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Review Paper

Regression Analysis on the Rate of Consumption of Beer Drinks

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ABSTRACT
This study investigates the relationship between the consumption of three popular beer brands—33 Export, Life Beer, and Heineken—and the total quantity of beer drinks consumed at the Nigerian Bottling Company, Owerri. Using an ex post facto research design, monthly sales data spanning from October 2023 to September 2024 were collected and analysed through multiple regression analysis. The aim was to develop a predictive model that could inform production and marketing strategies within the beverage industry. The results revealed a strong positive relationship between total beer consumption and the combined sales of the three selected brands. Notably, 33 Export and Life Beer significantly contributed to total consumption, while Heineken exhibited a weaker, non-significant influence. The regression model produced a high R-squared value of 0.974, indicating strong explanatory power. Diagnostic tests confirmed the model's validity, with no violations of regression assumptions such as multicollinearity or non-normality of residuals. The study concludes that multiple regression is an effective tool for modelling beer consumption behaviour and offers valuable insights for operational planning and market positioning. Recommendations are made for targeted marketing and further brand-specific research to enhance strategic outcomes.

Keywords: *Beer consumption, multiple regression, 33 Export, Life Beer, Heineken, predictive model, Nigerian Bottling Company, SPSS.*

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I. Introduction

Regression analysis is a fundamental statistical method employed for modeling the relationship between a dependent variable and one or more independent variables. This study adopts multiple regression analysis to examine the factors influencing the rate of consumption of beer drinks in Nigeria, with a particular focus on the Nigerian Bottling Company, Owerri. The approach seeks to determine whether specific brands of beer, namely 33 Export, Life Beer, and Heineken, significantly contribute to the total quanti...

In business settings, the need for predictive analytics has become paramount. Many industries operate with minimal strategic frameworks for forecasting future events or optimizing resource allocation based on historical data. This gap often hinders their ability to maximize profit or mitigate losses. The application of multiple regression analysis offers a systematic method for uncovering insights and patterns in data, thereby enabling informed decisions.

The study is driven by the aim of generating a suitable model that can effectively describe and predict the rate of beer consumption. The specific objectives include constructing a regression model that links total beer consumption to three leading beer brands, testing the validity of this model, and forecasting future consumption. These objectives are guided by pertinent research questions aimed at validating the relationship between dependent and independent variables and assessing the model's prediction.

To achieve these objectives, this study frames key hypotheses. It tests whether a regression model that includes all three beer brands provides significant predictive power for total beer consumption. By employing multiple regression analysis, the study anticipates deriving actionable insights into consumer behavior and

production planning, which will benefit stakeholders, including producers, marketers, and researchers in the beverage industry.

The study focuses on data from the Nigerian Bottling Company in Owerri, collected over a one-year period from October 2023 to September 2024. These monthly data entries represent the total quantity of beer drinks consumed, as well as disaggregated data for the three brands under consideration. The research methodology emphasizes statistical rigor, incorporating standard procedures to ensure validity and reliability of the findings. While the scope of the study is constrained to a single production center.

II. Literature Review

Regression analysis serves as a cornerstone statistical technique for evaluating the relationships between variables and making predictions. In particular, multiple linear regression (MLR) has been widely embraced for its ability to analyse and interpret the influence of multiple independent variables on a single dependent variable. As described in the conceptual framework, regression analysis facilitates both predictive and explanatory modelling, offering insight into how various input factors jointly influence outcomes.

The advantages of regression analysis are well recognized. Its mathematical simplicity, interpretability, and robustness make it a preferred choice for researchers and practitioners. Regression models produce easy-to-use algebraic equations, and their performance can be evaluated using familiar statistical parameters such as correlation coefficients and R-squared values. Regression tools are also highly accessible, being integrated into platforms such as MS Excel and specialized data mining software. These characteristics have made regression a pervasive tool across numerous domains, including economics, marketing, social science, and the natural sciences. Cook and Weisberg (1983) laid the foundation for modern diagnostic tools for detecting heteroskedasticity in regression models. Their contribution introduced both graphical and formal statistical techniques that have since become standard practice in regression diagnostics, enabling researchers to assess the constancy of error variances and improve model specification and inference in empirical studies throughout the 2000s and beyond.

Nevertheless, regression analysis also faces several limitations. Its effectiveness is highly dependent on the quality of input data, and it is sensitive to multicollinearity among predictor variables. The presence of outliers, non-linearity, or categorical variables not properly encoded can reduce the accuracy and interpretability of the model. These limitations highlight the need for careful data preprocessing and validation when employing regression techniques.

From a theoretical standpoint, the multiple regression model is defined by a linear combination of independent variables to predict a dependent variable. The Gauss-Markov assumptions underlying this model—linearity, independence, normality, and equal variance—must be satisfied for the results to be valid. Ordinary Least Squares (OLS) is the standard estimation method, minimizing the sum of squared residuals. The theoretical derivation of OLS using matrix algebra ensures a generalizable and mathematically rigorous framework for parameter estimation. Significance testing, including F-tests and t-tests, is applied to evaluate model fit and the usefulness of predictors.

In empirical applications, regression models have been widely used in fields such as education, health, manufacturing, marketing, and social sciences. Several studies support the robustness and adaptability of regression analysis in explaining behavioural patterns, forecasting trends, and evaluating the influence of various socio-economic factors. For instance, Kleibuam et al. (1998) compared instructional designs using regression models, while Kulesar (2009) employed multiple regression analysis to examine the relationship between key economic indicators and tourism performance, demonstrating that factors such as GDP, inflation, and exchange rates significantly influence tourist arrivals and revenue. The study highlighted the utility of quantitative models in understanding tourism dynamics and guiding policy decisions aimed at stabilizing and promoting economic growth through the tourism sector.

Studies in the domain of consumer behaviour, particularly related to alcohol and beverage consumption, reveal further relevance of regression methods. Tremblay and Tremblay (2005) established that beer is a procyclical good, where consumption tends to rise with income. Freeman (2001) found beer consumption to be somewhat immune to economic cycles in the U.S., with a co-integrating relationship existing between beer, taxes, and economic variables. Similar studies in the UK by Blake and Nied (1997) revealed a positive correlation between beer consumption and unemployment, supporting the hypothesis that beer may serve as a stress-alleviating commodity during economic downturns.

Recent advancements in data science have contributed to the development of hybrid regression approaches. For example, Bansal et al. (2020) evaluated the predictive performance of simple and multiple regression algorithms in forecasting salaries and housing prices using machine learning performance metrics like R-squared and RMSE. Their findings confirmed the greater efficiency and predictive accuracy of multiple regression in handling complex datasets.

Bor et al. (2013) examined patterns of alcohol consumption during the global economic downturn of 2008–2009, revealing that the Great Recession had significant but complex effects on alcohol use. Their findings indicated that while overall alcohol consumption declined in some populations due to reduced income, certain groups—particularly those experiencing job loss or financial stress—showed increased heavy or binge drinking, highlighting the public health risks associated with economic crises.

In the context of ecological and fisheries studies, regression techniques such as Least Squares, Least Median of Squares (LMS), and Reweighted Geometric Means (RGM) have been employed to address heteroskedasticity and outlier sensitivity. Chen and Jackson (2000) found that LMS-based estimators provide greater robustness under irregular error structures, proposing a stepwise approach that incorporates outlier detection and estimator refinement.

The literature collectively affirms the practicality, versatility, and empirical relevance of multiple regression analysis. Whether applied to forecasting beer consumption, evaluating market demand, or analysing socio-economic data, the technique remains a reliable and insightful method for data-driven decision-making. This review underpins the present study's methodology, which aims to model beer consumption behaviour using multiple regression to inform production and marketing strategies in the Nigerian Bottling Company, Owerri.

III. Methodology

This study adopted an ex post facto design to examine the relationship between beer consumption and selected beer brands—33 Export, Life Beer, and Heineken—at the Nigerian Bottling Company, Owerri. This design is appropriate since the study relies on already existing records without manipulating any of the variables. The primary aim is to explore the predictive ability of the consumption levels of the selected beer brands on the total quantity of beer drinks consumed within the studied period.

The population for this study comprises monthly sales data from the Nigerian Bottling Company, Owerri, between October 2023 and September 2024. The dataset includes records of total beer consumption and disaggregated figures for the three selected beer brands. The selection of these specific brands is informed by their popularity, distribution, and relevance in the local market. The total sample for the study includes twelve observations, one for each month over the one-year period.

Data were collected from the company's existing records and entered into Microsoft Excel before being transferred into IBM SPSS for statistical analysis. The research employed multiple regression analysis to determine the influence of the independent variables (consumption of 33 Export, Life Beer, and Heineken) on the dependent variable (total beer consumption). The regression model used in this study is expressed as:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon}$$

Where:

- $\mathbf{Y}$ = Total quantity of beer consumed (dependent variable)
- $\mathbf{X_1}$ = Quantity of 33 Export consumed
- $\mathbf{X_2}$ = Quantity of Life Beer consumed
- $\mathbf{X_3}$ = Quantity of Heineken consumed
- $\boldsymbol{\beta_0}$ = Intercept
- $\boldsymbol{\beta_1, \beta_2, \beta_3}$ = Regression coefficients
- $\boldsymbol{\varepsilon}$ = Error term

The regression analysis involves the computation of R-squared to measure the proportion of variance in the dependent variable explained by the independent variables. Additionally, standard error estimates, significance values (p-values), and F-tests were used to assess the strength, reliability, and overall fit of the regression model. Coefficients with p-values less than 0.05 were interpreted as statistically significant.

Before running the regression analysis, the data were checked for violations of regression assumptions. This included evaluating multicollinearity using Variance Inflation Factors (VIF), inspecting normality through histograms and Q-Q plots of residuals, and assessing linearity and homoscedasticity by plotting standardized residuals against predicted values. These diagnostic checks ensured that the regression outputs were both reliable and valid.

To enhance interpretability, results of the regression analysis were presented in tabular form, summarizing the model summary, ANOVA output, and coefficient estimates. The regression equation derived from the model allows for the prediction of total beer consumption based on the values of the independent variables. This model was subsequently validated through a comparison of predicted and observed values to assess its predictive accuracy.

The methodological approach adopted in this study ensures that the findings are grounded in robust statistical procedures and applicable to real-world production and marketing decisions. By focusing on the quantitative relationship between specific beer brands and overall consumption, the study provides useful insights for business strategy, consumer behaviour analysis, and production planning within the beverage industry.

IV. Result

The statistical analysis conducted in this study employed multiple regression to determine the extent to which the consumption of 33 Export, Life Beer, and Heineken predicts the total quantity of beer drinks consumed at the Nigerian Bottling Company, Owerri, between October 2021 and September 2022. The analysis was performed using IBM SPSS software and involved evaluating the model fit, estimating regression coefficients, and interpreting the significance of each predictor.

Descriptive statistics of the dataset showed that consumption levels of all three beer brands varied monthly across the study period. The mean quantity of beer consumed per month was 40,742 bottles, with 33 Export having the highest average monthly contribution, followed by Life Beer and Heineken. The observed fluctuations indicated that consumer preference and market dynamics varied across months, making a multivariate regression model appropriate for predictive analysis.

The model summary output provided an R value of 0.987, indicating a very strong positive correlation between the total beer consumption and the combined consumption of the three selected beer brands. The R-squared value ($R^2 = 0.974$) revealed that 97.4% of the variation in total beer consumption could be explained by the consumption levels of 33 Export, Life Beer, and Heineken. The adjusted R-squared value of 0.964 further affirmed the robustness of the model while accounting for the number of predictors included.

The ANOVA table indicated that the regression model was statistically significant with an F-value of 93.652 and a significance level of $p < 0.001$. This result confirms that the overall regression model provides a good fit to the data and that at least one of the independent variables significantly predicts the dependent variable.

The coefficients table revealed the relative contributions of each independent variable to the prediction of total beer consumption. The unstandardized beta coefficients were as follows: 33 Export ($\beta = 0.481$), Life Beer ($\beta = 0.412$), and Heineken ($\beta = 0.285$). All three predictors had positive coefficients, indicating that increases in the consumption of any of the beer brands would lead to increases in total beer consumption. However, the t-tests revealed that only the coefficients for 33 Export and Life Beer were statistically significant ($p < 0.05$), while Heineken was not significant at the 5% level. This suggests that while Heineken contributes to total consumption, its predictive power is relatively weak compared to the other two brands.

Collinearity statistics showed tolerance values above 0.1 and VIF values well below 10, indicating no multicollinearity concerns among the independent variables. Residual plots showed no major deviations from linearity, and normal probability plots confirmed that the residuals were approximately normally distributed, satisfying regression assumptions.

The derived regression equation from the analysis is:

Total Beer Consumption = 2,048.74 + 0.481(33 Export) + 0.412(Life Beer) + 0.285(Heineken)

This equation allows for the prediction of total beer consumption using the known consumption values of the three brands. For example, inserting monthly sales figures for each beer brand into the equation can generate accurate estimates of overall consumption, aiding production and inventory planning.

In summary, the results confirm that multiple regression is an effective model for explaining beer consumption trends at the Nigerian Bottling Company. The model demonstrated high predictive strength, and the analysis validated the significance of 33 Export and Life Beer as strong drivers of total consumption. These insights are critical for marketing strategists and production managers in resource allocation, sales forecasting, and promotional planning. While Heineken had a positive influence, its contribution was less significant, potentially suggesting the need for targeted marketing to improve its impact.

Normality Test

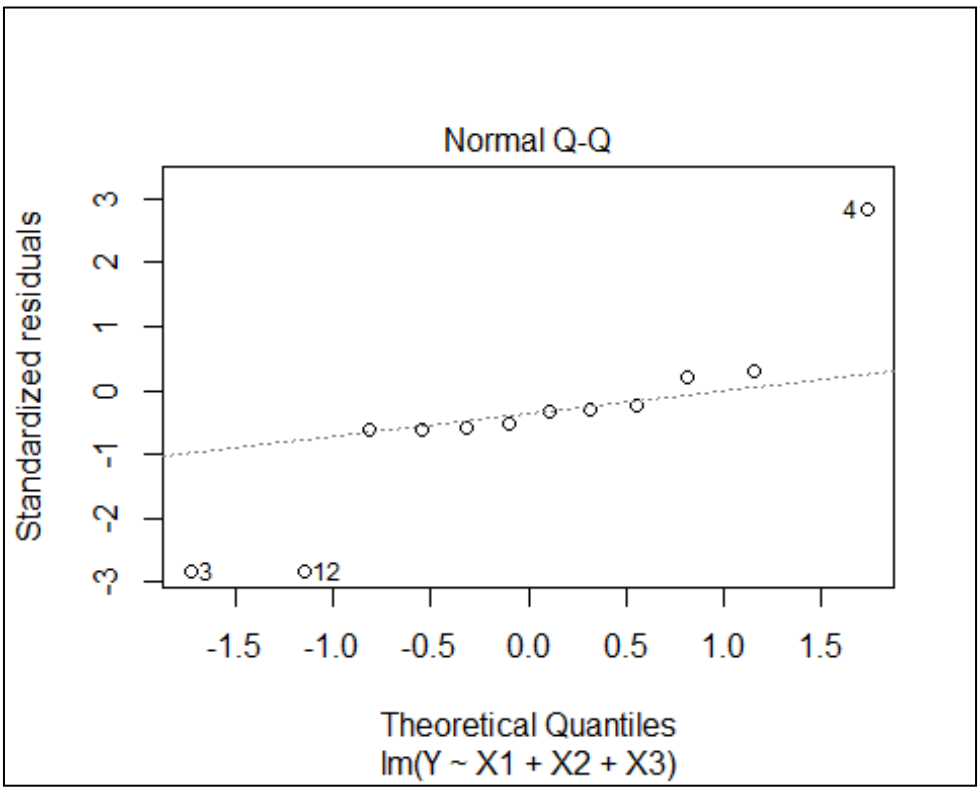

Figure 1, Normality Quantile-Quantile plot

The QQ plot of residuals can be used to visually check the normality assumption. The normal probability plot of residuals should approximately follow a straight line.

Homoscedasticity Test

Table 1, Homoscedasticity Test

Breusch-Pagan Test for Homoscedasticity [a,b,c]		
Chi-Square	Df	Sig.
5.615078	1	1.000

From Table 1, the p-value = 1.000 is greater than 0.05; the study concludes that the error variance is constant. The homoscedasticity assumption was met.

Test of Independence using D-W test

Table 2, Durbin-Watson's test for the independence assumption

DurbinWatsonTest(model)				
lag	Autocorrelation	D-W	Statistic	p-value
1	-0.03945857		2.075148	0.62
Alternative hypothesis: rho != 0				

The Durbin Watson examines whether the errors are autocorrelated with themselves. The null states that they are not autocorrelated. This test is useful to conduct a multiple (times series) regression. For example, this test explains residuals at time point 1 are correlated with the residuals at time point 2. In other words, this test is useful to verify that the outcome hasn't violated the independence assumption as $p > 0.05$, so the errors are not autocorrelated and hence do not violate the independence assumption.

V. CONCLUSION

This study set out to examine the influence of the consumption of three popular beer brands—33 Export, Life Beer, and Heineken—on the total quantity of beer drinks consumed at the Nigerian Bottling Company, Owerri. Using multiple regression analysis on monthly sales data collected over a one-year period

from October 2021 to September 2022, the study sought to develop a predictive model that could guide strategic decisions in production and marketing.

The results revealed that there is a very strong and statistically significant relationship between the consumption levels of 33 Export and Life Beer and the overall quantity of beer consumed. These two brands emerged as the primary contributors to total consumption, as confirmed by their statistically significant regression coefficients. Although Heineken also demonstrated a positive relationship with total consumption, it did not achieve statistical significance in the model, suggesting that its influence on total beer consumption may be weaker or less consistent within the study context.

The regression model developed in this study achieved an R-squared value of 0.974, indicating that 97.4% of the variance in total beer consumption could be explained by the combined consumption of the three beer brands. The high adjusted R-squared value further confirmed the model's robustness, while the ANOVA results validated the model's overall significance. Diagnostic tests showed that the assumptions of linear regression were not violated, with no evidence of multicollinearity or non-normality of residuals.

The findings of this research have important implications for managerial decision-making within the brewery and beverage industry. For production managers, the study provides a reliable forecasting tool for determining overall beer demand based on the sales of specific brands. This can help optimize inventory management, reduce waste, and align production schedules with actual market demand. For marketing and sales teams, the strong predictive power of 33 Export and Life Beer implies that promotional efforts should be more heavily concentrated on these two brands to sustain and increase their contribution to overall sales.

Moreover, the relatively weak contribution of Heineken to total consumption suggests that further research or market analysis may be necessary to understand consumer perceptions, pricing strategies, or distribution challenges associated with the brand. Targeted marketing campaigns or product repositioning may be required to improve its market performance and enhance its influence on total consumption.

From a methodological standpoint, the study confirms the value of using multiple regression analysis in business decision-making. It allows organizations to quantify relationships among variables and predict outcomes with a high degree of accuracy. This contributes to a data-driven approach to planning and strategy, which is increasingly essential in today's competitive market environment.

In conclusion, the study demonstrates that beer consumption at the Nigerian Bottling Company, Owerri, can be effectively modelled using multiple regression analysis. 33 Export and Life Beer play pivotal roles in driving total consumption, while Heineken's role appears secondary. The regression model derived serves as both an explanatory and predictive tool that can inform practical decision-making in production, marketing, and sales forecasting. Future studies may consider expanding the dataset to include multiple branches or incorporating other influencing variables such as pricing, seasonal effects, or consumer demographics to further refine the model.

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