IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 13, Issue 2 Ver. III (Mar. - Apr. 2017), PP 21-24
www.iosrjournals.org

Forecasting of Marsland Aviation Domestic Services Total Cost

Maysoon A. Sultan[*1], Mohammed H. Mudawi[2] and Afra H. Abdellatif[3]
[1]*Department of Statistics,Faculty of Science, Sudan University for Sciences and Technology, Khartoum, Sudan.*
[2]*Department of Statistics, Faculty of Science, Juba University, Juba, South Sudan.*
[3]*Department of Statistics, Faculty of Science, Sudan University for Sciences and Technology, Khartoum, Sudan.*

Abstract: *This paper attempt to estimate and forecast the total cost of Marsland Aviation domestic services. The data were obtained from the Planning Directorate of Sudan Civil Aviation Authority, Air Transport Directorate and Marsland Aviation. The data were statistically analyzed the annual cost function of Marsland Aviation for the period from 2004 to 2013. The researcher study was to find out how the total cost (TC) behaves in relation to the domestic output, in revenue passenger (PAX), cargo/ freight (FRT), fuel cost (FC) and load factor (LF). The result shall lead us to estimate an airline cost function, by using Classical Normal Regression model (CNLRM) to analyze the data obtained for this research. The model is represented as follows:*

$$\boldsymbol{TC_t = \beta_0 + \beta_1 PAX_t + \beta_2 FRT_t + \beta_3 LF_t + \beta_4 FC_t + u_t}$$

$$\boldsymbol{t = 1, 2, \dots, 10}$$

The Classical Normal Linear Regression Model (CNLRM) is acceptable to the predictive purpose of forecasting the function of Marsland Aviation total cost, with a high statistically significant value at 5% level. This result means that the estimated regression models make sense; with strong power for prediction and forecast. From the forecast result for the period 2014-2018 the researcher concluded that the total cost of Marsland Aviation, shall gradually decrease during the next five years. This is clearly noted in Marsland Aviation activities as reflected in their current actual status in 2016, due to the decreasing number of their fleet that minimizes their activities &, henceforth, the total cost of Marsland Aviation is now closed down and is out of business.
Keywords: *Classical Linear Regression Model, Passenger, Freight, Fuel Price, Load Factor.*

I. Introduction

Marsland Aviation Company was incorporated in 2001, and commenced operations the same year with flights to Western Sudan (Elgenaina), initially with one Antonov 24, while currently it operates flights to 10 destinations (8 domestic) (G.M. Marsland Airlines Statistic Section, 2012).
Marsland Aviation fleet consist of the following aircraft: (as of December 2012):

Table (1): Marsland Aviation Active Fleet:

Aircraft	**In Fleet**
Antonov AN-24	1
Boeing 737-200	1
Boeing 737-500	2
Yakovlev Yak-42D	1
Total	**5**

Source: G.M. Marsland Airlines Statistic Section (2012).

But now, Marsland Air stopped activities by the end of 2013.
In this paper ten years annual data of total domestic passengers and cargo, from 2004 to 2013, are statistically analyzed to determine a cost function.

Research Problem:
Preface:
1. Covers all States of Sudan.
2. Marsland Aviation Domestic movements carrying passengers and cargo during 2004- 2013.

The research objectives are list below:
1. Evaluation of Marsland Aviation domestic Services in Sudan in regards to Passenger / Cargo Movements.
2. Statistical Estimation & Forecast of a Marsland Aviation cost function to identify the extent of aviation development in Sudan.

II. Materials & Methods

Cost models are mathematical representation of the relationship between the total cost and explanatory variables (the output, in revenue passenger and cargo, fuel price and load factor), model specification reflects expectations of cost behavior, by using the Classical Normal Linear Regression Model (CNLRM), to evaluate the model for forecasting, by satisfying the main features of a good regression model.

Theoretical Frame:

Analysis of the data obtained from the Planning Directorate of Sudan Civil Aviation Authority, Air Transport Directorate and Marsland Aviation. These data consist of the total number of passengers and freight/cargo carried domestically in Marsland Aviation, and also the data consist of the total number and types of aircraft in Marsland Aviation through the years from 2004 to 2013. Addition of that the data of Fuel price obtained from Nile Bakri Aviation Co.Ltd., and price of currency from Bank of Sudan; which were used in calculation of Marsland Aviation total cost.

Specifications and Estimation of the Models:

- The data analyze the annually cost of Marsland Aviation for the period from 2004 to 2013.
- The researcher interested in finding out how the total cost (TC) behaves in relation to the domestic output, in revenue passenger (PAX) and cargo/ freight (FRT), fuel cost (FC) and load factor (LF). The result shall lead us to estimate Marsland Aviation cost function, by using Classical Normal Linear Regression Model (CNLRM), and evaluate the model for forecasting. The model represented as follow:

$$TC_t = \beta_0 + \beta_1 PAX_t + \beta_2 FRT_t + \beta_3 LF_t + \beta_4 FC_t + u_t \quad , \quad t = 1, \dots, 10 \ \mathbf{(1)}$$

And satisfied the main features of a good regression model [(3), (4), (5), (6)], represented by:
Feature (1): Regression line must be fitted to data strongly. Value of R-square should be more than 60%, because the higher R-square value; better the model or model fitted.
Feature (2): Most of explanatory variables (at least 50%) should individually significant to explain dependent variable. Here t-test was performed.
Feature (3): Explanatory variables should be jointly significant to explain dependent variables. Here F-test should be performed.
Feature (4): Residuals of the model have no serial correlation, no heteroscedasticity and are normally distributed.

- By using the Simple Exponential Smoothing (smoothing parameter equals 0.7), the researcher forecasted the data of the explanatory variables, and then used the results to forecast Marsland Aviation total cost from 2014 to 2018, by using CNLRM**.**
- CNLRM shall be applied by using the Eview Statistical Package to estimate an airline cost function.

III. Results & Discussion

Evaluation of the Model:
The estimated value of the total cost (CNLRM) is represented as follows:

Table (2): Significant Value of the Total Cost (TC) Regression Model (2) of Marsland Aviation:

Variable	Coefficient	Prob.
C	3141858	0.2104
PAX	-3.678765	0.4985
FRT	-3.989002	0.0059
LF	-209550.1	0.9398
FC	1.048604	0.0000

Source: Prepared by the researcher.

$$TC_t = 3141858 - 3.678765\mathrm{PAX_t} - 3.989002\mathrm{FRT_t} - 209550.1\mathrm{LF_t} + 1.048604 FC_t \qquad \mathbf{(2)}$$

As shown in the table (2), there is 50% of the explanatory variables: Freight (FRT) and Fuel Cost (FC); are statistically significant at level 5%, to influence the dependent variable; total cost (TC).

Table (3): Tests Results of Goodness of Fit of the Estimated Regression Model (2) of Marsland Aviation:

R-squared	0.990896
Prob(F-statistic)	0.000027
Durbin-Watson stat.	1.625457
Jarque-Bera-Normality Prob.	0.659185
Breusch-Godfrey Serial Correlation Chi-square Prob.	0.1463
Breusch-Pagan-Godfrey Heteroscedasticity Chi-square Prob.	0.864

Source: Prepared by the researcher.

The R-squared value of about 0.990896 is statistically a significant value (more than 60%), means that about 99% of variation in the total cost is explained by passenger, freight, load factor and fuel cost; that means the goodness of fit of the regression line is very high. Durbin-Watson statistic (1.625457) is found to be 2, so there is no first-order autocorrelation, either positive or negative. Also, the R-squared (0.990896) is less than Durbin-Watson statistic, which means this model is not spurious.The probability of F-statistic equal to 0.000027 is statistically significant at level 5%, means that the independent variables: passenger, freight, load factor and fuel cost are jointly significant to influence the total cost.

The P-value of Jarque-Bera normality test equal to 0.659185 is not statistically significant value at 5% level; so, we cannot reject the null hypothesis; that residuals are normally distributed. The Chi square P-value of Breusch-Godfrey serial correlation LM test equal to 0.1463 is not statistically significant at 5% level; so, we cannot reject the null hypothesis; that residuals are not serial correlation.The Chi square P-value of Breusch-Pagan-Godfrey heteroscedasticity test equal to 0.864 is not statistically significant value at 5% level, so we cannot reject the null hypothesis; that residuals are not heteroscedasticity.According to the above results, the researcher concludes that the residuals are normally distributed, not autocorrelated and homoscedastic; so, this result means that the estimated regression makes sense and is acceptable to predictive purposes and forecasting.

Forecasting:

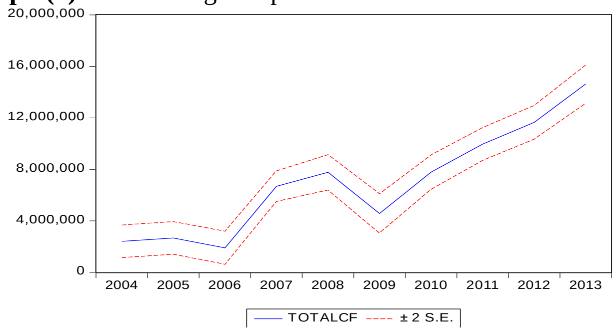
Table (4): Result of Forecasting Sample 2004-2013 of Marsland Aviation:

Root Mean Squared Error	**385280.7**
Theil Inequality Coefficient	**0.023852**
Bias Proportion	**0.00000**

Source: Prepared by the researcher.

As shown in table (4), the root mean squared error is equal to 385280.7, while Theil Ineqauality coefficient equal to 0.023852, which is close to zero, that means, the predictive power of this model is very strong. Bias proportion is equal zero that means, there is no gap between the actual total cost and the predictive total cost, and they are moving closely.

Graph (1): Forecasting Sample 2004-2013 of Marsland Aviation:



Source: Prepared by the researcher.

As shown in graph (1), the total cost value has been forecast and is passing throw 50% confidence interval; so, the forecasting of the total cost is significant and the ability of forecasting model is satisfactory.

Forecasting of Marsland Aviation Total Cost:

By using the Simple Exponential Smoothing (smoothing parameter equals 0.7), the researcher forecasted the data of the explanatory variables, and then used the results to forecast Marsland Aviation total cost from 2014 to 2018, by using CNLRM which is represented in the following table:

Table (5): Forecasting of Marsland Aviation Total Cost (US $) From 2014-2018:

Year	**2014**	**2015**	**2016**	**2017**	**2018**
Total Cost	**13498856.00**	**6248957.40**	**4073987.82**	**3421496.95**	**3225749.68**

Source: Prepared by the researcher.

The forecast table above (5), shows that the total cost of Marsland Aviation, shall gradually decrease during the next five years. This is clearly noted in Marsland Aviation activities as reflected in their current actual status in 2016, due to the decreasing number of their fleet that minimizes their activities &, henceforth, the total cost of Marsland Aviation is now closed down and is out of business.

To recapitulate, the following conclusions are detailed here below:

- The Classical Normal Linear Regression Model (CNLRM) is acceptable to the predictive purpose of forecasting the function of Marsland Aviation total cost, with a high statistically significant value of R-squared (99%), and statistically significant value of F-statistic at level 5%. Additionally, the residuals were Normally distributed; P-value of Jarque-Bera Normality Test is not statistically significant value at 5%

level, and also the residuals were not autocorrelation (not serial correlation); P-value of Breusch-Godfrey Serial Correlation; LM Test is not statistically significant value at 5% level, also the residuals were homoscedastic; R-squared P-value of Breusch-Pagan-Godfrey Heteroscedasticity Test; is not statistically significant value at 5% level. The Theil Ineqauality coefficients values are close to zero and zero Bias Proportions. These results mean that the estimated regression models make sense; with strong power for prediction and forecast.

- From the forecast result for the period 2014-2018 the researcher concluded that the total cost of Marsland Aviation, shall gradually decrease during the next five years. This is clearly noted in Marsland Aviation activities as reflected in their current actual status in 2016, due to the decreasing number of their fleet that minimizes their activities &, henceforth, the total cost of Marsland Aviation is now closed down and is out of business.

References

[1]. G.M. Marsland Airlines Statistics Section (2012), Khartoum, Sudan.
[2]. C.A.A., (2012). *Sudan Civil Aviation Planning Directorate*, Khartoum, Sudan.
[3]. Gujarati, D.N. and Porter, D.C. (2009). *Basic Econometrics*, Fifth Edition, Uni McGraw-Hill Companies.ted State Military Academy,West Point and University of Southern California.
[4]. Maddala, G.S. (1992). *Introduction to Econometrics*, Second Edition. University of Florida, Macmillan Publishing Company.
[5]. Greene, W.H. (1951). *Econometric Analysis*, Fifth Edition. New York University, Upper Saddle River, New Jersey.
[6]. Rawlings, J.O., Pantula, S.G. and Dickey D.A. (1932). *Applied Regression Analysis: A Research Tool*, Second Edition. North Carolina State University, Springer, USA.
[7]. Sultan, M.A., Mudawi, M.H. and Abdellatif, A.H. (2016). Past, Present & Future of Airlines Domestic Services in Sudan. *IOSR Journal of Mathematics (IOSR-JM).12*(3), Ver. IV, 74-85.