeria [7]. Ever since the commencement of the industry in Nigeria, it has thrived considerable due to the company's diversification strategies and active participant in the Nigeria eco-friendly market system.

[1] opined that Coca-Cola Company in Nigeria adopted the market strategies of the four (4) basic marketing strategies which are mainly known as the 4ps which represent price, product, promotion and place are exceedingly adopted by Coca Cola Company in Nigeria. Coca Cola Company strategy of sales was price penetration where low price is charged, and the company attends large market as possible. Marketing mix – according to [1]; [8] found that marketing mix consider the following factors: promotion, products, price and place. These four elements are commonly known as the "4Ps" and are considered in more detail in the contest of international marketing strategies. However, the commonly "4Ps" can also serve as a player in the short-term action and reaction pattern of firms in context of marketing responses to product life cycle.

Overview of Marketing Strategies Used by Coca-Cola Company in Nigeria

The coca cola in Nigeria have used the strategy of marketing mix to market her products internationally.

1. *Promotion tactics* - This explains the organisational total effort attempt to attained increase sales in the short run. The coca cola had spent a large sum of money on the given and provision of reasons and incentives to the middlemen and the consumers of the coca cola products to pull them to buy their products. As admit by [6] that "a firm can spend large sums of money on advertising or sales promotion, but it stands little chance of success if the product is of poor quality, if priced improperly or does not have adequate distribution to consumers".
2. *Price tactics* - Price is the determinant of the forces of demand and supply by allocating resources among the consumers and the producers in the market. Here it is use to predict the competitors' responses, it is also help to select particular pricing approaches for the firms' product. In Nigeria for example, the coca cola used what we called "price penetration".
3. *Place tactics* – This involve selection of distribution channels, transport arrangement etc. The Coca cola Company in areas of distributive channels has tried so much by reaching almost every part of Nigeria. The company is said to have twelve factory plants, sixty depots and over four hundred thousand dealers nationwide. The above expression shows that the coca cola company have a strong base in Nigeria in the areas of distribution channels. This also contributed to her fastest growing among the multinational enterprises in Nigeria.
4. *Product tactics*. - This approach mainly focuses on the life cycle of the product, brands, sizes etc. In Nigeria for instance, the Coca-Cola company since her establishment in Nigeria 1951, it is still growing and maturing, it's has not get to the declining stage [1].

Closely Related Works

According to [9] an experiment is a process or study that results in the collection of data. The results of experiments are not known in advance. Usually, statistical experiments are conducted in situations in which researchers can manipulate the conditions of the experiment and can control the factors that are irrelevant to the research objectives. [10] opined that the Analysis of Covariance (generally known as ANCOVA) is a technique that sits between analysis of variance and regression analysis. ANOVA can be extended to include one or more continuous variables that predict the outcome (or dependent variable). Continuous variables such as these, that are not part of the main experimental manipulation but have an influence on the dependent variable, are known as covariates and they can be included in an ANOVA analysis. [5] stated that in Analysis of Covariance (ANCOVA) there is a need to incorporate additional variable(s) into the model to reduce the error variance. Analysis of variance (ANOVA) models are restrictive in that they allow only categorical predicting variables. Analysis of covariance (ANCOVA) models remove this restriction by allowing both categorical predictors (often called grouping variables or factors) and continuous predictors (typically called covariates) in the model ("Analysis of Covariance (ANACOVA) ANACOVA is used to compare the mean response to different treatments when a quantitative variable.

Single Factor Analysis of Covariance

[2, 3] opined that the analysis of covariance design in its simplest form is one comparable to a single factor analysis of variance where we have a single categorical predictor variable (factor). In addition to a single continuous response variable, the value of a continuous covariate is recorded from each experimental unit.

3. Material and Methods

In other to achieve the specific objectives of the study, a detailed mathematically equations, and other approaches relevant to its realization were explored. The data collected for this study is a secondary sourced data that were gotten from the major Coca-Cola depots across the state (Makurdi, Gboko and Otukpo L. G. A). The data consist of the 4pics market strategies (Place, Promo mix, Product (Brand) mix, and Price mix) that is adopted by the Coca-Cola Company in Nigeria over the years. Also, interviews were carried with the respective Coca-Cola dealers and staffs to validate the information gotten from the depots.

Mathematical Model Formulation

If there is a linear relationship between the response and the covariate, an appropriate statistical model is

$$Y_{ij} = \mu + \alpha_i + \beta(X_{ij} - \overline{X}) + \varepsilon_{ij} \{i = 1,2,...,m, j = 1,2,...,n\} \quad (1)$$

where;

Y_{ij} is the j^{th} observation in the response variable taken under the i^{th} treatment.

X_{ij} is the measurement made on the covariate corresponding to Y_{ij}.

$\left(X_{ij} - \overline{X}\right)$ is the concomitant variable in the model.

$\overline{X}$ is the mean of the X_{ij} values.

μ is the overall mean

α_i the effect of the ith treatment

β is the linear regression coefficient indicating the tendency of Y_{ij} on X_{ij}, *while* ε_{ij} is the error term.

Assumptions of the Model

The error terms are independently and identically normally distributed with zero mean and variance, that is $N(0, \sigma^2)$

The regression coefficients are not equal to zero that is $\beta_j \neq 0, j = 1, \ldots, p$

The treatment effect sum to zero, that is $\sum_{i=1}^{m} \alpha_i = 0$

The values of the covariates can vary independently across the levels of the independent variable.

The relationship between Y_{ij} and X_{ij} is linear.

To further elicit the analysis of single factor covariance with response variable Y and a covariate X, the following equations are worthy of noting:

$$S_{yy} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{..}\right)^2, \; S_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - \overline{X}_{..}\right)^2, \; S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - \overline{X}_{..}\right)\left(Y_{ij} - \overline{Y}_{..}\right)$$

$$T_{yy} = n\sum_{i=1}^{m}\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^2, \; T_{xx} = n\sum_{i=1}^{m}\left(X_{i.} - \overline{X}_{..}\right), \; T_{xy} = n\sum_{i=1}^{m}\left(X_{i\,.} - \overline{X}_{..}\right)\left(\overline{Y}_{ij} - \overline{Y}_{..}\right)$$

$$E_{yy} = n\sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{i.}\right)^2, \; E_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - \overline{X}_{i\cdot}\right)^2, \; E_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - \overline{X}_{i.}\right)\left(Y_{ij} - \overline{Y}_{i.}\right) \quad (2)$$

For ease of computation, equation (2) can be simplified further as follows.

$$S_{yy} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{..}\right)^2 = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij}^2 - 2Y_{ij}Y_{..} + Y_{..}^2\right), \; S_{yy} = \sum_{i=1}^{m}\sum_{j=1}^{n}Y_{ij}^2 - 2\overline{Y}_{..}\sum_{i=1}^{m}\sum_{j=1}^{n}Y_{ij} + mn\overline{Y}_{..}^2$$

but

$$\overline{Y}_{..} = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}Y_{ij},$$

thus;

$$S_{yy} = \sum_{i=1}^{m}\sum_{j=1}^{n}Y_{ij}^2 - 2mn\overline{Y}_{..}^2 + mn\overline{Y}_{..}^2 \Rightarrow S_{yy} = \sum_{i=1}^{m}\sum_{j=i}^{n}Y_{ij}^2 - mn\overline{Y}_{..}^2 \quad (3)$$

More so, one can express the grand mean as $\overline{Y}_{..} = \frac{\overline{Y}_{i.}}{mn}$

$$S_{yy} = \sum_{i=1}^{m}\sum_{j=1}^{n}Y_{ij}^2 - \frac{\overline{Y}_{i.}^{\,2}}{mn}, \; S_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - \overline{X}_{..}\right)^2 = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}^2 - 2X_{ij}\overline{X}_{..} + X_{..}^2\right),$$

but;

$$\overline{X}_{..} = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij} \ ,$$

thus;

$$S_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}^2 - 2mn\overline{X}_{..}^{\,2} + mn\overline{X}_{..}^{\,2} \rightarrow S_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}^2 - mn\overline{X}_{..}^{\,2} \ldots \tag{4}$$

also

$$\overline{X}_{..} = \frac{\overline{X}_{i.}}{mn}, \ \therefore S_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij} - \frac{\overline{X_{i.}}^{2}}{mn}, \ \Rightarrow S_{xy} = \sum_{i=1}^{m}\sum_{j=i}^{n}\left(X_{ij} - \overline{X}_{..}\right)\left(Y_{ij} - \overline{Y}_{..}\right),$$

this can further be expressed as:

$$S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}Y_{ij} - X_{ij}\overline{Y}_{..} - Y_{ij}\overline{X}_{..} + \overline{X}_{..}\overline{Y}_{..}\right)$$

$$S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}Y_{ij} - \overline{Y}_{..}\sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij} - \overline{X}_{..}\sum_{i=1}^{m}\sum_{j=1}^{n} Y_{ij} + mn\overline{X}_{..}\overline{Y}_{..},$$

$$\overline{Y}_{..} = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n} Y_{ij}, \overline{X}_{..}\frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}$$

$$\Rightarrow S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}Y_{ij} - mn\overline{X}_{..}\overline{Y}_{..}mn\overline{X}_{..}\overline{Y}_{..}\tan\overline{X}_{..}\overline{Y}_{..},$$

$$S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}Y_{ij} - mn\overline{X}_{..}\overline{Y}_{..}$$

also

$$\overline{X}_{..} = \frac{1}{mn}\overline{X_{i.}} \ and \ \overline{Y}_{..} = \frac{1}{mn}\overline{X_{i.}}, \ S_{xy} = \sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}Y_{ij} - \frac{\overline{X_{i.}}\,\overline{Y_{i.}}}{mn} \tag{5}$$

where;

$$T_{yy} = n\sum_{i=1}^{m}\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^2 = n\sum_{i=1}^{m}\left(\overline{Y}_{i.}^{2} - 2\overline{Y}_{i.}\overline{Y}_{..} + \overline{Y}_{..}^{2}\right)$$

$$T_{yy} = n\sum_{i=1}^{m}\overline{Y}_{i.}^{2} - 2n\overline{Y}_{..}\sum_{i=1}^{m} Y_{i.} + mn\ \overline{Y}_{..}^{2}, but\ \overline{Y}_{..} = \frac{1}{m}\sum_{i=1}^{m} Y_{i.}$$

$$\Rightarrow T_{yy} = n\sum_{i=1}^{m}\overline{Y}_{i.}^{2} - 2mn\ \overline{Y}_{..}^{2} + mn\ \overline{Y}_{..}^{2}, \ T_{yy} = n\sum_{i=1}^{m}\overline{Y}_{i.}^{2} - mn\ \overline{Y}_{..}^{2}, \ \overline{Y}_{..} = \frac{1}{mn}\overline{Y}_{i.} and\ \overline{Y}_{i.} = \frac{Y_{i.}}{n}$$

$$\therefore T_{yy} = n\sum_{i=1}^{m}\frac{\overline{Y}_{i.}^{2}}{n} - \frac{\overline{Y}_{..}^{2}}{mn}, \ T_{xx} = n\sum_{i=1}^{m}\left(\overline{X}_{i.} - \overline{X}_{..}\right)^2 = n\sum_{i=1}^{m}\left(\overline{X}_{i.}^{2} - 2\overline{X}_{i.}\overline{X}_{..} + \overline{X}_{..}^{2}\right) \tag{6}$$

$$\Rightarrow T_{xx} = n\sum_{i=1}^{m}\overline{X}_{i.}^{2} - 2n\overline{X}_{..}\sum_{i=1}^{m}\overline{X}_{i.} + mn\ \overline{X}_{..}^{2}\ ,\ \overline{X}_{..} = \frac{1}{m}\sum_{i=1}^{m}X_{i.}$$

$$T_{xx} = n\sum_{i=1}^{m}\overline{X}_{i.}^{2} - 2mn\overline{X}_{..}^{2} + mn\overline{X}_{..}^{2} \Rightarrow n\sum_{i=1}^{m}\overline{X}_{i.}^{2} - mn\overline{X}_{..}^{2}, \tag{7}$$

where:

also

$$\overline{X}_{i.} = \frac{X_{i.}}{n}\ \ and\ \ \overline{X}_{..} = \frac{X_{..}}{mn},\ T_{xx} = \frac{X_{i.}^{2}}{n} - \frac{X_{..}^{2}}{mn},$$

so that

$$T_{xy} = n\sum_{i=1}^{m}\left(\overline{X}_{i.} - \overline{X}_{..}\right)\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)$$

$$T_{xy} = n\sum_{i=1}^{m}\left(\overline{X}_{i.}\overline{Y}_{i.} - \overline{X}_{i.}\overline{Y}_{..} - Y_{i.}\overline{X}_{..} + \overline{X}_{..}\overline{Y}_{..}\right) \Rightarrow n\sum_{i=1}^{m}\overline{X}_{i.}\overline{Y}_{i.} - n\overline{Y}_{..}\sum_{i=1}^{m}\overline{X}_{i.} - n\overline{X}_{..}\sum_{i=1}^{m}\overline{Y}_{i.} + mn\overline{X}_{..}\overline{Y}_{..}$$

but $\overline{X}_{..} = \frac{1}{m}\sum_{i=1}^{m}X_{i.}$ *and* $\overline{Y}_{..} = \frac{1}{m}\sum_{i=1}^{m}Y_{i.}$

so that

$$T_{xy} = n\sum_{i=1}^{m}\overline{X}_{i.}\overline{Y}_{i.} - mn\overline{X}_{..}\overline{Y}_{..} - mn\overline{X}_{..}\overline{Y}_{..} + mn\ \overline{X}_{..}\overline{Y}_{..}\ T_{xy} = n\sum_{i=1}^{m}\overline{X}_{i.}\overline{Y}_{i.} - mn\ \overline{X}_{..}\overline{Y}_{..} \tag{8}$$

Similarly,

$$\overline{X}_{i.} = \frac{X_{i.}}{n}, Y_{i.} = \frac{Yi.}{n}\ \ and\ \ \overline{X}_{..} = \frac{X_{..}}{mn},\ \ \overline{Y}_{..} = \frac{Y_{..}}{mn}\ \ ,\ T_{xy} = n\sum_{i=1}^{m}\frac{X_{i.}Y_{i.}}{n} - \frac{X_{..}Y_{..}}{mn}$$

$$E_{yy} = \sum_{i=1}^{a}\sum_{j=1}^{n}\left(Y_{i_j} - \overline{Y}_{i\cdot}\right)^{2} - 2\left(Y_{ij} - \overline{Y}_{..}\right)\left(\overline{Y}_{i.} - \overline{Y}_{..}\right) + \left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^{2}$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{i.}\right)^{2} - 2\sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{..}\right)\left(\overline{Y}_{i.} - \overline{Y}_{..}\right) + n\sum_{i=1}^{m}\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^{2}$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{..}\right)^{2} - 2n\sum_{i=1}^{m}\ \left(\overline{Y}_{i.} - \overline{Y}_{..}\right) + n\sum_{i=1}^{m}\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^{2}$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij} - \overline{Y}_{..}\right)^{2} - n\sum_{i=1}^{m}\left(\overline{Y}_{i.} - \overline{Y}_{..}\right)^{2}$$

Thus, this can be expressed as: $E_{yy} = S_{yy} - T_{yy}$, similarly one can express the expectations of the covariates as:

$$E_{xx} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij} - X_{i.}\right)^{2} = \sum_{i=1}^{m}\sum_{j=1}^{n}\left[\left(X_{ij} - \overline{X}_{..}\right) - \left(X_{ij} - \overline{X}_{..}\right)\right]^{2}$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-X_{i.}\right)^2-2\left(X_{ij}-\overline{X}_{..}\right)\left(X_{i.}-\overline{X}_{..}\right)+\left(X_{ij}-X_{..}\right)^2$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-\overline{X}_{..}\right)^2-n\sum_{i=1}^{m}\left(\overline{X_{i.}}-\overline{X}_{..}\right)^2$$

Thus;

$$E_{xx}=S_{xx}-T_{xx} \tag{9}$$

and

$$E_{xy}=\sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-\overline{X}_{i.}\right)\left(Y_{ij}-\overline{Y}_{i.}\right)$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left[\left\langle\left(X_{ij}-\overline{X}_{..}\right)-\left(\overline{X}_{i.}-\overline{X}_{..}\right)\right\rangle\left\langle\left(Y_{ij}-\overline{Y}_{..}\right)-\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)\right\rangle\right]$$

$$\Rightarrow \sum_{i=1}^{m}\sum_{j=1}^{n}\left[\left(X_{ij}-\overline{X}_{..}\right)\left(Y_{ij}-\overline{Y}_{..}\right)-\left(X_{ij}-\overline{X}_{..}\right)\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)-\left(Y_{ij}-\overline{Y}_{..}\right)\left(\overline{X}_{i.}-\overline{X}_{..}\right)+\left(\overline{X}_{i.}-\overline{X}_{..}\right)\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)\right]$$

$$E_{xy}=\sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-\overline{X}_{..}\right)\left(Y_{ij}-\overline{Y}_{..}\right)-\sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-\overline{X}_{..}\right)\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)$$

$$-\sum_{i=1}^{m}\sum_{j=1}^{n}\left(Y_{ij}-\overline{Y}_{..}\right)\left(\overline{X}_{i.}-\overline{X}_{..}\right)+n\sum_{i=1}^{m}\left(\overline{X}_{.i}-\overline{X}_{..}\right)\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)$$

$$=\sum_{i=1}^{m}\sum_{j=1}^{n}\left(X_{ij}-\overline{X}_{..}\right)\left(Y_{ij}-\overline{Y}_{..}\right)-n\sum_{i=1}^{m}\left(\overline{X}_{i.}-\overline{X}_{..}\right)\left(\overline{Y}_{i.}-\overline{Y}_{..}\right)$$

$$\Rightarrow E_{xy}=S_{xy}-T_{xy} \tag{10}$$

Since the regression coefficient β in the model has been assumed to be non-zero. The hypothesis $H_0:\beta_j=0, j=1,....,n$ is tested by using the test statistic

$$F_{cal}=\frac{\beta E_{xy}}{MSE} \text{ with } [m(n-1)-1]$$

degrees of freedom and $\hat{\beta}=\frac{E_{xy}}{E_{xx}}$,

so that

$$SSE=E_{yy}-(E_{xy})^2/E_{xx}$$

and $MSE=\frac{SSE}{m(n-1)-1}$

Consider the null hypothesis, it is distributed as a Fisher distribution.

Decision criteria: reject H_0 if $F_{cal}>F_{Tab}$ or in same manner using the p-value approach, reject H_0 if $P-value_{cal}<0.05$

To test the hypothesis of no treatment effect i.e.

$H_0:\alpha_i=0, i=1,...,m$, compute the test statistic

$$F_{cal*}=\frac{[SSE'-SSE]/m-1}{SSE/m(n-1)-1} \tag{11}$$

Decision criteria:

reject H_0 if $F_{cal*}>F_{Tab}$

in same manner using the p-value approach, reject H_0 if $P-value_{cal}<0.05$

For computational purposes, the ANOVA/ANCOVA results of analysis are summarized using a table.

Consider the tabular layout below:

Table 1. Summary of Treatment Effects.

Source of Variation	Sum of Square	Degree of Freedom	Mean Square	F_{cal}
Treatment	$\left(\frac{S_{yy}-(S_{xx})^2}{S_{xx}}\right)-\left(\frac{E_{yy}-(E_{xx})^2}{E_{xx}}\right)$	$(m-1)$	$\frac{SSE'-SSE}{m-1}$	$\frac{MST_R}{MSE}$
Regression	$\frac{(S_{xy})^2}{S_{xx}}$	1	$\frac{SSE}{m(n-1)-1}$	
Error	$\left(\frac{E_{yy}-(E_{xx})^2}{E_{xx}}\right)$		$m(n-1)-1$	
Total	S_{yy}		$mn-1$	

4. Results of Analysis

Table 2. Test of Between-Subject Effects (Dependent Variable: Brand Mix).

Source	Type III sum of squares	df	Mean Square	F	Sig.
Corrected Model	10.317[a]	2			
Intercept	385.208	1	5.158	4.390	0.015
Place	10.317	2	385.208	327.837	0.000
Error	137.475	117	5.158	4.390	0.015
Total	533.000	120	1.175		
Corrected Total	147.792	119			

a: R Squared = 0.070 (Adjusted R Squared = 0.054

Table 3. Test of Between Effects (Dependent Variable: Promotion Mix).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8.550[a]	2			
Intercept	1098.075	1	4.275	1.358	0.261
Place	8.550	2	1098.075	348.761	0.000
Error	368.375	117	4.275	1.358	0.261
Total	1475.000	120	3.149		
Corrected Total	376.925	119			

a: R Squared = 0.023 (Adjusted R Squared = 0.06)

Table 4. Test of Between Subjects Effects (Dependent Variable: Price Mix (Wholesale Price in Naira)).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15.050[a]	2			
Intercept	421.875	1	7.525	4.400	0.014
Place	15.050	2	421.875	246.704	0.000
Error	200.075	117	7.525	4.400	0.014
Total	637.000	120	1.710		
Corrected Total	215.125	119			

a: R Squared = 0.070 (Adjusted R Squared = 0.054)

The ANOVA table were used to check the assumption of the model, from the ANOVA tables above, Price mix is statistically significant which does not meet the assumption of independence of the covariates across the levels of the dependent variables.

Thus; price mix will be omitted from the model. Next check the assumption of homogeneity of regression, here this assumption means that the slope for Promo mix, Brand mix are and the distribution across the depots are similar, to validate this assumption, the univariate ANOVA approach was applied, which displayed the following results.

Table 5. Tests of Between-Subjects Effects (Dependent Variable: Number Sold).

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	113284867[a]	11	10298624.27	3.526	0.000
Intercept	36282726.91	1	36282726.91	12.423	0.001
Place	3327212.307	2	1663606.153	0.570	0.567
Brand	11057863.33	1	11057863.33	3.786	0.054
Promo	9580950.018	1	9580950.018	3.280	0.073
Place*Brand	9241135.075	2	4620567.537	1.582	0.210

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Place*Promo	2606968.632	2	1303484.316	0.446	0.641
Place*Brand*Promo	10045246.09	3	3348415.362	1.146	0.334
Error	315433314.8	108	2920678.840		
Total	765614318.0	120			
Corrected Total	428718181.7	119			

a. R Squared = 0.264 (Adjusted R Squared = 0.189)

Here prior Interest is given to the row containing *Place*Brand*Promo* with a p-value of 0.334 which is not statistically significant, thus; accept the null hypothesis that meet the condition for homogeneity of regression. Having satisfied the two assumptions for ANCOVA, on can proceed with the analysis, but first check the analysis without the effects of the covariates

Table 6. Descriptive Statistics (Dependent Variable: Number Sold).

Major Suppliers depots	Mean	Standard Deviation	N
Makurdi	1509.3000	2154.06757	40
Gboko	2345.2500	2066.10590	40
Otukpo	1172.1000	1155.71039	40
Total	1675.5500	1898.07107	120

Table 7. Levene's Test of Equality of Error Variances[a].

F	df1	df2	Sig.
2.359	2	117	0.099

Tests the null hypothesis that the error
Variance of the dependent variable is equal
Across groups
a: Design: Intercept + Place

Table 8. Test of Between-Subjects Effects (Dependent Variable: Number Sold).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model		2				
Intercept		1	14591981.10	4.273	0.016	0.068
Place		2	336896136.3	98.650	0.000	0.457
Error		117	1491981.10	4.273	0.016	0.068
Total		120	3414822.389			
Corrected Total		119				

a. R Squared = 0.068 (Adjusted R Squared = 0.052)

From the Test between table above, it can be seen that the various sales at the three depots in the state are significant with a p-value of 0.016 and squared partial Eta of 0.068 which is small, and this means that the effects of the three levels that explained 6.8% of the dependent variable is only a 1.6% chance that this result happen to random error alone. Next consider the analysis using the covariate bearing in mind their effects, thus; consider the tables below:

Table 9. Levene's Test of Equality of Error Variances[a] (Dependent Variable: Number Sold).

F	df1	df2	Sig.
1.648	2	117	0.197

Tests the null hypothesis that the error
Variance of the dependent variable is equal
Across groups
a: Design: Intercept + Brand + Promo + Place

Table 10. Tests of Between-Subjects Effects (Dependent Variable: Number Sold).

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	60625120.6[a]	4				
Intercept	165274056.4	1	15156280.15	4.735	0.001	0.141
Brand	205442292.37	1	165274056.4	51.635	0.000	0.310
Promo	149754.538	1	20542292.37	6.418	0.013	0.053
Place	30284163.44	2	149754.538	0.047	0.829	0.000
Error	368093061.1	115	15142081.72	4.731	0.011	0.076
Total	765614318.0	120	3200809.227			
Corrected Total	428718181.7	119				

a. R Squared = 0.141 (Adjusted R Squared = 0.112)

From the above table for test of between subject effects, the p-value for Place is now 0.011 which is significant, which means that when you hold constant Promo and Brand the number of Coca-Cola soft drinks sold at each depot is different and is about 11% chance that it occurred at random error alone, also, the squared partial Eta value increased from 6.8% to 7.6%.

5. Conclusion and Recommendation

In modern times, marketing is changing in order to captivate and entice the mind of customers for certain products or service. The Coca-Cola Company in Nigeria in its push to dominate the soft drink industry uses the 4pics market strategies (Place, Promotion, Product, and Price) to boost its sales. From the validation of assumption of the model, it is worthy to note that brands of Coca-Cola Products (35cl RGB, 50cl RGB, etc.) and Promotion Mix (Advertising, Direct Marketing, Internet Marketing, Sale Promotion, etc.) have significant effects in determining the sales of Coca-Cola products in the location of interest. Thus; from the results and interpretations of the analysis, reject the first null hypothesis setup earlier and concluded that there is a significant difference at the 5% level of significance in the market strategies adopted by Coca-Cola in the sale of soft drinks across targeted depots in Benue state. Also, reject the second null hypothesis and concluded that there is a significant difference at the 5% level of significant, among the sales output from different depot in the state during the promotion campaign. More so, in checking the assumptions for ANCOVA, Price mix have little or no impact in the sales of the products due to the fixed prices measures adopted across the country to checkmate excess in the face of economic meltdown that have bedevilled Nigeria. Therefore, the Price Mix is irrelevant to the model in this study. In recommendation, this study have made some remarkable breakthrough in explaining the effects of the covariates on the dependent variables, yet the study need to investigate further some of the brands, advertising strategies that can establish long term public relationships between the target population and the Company. Therefore, there are needs to address some of these issues that may arises using other powerful Statistical tools like the Generalized Estimating Equations (GEE), Supervised Machine learning approaches like Random Forest and Support Vector Machine (SVM) to validate the accuracy of the estimators using the working correlation matrix and model selection approaches.

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