International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2021; 6(6): 46-53

www.mathsjournal.com
Received: 19-09-2021
Accepted: 21-10-2021

Esemokumo Perewarebo Akpos
Department of Mathematics and Statistics, Ignatius Ajuru University of Education Rivers State P.M.B. 5047, Port Harcourt, Rivers Nigeria

Victor-Edema Uyodhu A
Department of Mathematics and Statistics, Ignatius Ajuru University of Education Rivers State P.M.B. 5047, Port Harcourt, Rivers Nigeria

Corresponding Author:
Esemokumo Perewarebo Akpos
Department of Mathematics and Statistics, Ignatius Ajuru University of Education Rivers State P.M.B. 5047, Port Harcourt, Rivers Nigeria

Marketing strategies and organizational performance of Nigeria's selected tourist sites via multivariate regression technique

Esemokumo Perewarebo Akpos and Victor-Edema Uyodhu A

Abstract
The study is on effect of market strategies on the organizational performance of selected tourist sites in Nigeria via multivariate regression technique. Two measures of organizational performance, being the dependent variable employed in the study are market performance and brand image, while five measures of marketing strategies, being the independent variable are Concentration Strategy, Distribution Strategy, Differentiation Strategy, Promotional Strategy and Pricing Strategy. Prior to a detailed study of the data, the statistical methods for data analysis were specifically discussed. The R package was used to conduct data analysis in this study. Finally, each study' findings were carefully interpreted. Result of the analysis revealed that marketing strategies jointly contributed to the organizational performance of selected tourist sites in Nigeria at a degree of significance of 5%. A further examination of significance in terms of parameters showed that Concentration Strategy and Differentiation Strategy indicated substantial association with market performance at a degree of significance of 5%, while Distribution Strategy, Promotional Strategy and Pricing Strategy are insignificant. Again, only Differentiation Strategy and Pricing Strategy have a significant relationship with brand image in the second model, whereas Concentration Strategy, Distribution Strategy and Promotional Strategy indicated no substantial association with brand image at a degree of significance of 5%.

Keywords: multivariate linear regression, least squares, organizational performance, marketing strategies and design matrix

1. Introduction

Multivariate multiple regression (MMR) is employed to model the linear association between more than single explanatory variable (EV), but more than single response variable (RV). When MMR has more than one EV, it is said to be multiple. MMR is multivariate because there is more than one RV. This study looks at a scenario where the EV is five, while the RV is two. This is a situation of studying marketing strategies and organization performance of selected tourist sites in Nigeria, where the dependent variable is organizational performance comprising of two measures (market performance and brand image), whereas the independent variable is marketing strategies, comprising of five measures (Concentration Strategy, Distribution Strategy, Differentiation Strategy, Promotional Strategy and Pricing Strategy). Hence, the objectives of this study are;

- to fit models for organizational performance (Market Performance and Brand Image) on the five marketing strategies (Concentration Strategy, Distribution Strategy, Differentiation Strategy, Promotional Strategy and Pricing Strategy) via Multivariate Multiple Linear Regression technique and
- to test for the models as well as Multivariate Regression Parameters in order to draw meaningful conclusion.

2. Statement of Problem

Marketing strategies with organization performance has been employed in many research studies, especially in the areas of business related disciplines. Many related variables that were studied employed multiple regression, even when the dependent variable could accommodate more than one variable. It is as a result of the little or no knowledge of multivariate multiple regression by researchers in business area that led to this present study. The problem of not being able to work with more than one dependent variable will be address in this study, as two dependent variables will be jointly correlated with five independent variables.

3. Literature Review

In a work by Oguebu (2011) [7], the response variables employed were average weight and bulk density of cheese balls, while the explanatory variables were oven temperature, moisture content before extrusion and moisture content after extrusion. Only oven temperature was significant in the model according to their result. A recommendation based on the result of the study suggested that larger dimensions of data set should be generated so as to incorporate more variables.

Onyenawuli (2012) [8] did a work on a multivariate regression of measures of health versus socio-demographic characteristics of patients in Nigeria. The response variables employed were Blood Pressure, Body Mass Index (BMI), Pulse, while the explanatory variables were age, sex, marital Status of patients. The result showed that age, sex and marital status were significantly correlated to the dependent variable. Hence; the model did well as a predictive equation.

Ekezie *et al* (2013) [4] fitted a multivariate linear regression between dependent variables (Systolic Blood Pressure, Temperature, Height), being the vital signs and explanatory variables (Age, Sex of patients), being the social characteristics. SAS software package was employed to run the data for the study and the results revealed that the model was appropriate for joint relationship between dependent variables and explanatory variables. Further analysis of their study revealed that only age had impact on the vital signs of the patients. The study recommended that further study should increase the explanatory variables to at least four in order to compare results.

4. Model Techniques

Multiple linear regression has its basic model as:

$$V_i = \lambda_0 + \lambda_1 Z_{i1} + \lambda_2 Z_{i2} + + \lambda_3 Z_{i3} \cdots + \lambda_r Z_{ir} + e_i \qquad \text{... (1)}$$

For each item, $i = 1, 2, 3, \cdots, n$

Equation (1) considered n observations of one response variable V_i and r explanatory variables Z_{ij} .

$$\left.\begin{aligned} V_1 &= \lambda_0 + \lambda_1 Z_{11} + \lambda_2 Z_{12} + \lambda_3 Z_{13} + \cdots + \lambda_r Z_{1r} + e_1 \\ V_2 &= \lambda_0 + \lambda_1 Z_{21} + \lambda_2 Z_{22} + \lambda_3 Z_{23} + \cdots + \lambda_r Z_{2r} + e_2 \\ V_3 &= \lambda_0 + \lambda_1 Z_{31} + \lambda_2 Z_{32} + \lambda_3 Z_{33} + \cdots + \lambda_r Z_{3r} + e_3 \\ &\vdots \qquad\qquad \vdots \qquad\qquad \vdots \\ V_n &= \lambda_0 + \lambda_1 Z_{n1} + \lambda_2 Z_{n2} + \lambda_3 Z_{n3} + \cdots + \lambda_r Z_{nr} + e_n \end{aligned}\right\} \qquad \text{... (2)}$$

as:

$$\left.\begin{aligned} &(i) \quad E(e_i) = 0; \\ &(ii) \quad Var(e_i) = \sigma^2 (fixed); \, \& \\ &(iii) \quad C(e_i, e_{i'}) = 0, \, i \neq i' \end{aligned}\right\rangle \qquad \text{... (3)}$$

Where E is the expectation, Var is the variance and C is the covariance

Equation (2) is represented in matrix form as;

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ \vdots \\ V_n \end{bmatrix} = \begin{bmatrix} 1 & Z_{11} & Z_{12} & Z_{13} & \cdots & Z_{1r} \\ 1 & Z_{21} & Z_{22} & Z_{23} & \cdots & Z_{2r} \\ 1 & Z_{31} & Z_{32} & Z_{33} & \cdots & Z_{3r} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & Z_{n1} & Z_{n2} & Z_{n3} & \cdots & Z_{nr} \end{bmatrix} \begin{bmatrix} \lambda_0 \\ \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_r \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_2 \\ \vdots \\ e_n \end{bmatrix}$$

or $V = Z\lambda + e$

where V has a dimension of $(n \times 1)$, Z has a dimension of $[n \times (r+1)]$,

λ has a dimension of $[(r+1)\times 1]$ and e has a dimension of $(n\times 1)$

Equation (3) becomes:

i. $E(e)=0$; &

ii. $C(e)=E(ee')=\sigma^2 I$

The Regression Equation becomes

$$V = Z\lambda + e \qquad \dots (4)$$

$$E(e) = \underset{(n\times 1)}{0}, \text{ and } C(e) = \underset{(n\times n)}{\sigma^2 I}$$

The unknown parameters are λ and σ^2 and the matrix Z has the vector $\begin{pmatrix} Z_{j0} \\ Z_{j1} \\ \vdots \\ Z_{jr} \end{pmatrix}^T$

5. Multiple Regression in Multivariate Form

Examining an association for the RV; $V_1, V_2, ..., V_m$, with m responses and sets of EV; $Z_1, Z_2, ..., Z_r$. Every assumed response has a model regression of its own, resulting in the following results as in Equation (5)

$$\left.\begin{aligned} V_1 &= \lambda_{01} + \lambda_{11}Z_1 + \lambda_{21}Z_2 + \lambda_{31}Z_3 + \cdots + \lambda_{r1}Z_r + e_1 \\ V_2 &= \lambda_{02} + \lambda_{12}Z_1 + \lambda_{22}Z_2 + \lambda_{32}Z_3 + \cdots + \lambda_{r2}Z_r + e_2 \\ &\vdots \qquad\qquad \vdots \qquad\qquad \vdots \\ V_m &= \lambda_{0m} + \lambda_{1m}Z_1 + \lambda_{2m}Z_2 + \lambda_{3m}Z_3 + \cdots + \lambda_{rm}Z_r + e_m \end{aligned}\right\} \qquad \dots (5)$$

The residual term $e = [e_1 \quad e_2 \quad e_3 \quad \cdots \quad e_m]'$ has $E(e)=0$ and $Var(e)=\Sigma$.

Let $\begin{pmatrix} Z_{j0} \\ Z_{j1} \\ \vdots \\ Z_{jr} \end{pmatrix}'$ represent the values of EV, $V_j = \begin{pmatrix} V_{j1} \\ V_{j2} \\ \vdots \\ V_{jm} \end{pmatrix}$ represent various responses, & $e_j = [e_{j1} \quad e_{j2} \quad e_{j3} \quad \dots \quad e_{jm}]'$ represent various errors. The design matrix written in matrix notation becomes

$$\underset{[n\times(r+1)]}{Z} = \begin{bmatrix} Z_{10} & Z_{11} & Z_{12} & \cdots & Z_{1r} \\ Z_{20} & Z_{21} & Z_{22} & \cdots & Z_{2r} \\ Z_{30} & Z_{31} & Z_{32} & \cdots & Z_{3r} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ Z_{n0} & Z_{n1} & Z_{n2} & \cdots & Z_{nr} \end{bmatrix}$$

Given

$$\underset{(n\times m)}{V} = \begin{bmatrix} V_{11} & V_{12} & V_{13} & \cdots & V_{1m} \\ V_{21} & V_{22} & V_{23} & \cdots & V_{2m} \\ V_{31} & V_{32} & V_{33} & \cdots & V_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ V_{n1} & V_{n2} & V_{n3} & \cdots & V_{nm} \end{bmatrix} = \begin{bmatrix} V_1' \\ \cdots \\ V_2' \\ \cdots \\ V_3' \\ \cdots \\ \vdots \\ V_m' \end{bmatrix}$$

$$\underset{[(r+1)\times m]}{\lambda} = \begin{bmatrix} \lambda_{01} & \lambda_{02} & \lambda_{03} & \cdots & \lambda_{0m} \\ \lambda_{11} & \lambda_{12} & \lambda_{13} & \cdots & \lambda_{1m} \\ \lambda_{21} & \lambda_{22} & \lambda_{23} & \cdots & \lambda_{2m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \lambda_{r1} & \lambda_{r2} & \lambda_{r3} & \cdots & \lambda_{rm} \end{bmatrix} = \begin{bmatrix} \lambda_1' \\ \cdots \\ \lambda_2' \\ \cdots \\ \lambda_3' \\ \cdots \\ \vdots \\ \lambda_m' \end{bmatrix}$$

and

$$\underset{(n\times m)}{e} = \begin{bmatrix} e_{11} & e_{12} & e_{13} & \cdots & e_{1m} \\ e_{21} & e_{22} & e_{23} & \cdots & e_{2m} \\ e_{31} & e_{32} & e_{33} & \cdots & e_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ e_{n1} & e_{n2} & e_{n3} & \cdots & e_{nm} \end{bmatrix} = \begin{bmatrix} e_1' \\ \cdots \\ e_2' \\ \cdots \\ e_3' \\ \cdots \\ \vdots \\ e_n' \end{bmatrix}$$

The model for multivariate regression in linear form is

$$V = Z\lambda + e \qquad \ldots(6)$$

but $E(e_i) = 0$, $C[e_i, e_j] = \sigma_{ij} I_n \quad i, j = 1,2,3,\ldots,m$

The regression model in linear form with ith response $V_{(i)}$ is

$$V_{(i)} = Z\lambda_{(i)} + e_{(i)} \qquad \ldots(7)$$

In the solution of a single response conforming, set

$$\hat{\lambda}_{(i)} = (Z'Z)^{-1} Z'V_{(i)} \qquad \ldots(8)$$

The results of collecting these estimates of univariate least squares are as follows:

$$\hat{\lambda} = \begin{bmatrix} \lambda_1' \\ \cdots \\ \lambda_2' \\ \cdots \\ \lambda_3' \\ \cdots \\ \vdots \\ \lambda_m' \end{bmatrix}$$

$$= (Z'Z)^{-1} Z' \begin{bmatrix} V_1' \\ \cdots \\ V_2' \\ \cdots \\ V_3' \\ \cdots \\ \vdots \\ V_m' \end{bmatrix}$$

or

$$\hat{\lambda} = (Z'Z)^{-1} Z'V \qquad \ldots(9)$$

The parameters' choice can take

$A = \left[a_{(1)} \; \vdots \; a_{(2)} \; \vdots \; a_{(3)} \; \vdots \; \cdots \; \vdots \; a_{(m)} \right]$, errors in the matrix become

$V - ZA$. The cross-products matrix with the error sum of squares is

$$= \begin{bmatrix} \left(V_{(1)} - Za_{(1)}\right)'\left(V_{(1)} - Za_{(1)}\right) \cdots \left(V_{(1)} - Za_{(1)}\right)'\left(V_{(m)} - Za_{(m)}\right) \\ \vdots \qquad \vdots \qquad \vdots \\ \left(V_{(m)} - Za_{(m)}\right)'\left(V_{(1)} - Za_{(1)}\right) \cdots \left(V_{(m)} - Za_{(m)}\right)'\left(V_{(m)} - Za_{(m)}\right) \end{bmatrix} \qquad \ldots(10)$$

Choosing $a_{(i)} = \hat{\lambda}_{(i)}$ minimizes the sum of squares for ith diagonal $\left(V_{(i)} - Za_{(i)}\right)'\left(V_{(i)} - Za_{(i)}\right)$. Again, $tra\left[\left(V - ZA\right)'\left(V - ZA\right)\right]$ by choosing $A = \hat{\lambda}$ is minimized. $\left|\left(V - ZA\right)'\left(V - ZA\right)\right|$ the generalized variance is minimized also by estimates $\hat{\lambda}$ of the least squares.

By employing the estimates $\hat{\lambda}$ of the least squares, the predicted values for the matrices and residuals can be formed as;

$$\left.\begin{array}{l} \text{Transpose of predicted values}: \hat{V}' = \hat{\lambda}'Z' \\ \text{Errors}: \hat{\text{e}} = \text{V - } Z\hat{\lambda} \end{array}\right\} \qquad \ldots \quad (11)$$

6. Data Analysis

The techniques discussed statistically in this study were employed to analyse the data collected for this study. The software R package was used to run the set of data for this study for easier computation.

Table 1: Data on Marketing Strategies (Z) or (MS) and Organization Performance (V) or (OP) of Selected Tourist Sites in Nigeria

S/N	Market Performance (V_1) MP	Brand Image (V_2) BI	Concentration Strategy (Z_1) CONS	Distribution Strategy (Z_2) DI SS	Differentiation Strategy (Z_3) DIFS	Promotional Strategy (Z_4) PROS	Pricing Strategy (Z_5) PRIS
1	3	22	8	8	7	8	8
2	3	23	9	11	9	9	10
3	3	23	8	9	10	9	9
4	3	22	9	9	9	8	8
5	3	23	9	9	9	9	9
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
99	3	22	8	8	8	8	8
100	3	23	9	9	8	9	9

Source: Extracted from Echeta (2019)

6.1 Fitting Full Multivariate Regression Model

R Output 1

```
> akpos<-lm(cbind(MP,BI)~ CONS+DISS+DIFS+PROS+PRIS)
> summary(akpos)
Response MP:
lm(formula = MP ~ CONS + DISS + DIFS + PROS + PRIS)
Resids:


Min. 1Q Median 3Q Max.
-0.60821 -0.23052 -0.01128 0.23765 0.84833

Coeffs:
Estimate Std Error t value Prob.(>|t|)
(Intercept)   -0.02008   0.25122   -0.080   0.93648
CONS          0.07675    0.03497   2.195    0.03062 *
DISS          0.04912    0.02739   1.793    0.07615.
DIFS          0.15414    0.04715   3.269    0.00151 **
PROS          -0.01721   0.04284   -0.402   0.68877
PRIS          0.09114    0.05099   1.787    0.07709
---

Resids std error: 0.3103 on 94 DF
Multiple R^2: 0.6092, Adjusted R^2: 0.5884
F-stat: 29.3 on 5 & 94 DF, p-Value: < 2.2x10^-16
Response BI:

Lm (formula = BI ~ CONS + DISS + DIFS + PROS + PRIS)

Resids:
 Min 1Q Median 3Q Max
-1.28315 -0.22229 0.03316 0.23029 2.33405

Coeffs:
Estimate Std Error t value Prob.(>|t|)
(Constant)    14.12770    0.41029    34.433 < 2x10^-16 ***
CONS          0.06347     0.05711    1.111 0.26919
DISS          0.07658     0.04474    1.712 0.09023
DIFS          0.23322     0.07701    3.028 0.00317 **
PROS          0.02632     0.06996    0.376 0.70763
PRIS          0.59652     0.08327    7.163 1.74x10^-10 ***
---

Resid std error: 0.5068 on 94 DF
Multiple R^2: 0.8153, Adjusted R^2: 0.8055
F-stat: 83.01 on 5 & 94 DF, p-Value: < 2.2x10^-16
```

From software output 1 for R, it implies that

$$\hat{\lambda}_1 = \begin{bmatrix} -0.02008 \\ 0.07675 \\ 0.04912 \\ 0.15414 \\ -0.01721 \\ 0.09114 \end{bmatrix} \quad \hat{\lambda}_2 = \begin{bmatrix} 14.12770 \\ 0.06347 \\ 0.07658 \\ 0.23322 \\ 0.02632 \\ 0.59652 \end{bmatrix}$$

This implies that the models for the fitted multivariate regression are;

$$\hat{V}_1 = -0.02008 + 0.07675Z_1 + 0.04912Z_2 + 0.15414Z_3 - 0.01721Z_4 + 0.09114Z_5$$

$$\hat{V}_2 = 14.12770 + 0.06347Z_1 + 0.07658Z_2 + 0.23322Z_3 + 0.02632Z_4 + 0.59652Z_5$$

6.2 Test of Significance for the Multivariate Regression Model

From Output 1, the p-value 2.2×10^{-16} is less than 5%. Hence, H_0 is rejected and the conclusion becomes that market strategies have effect on the organizational performance of selected tourist sites in Nigeria.

Output 2: Analysis of Variance Table

```
> OP=cbind (MP, BI)
> MS=cbind (CONS, DISS, DIFS, PROS, PRIS)
> peres<-lm (OP~MS)
> anova (peres)

ANOVA
 DF Pillai Approx. F Num. DF Den. DF Prob.(>F)
(Constant) 1 0.99962 122120 2 93 < 2.2x10^-16 ***
MS 5 0.93619 17 10 188 < 2.2x10^-16 ***
Resids    94
```

Since marketing strategies jointly contributed to the organizational performance of selected tourist sites in Nigeria, it becomes necessary to further test the parameters for the regression technique.

6.3 Test of Significance for the Parameters in Multivariate Regression Model

It can be observed from Output 1 that Concentration Strategy and Differentiation Strategy have substantial association with market performance at a degree of significance of 5%, while Distribution Strategy, Promotional Strategy and Pricing Strategy are insignificant. In model two as displayed in Output 1, Differentiation Strategy and Pricing Strategy have a significant relationship with brand image, whereas Concentration Strategy, Distribution Strategy and Promotional Strategy have insignificant relationship with brand image at a degree of significance of 5%.

87. Conclusions

1. A model was fitted for the association between organizational performance (market performance and brand image) on one hand, and the five marketing strategies (Concentration Strategy, Distribution Strategy, Differentiation Strategy, Promotional Strategy and Pricing Strategy) via Multivariate Linear Regression technique.
2. A further examination of significance in terms of parameters showed that marketing strategies jointly contributed to the organizational performance of selected tourist sites in Nigeria. A further test of significance on the parameters showed that Concentration Strategy and Differentiation Strategy have substantial association with market performance at a degree of significance of 5%, while Distribution Strategy, Promotional Strategy and Pricing Strategy are insignificant. Again, only Differentiation Strategy and Pricing Strategy have a significant relationship with brand image in the model two, whereas Concentration Strategy, Distribution Strategy and Promotional Strategy do have insignificant relationship with brand image at a degree of significance of 5%.

8. References

1. Cohn KV. Maximum Likelihood estimators in Multivariate Linear normal models. Journal of Multivariate Analysis 2000;33(4):182-201.

2. Echeta SO. Pricing/skimming Strategy and Performance of Obudu Mountain Resort in Nigeria. Unpublished Ph.D. Seminar Presented in the department of Hospitality and Tourism Management, Faculty of Business Administration, Imo State University, Owerri, Nigeria 2019.
3. Echeta SO. Promotional/Advertising Strategy and Performance of Obudu Mountain Resort in Nigeria. Unpublished Ph.D. Seminar Presented in the department of Hospitality and Tourism Management, Faculty of Business Administration, Imo State University, Owerri, Nigeria 2019.
4. Ekezie DD, Opara J, Anderson NC. Application of Multivariate Multiple Linear Regression Model on Vital Signs and Social Characteristics of Patients. International Journal of Engineering and Science 2013;2(6):40-56.
5. Ezeokeke C, Okoli C. A Comparison on Impact of HIV/AIDS Patients Characteristics on their Blood Pressure in Nigeria. European Journal of Engineering and Technology Research 2020;5(8):884-890.
6. Johnson RA, Wichern DW. Applied Multivariate Statistical Analysis. Prentice Hall, Englewood Cliffs, New Jersey 1992, 285 -328.
7. Oguebu CE. A Multivariate Linear Regression Study of confectionery products; A case study of Cheese Balls produced by Zubix International Company Ogidi between January 2010 to March 2011. Unpublished M.Sc. Thesis submitted to the department of Statistics, UNIZIK, Anambra State, Nigeria 2011.
8. Onyenawuli PA. A Multivariate Linear Regression Study on measures of health and socio-Demographic characteristics of patients. Unpublished M.Sc. Thesis submitted to the department of Statistics, Faculty of Science, Imo State University, Owerri, Nigeria 2012.