Forecasting International Air Transport Arrivals using Monthly Seasonal Indices: Evidence at Entebbe International Airport

Freddie Mawanga
ffmawanga@yahoo.co.uk or
fmawanga@mubs.ac.org

Abstract

The study models international passenger air transport arrivals in Sub-Saharan Africa using evidence at Entebbe International Airport. Approach was quantitative analysis of monthly trends by generating monthly seasonal index model and using the model to make monthly forecasts one year ahead. Monthly data from 1998 to 2012 were used to describe and test characteristics in arrivals using Microsoft Excel 2007. Modelling of the monthly seasonal indexes was by using a 12-month centred moving average. Findings revealed serial correlation and seasonality in the trends January, July, August, October, November and December with higher volumes and the other months with lower volumes than the annual monthly average volumes. The study revealed also that there is a significant higher volume of arrivals in the second half of the year than the first half. The model index was analysed using different statistical tests and was proved to have goodness of fit for the data. An estimate regression equation was generated to compute the model evaluation forecasts and later on an actual monthly forecast one year ahead were computed covering the period from June 2012 to May 2013. The study contributes to existing literature on analysing and forecasting international airport arrivals using classical approaches, which are more appreciated to users and more efficient in capacity management as well as service delivery. The study has policy and management implications as discussed.

Key words: International Airport Arrivals, Seasonal Indexes, Moving Average, Sub-Saharan Africa, Forecasting

Introduction

There has been rapid growth in international air transport in recent years with all countries recording increasing volumes of passenger arrivals from different parts of the world. Eita, Jordaan and Jordaan (2011) estimated that air transport constitutes at least 40% of all international arrivals and in developing countries the proportion is higher. The International Civil Aviation (2011) revealed that international air transport arrivals by volume include 51% travelling for leisure, recreation and holidays; 15% travelling for business and professional purposes and the rest visiting friends or relatives, on religious trips, pilgrimages or for medical services. International arrivals fluctuate that is why Khadaroo and Seetanah (2007) ever that these characteristics have interested scholars to describe, explain and model air transport arrivals using different approaches. While many policy and forecasting studies on international air transport arrivals have been conducted in developed countries, there is little literature on the subject in Sub-Saharan Africa and where it exists focus is on causal relationships (Eita, et. al., 2011). This study is a contribution to the extant knowledge in Sub-Saharan Africa, and analysed monthly international air transport arrivals at Entebbe International Airport.

Entebbe Airport is the only international airport in the land locked country of Uganda. The airport also serves as a first international contact for some air arrivals to Southern Sudan, Eastern Congo and Rwanda. The Uganda Bureau of Statistics (UBOS) annual report of 2010 revealed that there is a progressive increase in volume of arrivals annually with repeated monthly peaks in June to August caused by Summer holiday makers from Europe and America and to Namugongo for Christian pilgrimages at the Martyrs' shrine. Other peak periods according to the same report are from November to January attributed to Christmas holidays makers, visits to friends and tourist attractions. The New Vision of December 31, 2012 reported that Entebbe Airport received 1.5 million international passengers in the year reflecting a 13% growth and that there was a potential for the volume of arrivals to increase because of diverse favourable factors to the international community. These arrival trends justify a quantitative analysis to support existing qualitative management decisions used in resource allocation, activity scheduling and forecasts and which is contributed through this study and extends to partially fill a knowledge gap by Khadaroo and Seetanah (2007) who found that there are very few forecast studies in international air transport arrivals in developing countries.

Statement of the Problem

All international airport arrivals into Uganda are through Entebbe International Airport. Uganda Civil Aviation Authority has recorded growth in international air transport arrivals over a decade now. Most of such data are analysed and presented as summarised tables or as monthly or annual graphical trends intended for general visualisation of the patterns. Consequently, management decisions and forecasts of the monthly arrivals have been mainly qualitative supported by basic causal indicator factors. This has made the Aviation Authority fail to have more objective information in their operational and strategic plans particularly in the efficient resource allocation and service delivery as varying demands. More still, many studies of international air transport arrivals worldwide focus mainly on its relationship with socio-economic and political factors (Khadaroo and Seetanah, 2007; Bofinger, 2009; Aktürk and Küçüközmen, 2006), which make such models complex for most users of arrival data to understand and thus, integrate in their day-to-day operations. This study analysed international air transport arrivals at Entebbe using classical decomposition of monthly seasonal indices because the method provides a comprehensive simple deterministic picture of trends and forecasts (Ittig, 2004) using one parameter that can easily be incorporated into and utilised in the operations of Uganda Civil Aviation Authority compared to the complex approaches and does not require testing, predicting and diagnosing the model equation (Box and Jenkins, 1976) as required in other approaches.

Literature Review

In all sectors of human life, there are tendencies of variations in activities or processes as time passes and this is commonly exhibited as seasonality. Some of the common approaches to analysing seasonality include indices approach used to measure the extent of seasonality; ARIMA modelling (Bofinger, 2009; Box. and Jenkins, 1976) and time series methods that consider the series in their components (Greenidge and Jackman, 2009; Shen, Li and Song, 2009; Nadal, Font, and Rossello, 2004). These approaches have been also used in analysing seasonality in air transport arrivals worldwide. However, almost all these approaches have not been fully integrated in operations of the sector partly because of being complex for the practitioners. Academically, seasonality is a repetitive characteristic in a time series within a business cycle and caused by factors like weather effects, calendar effects, trading day effects timing decisions like vocation, moving holidays, social and cultural behaviour of consumers. These factors could be categorised as stable, changing at discrete intervals, varying continuously but predictable or unpredictable (Chu and Glymour 2008). Seasonality research may focus on seasonal distribution by describing properties of the data and modelling them. Focus on differences in the seasonal patterns between subgroups of the data or take a form in which two or more time series are correlated (Chatfield, 1996). Despite existence of the advanced approaches for analysing seasonality, available literature propose its analysis using classical approaches like seasonal indices (Barnett, Baker and Dobson, 2012; Lee, 1996) because of their advantage in efficiency capacity management and revealing easy to use variations. In air transport arrivals, variations exist and thus, could be investigated using this approach.

Evidence by UNWTO (2008) revealed that global international air transport travel has been growing at an annual rate of 4.8% in the last 20 years despite two major world recessions, terrorist acts, the Asian financial crisis of 1997 and two Gulf wars, Lyle (2012) estimated the annual global volume of arrivals to be over 1.6 billion passengers. Growth in this transport sector is attributed to liberalisation, speed, competitiveness, cost, flexibility, reliability, safety, connectivity and at times being the only means of access to geographically isolated areas (Bofinger, 2009). That is why Pavlyuk (2012) in a study of the European market recommends increase in scientific and practical analysis of airport performance and determinants to support management as well as policy setting in air aviation.

International air transport arrivals have also been growing in Sub-Saharan Africa and while the market is not yet constrained by infrastructure, it has challenges of safety, scheduling and investment in parallel taxiways, which could be accommodated in the financial plans of the respective Civil Aviation Authorities. A study by Khadaroo and Seetanah (2007) affirms that air transport in Sub-Saharan Africa presents a strong dichotomy in the South and East African markets due to three strong hubs at Nairobi, Addis Ababa and Johannesburg airports. However, Bofinger (2009) found that political stability, tourism infrastructure, marketing and information availability are challenges in air transport of all developing countries, which is not the case in developed countries, according to Aktürk and Küçüközmen (2006) in a study of seasonality air transport arrivals in Turkey from UK and Australia. Entebbe airport being in the East- South African corridor is likely to benefit from the existing opportunities when current constraints are addressed.

Volumes and characteristics of international air transport arrivals vary from country to country. For example, Andrews, Kahara-Kawuki, Tamwesigire and Yigletu (2005) on studying Uganda international tourism, which is a proxy for international air transport arrivals reveal that 40% to be business and professional while in the USA this category was 28%. The same study found that over 90% of the international arrivals in Uganda were in the age range of 25 – 54 years revealing an opportunity of focus to boost international air transport arrivals.

There are impacts related to international air transport arrivals in destination countries. Christie and Crompton (2001) consider socio-economic impacts like congestion, crowded streets, slower traffic, lack of parking, queues for services, significant increases in the costs of community services and strain on regular infrastructure as well as services. Deshpande and Arýkan (2012) focus on environment impacts like generation of high volumes of Carbondioxide due to increase in use of smaller aircrafts, high cruise altitude of planes and longer itineraries for carriers. In air transport, seasonality may have positive economic opportunities like planning maintenance work on infrastructure and specialist trades being fitted during off-peak seasons. However, Baum and Hagen (1999) state that where seasonality has negative impact, approaches to counteract it should include lengthening the main season, diversifying markets, using differential pricing and tax incentives on a temporal basis, encouraging staggering on holidays and providing off-season activities such as festivals and conferences. Therefore, managers of Civil Aviation Authorities and policymakers may consider seasonality as a "disgrace," especially when they have to tackle consequences in terms of unemployment, migration, less income and disinvestment.

International air transport arrivals are a function of time and when analysed they should exhibit a long-term pattern, seasonality within a business cycle and randomness (Box and Jenkins, 1976). An initial approach of studying these characteristics according to Chatfield (1996), is a graphical presentation, which is also as an aid to the best statistical analysis approach. Generally, most economic activities exhibit multiplicative trends (Chatfield 1996) and expressed as $Y = T*S*E = T*(1+r)^{t}*S*E$, where t is passage of time, Y is observed value, T is the trend component in the observation, S is the seasonal component and E is the noise. Iwueze, Akpanta and Iwu (2008) suggest that when natural logarithms of a multiplicative trend are plotted, they yield an additive relationship output and can be used to identify such trends.

Investigation of seasonality can take many approaches and one of them is decomposition approach by using moving averages and for a business cycle with 12 months season. Box and Jenkins (1976) express the moving average for s as:

$$MA_t = (P_{t-6} + \dots + P_t + \dots + P_{t+5})/12$$

Where MA_t is the moving average, P_{t-6} is an observation at a half the seasonal cycle lag, P_t is observation at current time t, and P_{t+5} is observation at time t-1+half of seasonal cycle ahead. Ittig (1997) urgues that this approach may introduce a systematic error in seasonal index estimates if a trend is present, Ittig (1997) recommended use of a logarithmic regression of moving averages since it yields a consistent trend, has theoretical justification and simultaneously, separates the trend, seasonal influences as well as smoothes the noise. However, Helmut and Fang (2011) found that using logarithms of price indices yielded higher root mean square errors than actual values. Ittig (2004) asserts that seasonal indices are more comprehensive and favourable in trends that have an impact of qualitative behaviour than ARIMA models. Song and Li (2008) assert that seasonal indices analysis requires at least twice the number of seasons used in the study. According to Atuk and Ural (2002) analysing seasonality using indices is a four-step procedure involving computing indices, adjusting un-seasonal data, computing deseasonalised forecasts and finally, adjusting de-seasonalised data to seasonal trends. However, they (ibid) point out that deseasonalising forecasts is effective for short-term forecasting.

Detecting existence of seasonality may involve Box Jenkins ARIMA methods, smoothing and seasonal indices that involve decomposition of the general time series. Seasonality can also be detected as a consistent deviation of a given seasonal index ratio in the same direction from the 100 line regardless of the intensity (Atuk and Ural 2002). According to Box and Jenkins (1976), seasonal indices insulate the method from testing, predicting and diagnosing the equation as required in other approaches. A statistical approach for testing seasonality according to Box and Jenkins

(1976), a statistical approach for testing seasonality is using Pearson ÷2-

Goodness-of-Fit test which is expressed as:

$$T = \sum_{i=1}^{k} \{(Oi - Ei)^2\}/Ei$$

where i = 1, . . . , k are the groups in the sample according to the business cycle, Oi and Ei are the observed and expected cell frequencies of the i^{th} class, respectively. When T is greater than a critical value at a given number of degrees of freedom k-1, then the Null hypothesis is rejected. However Campbell and Machin (1993) stated that one of the limitations of this test is failure to incorporate the ordered structure of the data, and to distinguish between irregular fluctuation and a smooth cyclical pattern thereby making correlation analysis of univariate seasonality data questionable. The test assumes a distribution function F(x) and a theoretical distribution function F0(x). Then it examines the Null-Hypothesis

H0 : F(x) = F0(x)

Seasonality is also tested by using seasonal variance in which means between monthly arrivals are tested to be significant at $p < 0.05$) and in univariate time series it is used to establish whether or not time is a statistically significant source of variation. The one-way analysis (ANOVA) of variance allows comparisons between two or more group means, Maes, at. al., 1993).

Wall and Yan (2003) held that seasonal indices allow estimation of static values like seasonal range, seasonality ratio or swing, monthly ratios, seasonal variation and peak seasonal factor. The indices reveal whether as not seasonal volumes of a particular season are better than usual during a range of good seasons or not which is not possible in other seasonal analysis approaches. In due regard, Song and Li (2008) conclude that while there are different measures of seasonality in literature, there is no single widely accepted method. Instead, the methods can complement weaknesses of another.

Understanding existence of serial correlation in time series contributes to better planning. According to Montgomery, Peck and Vining (2001) one way to test serial correlation is by Durbin–Watson test, d, expressed as

$$d = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2},$$

Where e_t is the error between the observed and regressed values at time t and e_{t-1} is the corresponding value at one lag. If $d < d_{L,á}$, a positive autocorrelation exists. If $d > d_{U,á}$, no correlation exists and if the value lies between the limits, there is no conclusion.

Any model should be evaluated by considering forecast errors using observed data; $A_{t;}$; when compared with forecast data, F_t; (Busetti and Harvey 2003). Evaluation of accuracy of seasonal indices has been used by scholars like Padhan (2012) with absolute errors (|E|) and squared errors (E^2) and Ching-Fu and colleagues (2009) with mean absolute percent error (MAPE) expressed as:

$$\text{MAPE}= \frac{100\%}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|,$$

Where, n is the number of predictions, F_t is the estimated model parameters and A_t is actual observation. The criterion of MAPE is the decisive factor because it is expressed in easy generic percentage terms. Lewis (1982) stated that for MAPE d” 10% the model indicates a high accuracy forecasting.

Forecasting is a necessary input to planning. Often, forecasts are generated subjectively by group discussion (Dobre and Alexandru 2008) based on experience, intuition and guesswork, or by causal modelling. Forecasting has an error, which can be a result of bias caused by cumulative actual demand not being the same as the forecast demand or random variation caused by cumulative actual demand varying from cumulative forecasts and take many forms although practical approaches (Box and Jenkins, 1976) hardly exceed 2 or 3 years ahead. Using a smoothing approach, a forecast is expressed as:

$$X_{t+1} = X_t + Ø(X_t - X_{t-1}).$$

Where X_{t+1} is the forecast value one period after current value at time t, X_t is the current estimated value time t, value Ø is a smoothing factor and X_{t-1} is the observation one lag behind the current value. Forecasts are also generated using smoothing followed by regression in the equation $y_t = b + mx_t$ and seasonal adjustments (Box and Jenkins, 1976).

MATERIALS AND RESEARCH METHODOLOGY

The study was exploratory and analytical using secondary longitudinal data. Data were collected from Uganda Civil Aviation Authority as monthly international air transport arrivals through Entebbe Airport. Entebbe Airport is the only international airport in Uganda. While available monthly data were for two decades, the study used 48 most recent months because they were highly consistent patterns and large enough for seasonal index analysis. The data used were monthly arrivals from June 2008 up to May 2012, covering four business cycles (Song and Li 2008) as shown in Table 1.

Table 1: *Actual Monthly Volume (AMV) of International Arrivals at Entebbe Airport*

Month	Year				
	2008	2009	2010	2011	2012
Jan		36,717	41,013	42,672	53,759
Feb		32,957	35,503	33,901	44,925
Mar		35,785	38,309	40,969	49,375
Apr		35,441	36,224	42,523	46,426
May		36,862	42,610	42,586	48,253
Jun	40,810	37,756	43,102	46,997	
Jul	43,630	44,933	51,643	55,724	
Aug	42,064	42,744	49,141	47,709	
Sep	40,022	38,556	40,650	44,206	
Oct	39,741	44,944	47,062	50,403	
Nov	39,092	37,418	44,423	49,461	
Dec	41,853	44,786	49,111	54,753	

Analysis was carried out with the help of Microsoft Excel 2007 program because of its computational and graphical power. Initially, data were investigated by graphical presentation to establish any multiplicative and seasonal characteristics. That was followed by statistical testing of the data for seasonality using Chi-square test. The test was at a significance level of $p = 0.05$ for 47 degrees of freedom using the Hypothesis

Ho: F(x) = F0(x), There is no significant difference between monthly international air port arrivals at Entebbe Airport.

Modeling and forecasting were carried out by decomposition analysis as explained by Atuk and Ural (2002). The analysis involved calculation of normalised monthly seasonal indices (MSI) using the 12-term centred moving average (CMA), Seasonal Errors (SE) and seasonal factor (SF). The monthly seasonal indexes (MSI) were used with Actual Monthly Volumes to compute the De-seasonalised monthly volumes (DMV). A regression model y = mx + b was formulated using the 12-term moving average (CMA) values and outputs of the regression interpreted whether or not the model can be used for forecasting using the hypotheses.

(a) The F-Value which shows overall significance of the regression model using the Null Hypothesis:

Ho: F-value= 0 :All regression coefficients are zero, that is, the model has no variables.

(b) The t-Statistic which measures the likelihood that the value of a parameter is not zero.

Ho: t Statistic = 0 then the actual value of that particular parameter is zero.

After confirming acceptability of the regression model, forecast of the study data (FAV) were calculated and actual forecasts for a period of 12 months after May 2012 were made to generate the De-seasonalised forecasts (DSF) that were used with the seasonal indices (MSI) to produce actual forecasts (AF). Investigation for serial correlation was by using the Durbin-Watson test on the actual monthly volumes (AMV) and their forecast volumes (FAV). Existence of a significant difference between average of the actual monthly volumes (AAMV) of arrival for the first and second half of the year as a business cycle were tested by using the ANOVA test half and the hypothesis.

H_2: $F(x_1) - F(x_2) = 0$, There is no significant difference between the average volume of international airport arrivals in the first half and second half of the year

Evaluation of the forecasting power of the model was by measuring the

Mean Average Percentage Error (MAPE) of the index model data. That was computed as the percentage of the ratio of the sum of the absolute deviations between the De-seasonalised monthly volumes (DMV) arrivals and forecast for the actual arrivals (FAV) divided by the number of periods (48 months) expressed by the equation:

$$1/n \sum_{1}^{n} \frac{|DMV - FAV|}{FAV}$$

FINDINGS

A line graph of the collected data is shown in Figure 1. An eye-ball view of the graph shows an increase in monthly arrivals with deviations that are progressively increasing. For example, the deviation from June to July 2008 is lower than that of the same months in 2009 or other successive years. This analysis indicates a multiplicative trend in the arrivals. There are also consistent low volumes of arrivals in some months like February and peak volumes in months of July and December, while overall a seasonal peak period from June to August is recognizable as shown in Figure 1.

Figure 1: *Monthly International Arrivals at Entebbe Airport*

Statistical test of seasonality by Chi- square at $p < 0.05$ with 47 degrees of freedom has a critical value of 64 and the study output was 20895. Since the output value was greater than the critical value, the Null Hypothesis that the monthly arrivals are the same is rejected. The seasonal variations must have causal factors that need further investigations. Monthly indices of the arrivals after normalization are shown in Table 2.

Table 2: *Normalised Monthly Seasonal Indices*

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Index	1.014	0.837	0.935	0.899	0.947	0.999	1.160	1.056	0.959	1.062	1.028	1.105

Table 2 shows average monthly arrivals above annual average in some months in the first half and second half of the year. However, the ANOVA test to confirm that there is no significant difference between these volumes of arrival in the first and second half of the year yielded an output F-value = 11.539 ($p = 0.007$) and the critical value F-critic = 4.965 at significance of $p < 0.05$ with 11 degrees of freedom using Average Actual Monthly Volumes (AAMV) of the data. Since the computed value is greater than the critical value the Null Hypothesis was rejected implying that volumes of arrival in the two halves of the year are different with mean index variance in second half of 0.093 and first half of 0.086.

Linear regression of the 12-term centred moving average yielded outputs (Adjusted r squared = 82%, F-value 242 and F-sign = 0.00) showing that time predicts 82% of arrivals and the model is representative of the trend. The t statistic for the constant and coefficient of the time variable were 58.5 and 14.5 respectively and their probabilities were each 0.000. The t-statistics for each parameter and their probabilities being Zero each is confirmation that none of the parameters in the regression equation is zero. The estimation equation yielded an output expressed as

: y = mx + b

where m = 0.030 and b = 3.458 could therefore be used to forecast the trends.

Forecasts of monthly volumes of arrivals for the periods June 2008 to May 2012 and for the next 12 months after May 2012 were computed and shown in Table 3.

Table 3: *Monthly Moving Averages and Forecast of Arrivals*

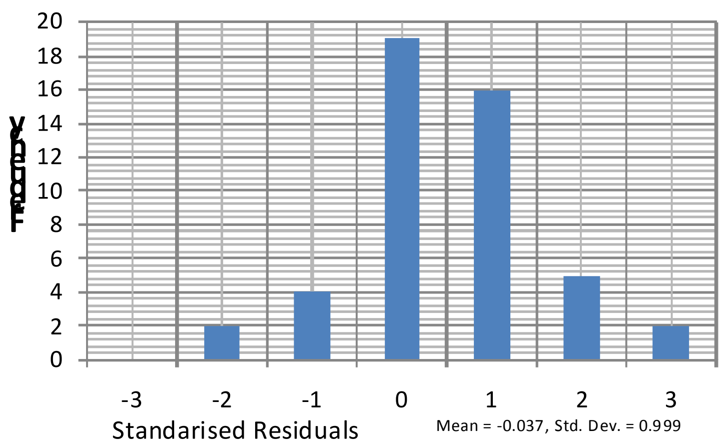
	Year										
	2008		2009		2010		2011		2012		2013
Month	DMV	FAV	DMV	FAV	DMV	FAV	DMV	FAV	DMV	FAV/AF	AF
Jan			36,226	38,262	40,465	41,890	42,102	45,518	53,041	49,145	53,488
Feb			39,396	38,564	42,439	42,192	40,524	45,820	53,702	49,448	44,401
Mar			38,281	38,866	40,982	42,494	43,827	46,122	52,820	49,750	49,897
Apr			39,424	39,169	40,295	42,797	47,302	46,424	51,644	50,052	48,257
May			38,926	39,471	44,996	43,099	44,971	46,727	50,955	50,355	51,120
Jun	40,863	36,145	37,805	39,773	43,158	43,401	47,058	47,029		50,591	
Jul	37,607	36,448	38,730	40,076	44,513	43,704	48,031	47,331		59,121	
Aug	39,830	36,750	40,474	40,378	46,531	44,006	45,175	47,634		54,137	
Sep	41,721	37,052	40,193	40,680	42,376	44,308	46,083	47,936		49,464	
Oct	37,414	37,355	42,312	40,983	44,306	44,611	47,451	48,238		55,093	
Nov	38,043	37,657	36,414	41,285	43,231	44,913	48,134	48,541		53,607	
Dec	37,871	37,959	40,525	41,587	44,439	45,215	49,544	48,843		57,988	

The study investigated a possible serial correlation between monthly arrivals using the Durbin-Watson test. It produced an output d= 1.266. At significance level $p < 0.05$ and T = 48 the critical values of the Durbin-Watson test are $d_{L,á} = 1.49275$ and $d_{u,á} = 1.57762$. Since d is less than $d_{Lá}$ the conclusion is that there is a positive serial correlation between monthly volumes of arrival. Interpretation of the output is that a positive error in a particular month contributes to a positive error in the following month, hereby showing a compounding error measure in the trends of international monthly arrivals.

Evaluation of accuracy of the forecast model using the Mean Average Percentage Error (MAPE) had an output value of 4% and this was less than 10% (Lewis, 1982) revealing that the seasonal index model has good fit accuracy in forecasting monthly arrivals.. Furthermore, the difference between the highest and lowest seasonal indices in the model, called the amplitude or swing; of the model index was 0.324. It is another measure of efficiency of capacity management in service delivery to international arrivals by air transport through Entebbe Airport.

A plot of the residuals of the regression equation was used to test good-fit of the model. The residuals exhibit some approximation of normal distribution as shown in Figure 4.

Figure 4: *Standard Residual Plot*



The pattern shows an approximation of a normal distribution although the curve is skewed to the right. Therefore, output confirms a good fit regression model for forecasting arrivals

DISCUSSION

Seasonally peak periods of international arrivals from June to August are mainly due to Summer holiday makers from America and Europe; arrivals of participants for annual pilgrimages at Namugongo Shrine, while another peak from November to January is due to passengers going for Christmas holidays from the same places and other countries that could like to use such periods also to enjoy the tourism attractions in Uganda that at times have attractive packages.

Low monthly volumes of arrivals indicate potential visitors being occupied more in their countries of origin and this could indicate that most arrivals constitute non-official visits. During low volume arrivals, the Authority should investigate other categories of potential arrivals from other countries through promotions, special packages and other segments of passengers. The low period in the period from February to June can be utilised by the Authority to plan maintenance of the infrastructure, organise short training sessions or holidays for some of their employees, identify operations that can be downsized and overall, reduce resource allocations in these months to achieve efficiency as suggested by Lee and Balakrishnan (2008). On the other hand, these periods offer opportunities to the Authority working in collaboration with Air Carriers and other stakeholders like tourism sector to set-up promotional services to reduce redundancy of infrastructure. The statistical test of seasonality by Chi- square gave an output value that was greater than the critical value, implying that there is a significant seasonal trend in variations thus, reconfirming existence of other causal factors that need further investigations.

The normalized monthly seasonal indices, with values above annual average show that the Authority could utilise factors that contribute to this relatively higher inflow and also promote more arrivals since they have capacity to handle more volumes as asserted by Khadaroo and Seetanah (2007). Furthermore, these monthly variations are consistent with assertions by

Greenidge and Jackman (2009) as well as Nadal et. al. (2004) that international tourists and visitors from Europe and America are substituting traditional resort destinations with more adventurous areas like African countries and that the same passengers have preferred frequent short time visits to single long time visits.

Over all there is a significant difference between the first half and second half annual arrivals. Each trend is in agreement with annual of the Uganda Civil Aviation reports that overall, periods June to August and then December have higher arrival values mainly because of annual pilgrimages, Summer holidays from the Western world and Christmas holidays reinforced by favourable tourism terms in the country for those periods.

The Durbin-Watson test and analysis that revealed a positive serial correlation between successive monthly volumes of arrival mean that parameter estimates are more precise than they really are, thus there is likelihood of to reject the null hypothesis when it should not be rejected. Considering this finding in context of management of international arrivals, it shows that, there are other factors other than time used in this study that contribute to a positive error in the international monthly air transport arrivals. The factors continue creating an upward (positive) bias in the error term, violating assumptions of independence of errors. This implies also that existence of a positive serial correlation of the Durbin Watson test makes the F-statistic high, thus affecting the efficiency of the estimation equation by making it more accurate (inflated) than it should be or making an underestimate of the true standard errors as discussed by Greenidge and Jackman (2009). This could create a challenge of suggesting that the model parameter(s) are significance when they could have been possibly insignificant. However since the Durbin Watson value was 1.266 and closer to the overall value of 2.00 (for no correlation), one could conclude that overall, passage of time contributes to these trends.

The study revealed a small swing in the index model, which was 0.324. This shows that under extreme cases, the monthly deviation from the annual average index of international air transport arrivals is 0.162. In context of planning, the swing shows that there are no extreme months of arrivals that could demand high resource allocation or very low resource utilization. Consequently, throughout the year, there is little strain on operations of the Authority in handling volumes of arrivals in the different months. This could add knowledge to operations of Uganda Civil Aviation Authority, while individual months have variations in international arrivals. Overall, the efficiency of their capacity management is stable and it could assist in strategic planning.

CONCLUSION

This study has revealed that classical analysis of seasonality provides useful and easy aspects to understand comprehensive time series trends demonstrated using monthly international air transport arrivals at Entebbe Airport in Uganda. Data analysis also demonstrated that even by investigating seasonality using seasonal indices, one can carry out most of the statistical tests applicable to the advanced methods on the concept of seasonality and yield workable models. The other benefit from the study is provision of a monthly index model that is easy to understand and thus it can be utilized in efficient resource management as well as planning on monthly basis rather than a general seasonality model. This finding suggests that scholars could make their studies on seasonality more appreciated by practitioners by considering the analysis that is user-friendly or comparative modeling studies.

POLICY AND MANAGEMENT IMPLICATIONS

The study developed a monthly seasonal index model using univariate longitudinal data. This study contributes to further understanding of variations in international air transport arrivals which should assist management to make better forecasts, effective utilisation of resources, scheduling of activities like training, routine maintenance, holidays, promotional and procurement strategies including financial cash flow on a monthly basis rather than as annual plans (Wu and Caves, 2003; Lee and Balakrishnan, 2008). Furthermore, the country could benefit more from international air transport arrivals for official visits by promoting its ability to host the required events as noted by Andrews, et. al. (2005). The study shows particularly that the first half of the year has relatively lower international arrivals. This suggests special operational and strategic interventions to optimally utilize the resources efficiently through the year as asserted by Baum and Hagen (1999. Overall, the seasonality model can be incorporated in enhancing international arrivals at Entebbe Airport because it is strategically located in the region.

LIMITATION AND AREAS FOR FURTHER RESEARCH

The study used univariate longitudinal data, which hide the long-term trend in arrivals and periods with extreme values. Studies covering demographic characteristics of passengers and other modeling methods could be investigated so as to provide highly enhanced and comparative analysis including understanding of international air transport arrivals at Entebbe Airport.

REFERENCES

Aktürk, T. & Küçüközmen, C. (2006). An Econometric Approach to Tourism Demand: Arrivals from UK and Australia to Turkey, Paper presented at the Third Graduate Research in Tourism Conference, Anatolia: Turizm Araþtýrmalarý Dergisi, Çanakkale Onsekiz Mart Üniversitesi, 25-28 May 2006, Çanakkale.

Andrews, D., Kahara-Kawuki, A., Tamwesigire, C. & Yigletu, A. (2005) .Tourism And Economic Development In East Africa: The Case Of Uganda. *Journal of the Southwestern Society of Economics,* 32: 51 – 63

Atuk, O. & Ural, B. (2002). Seasonal Adjustment Methods: An Application to the Turkish Monetary Aggregates: Central Bank Review, Research and Monetary Policy Department. *Central Bank of the Republic of Turkey,* 2(1): 21-37.

Barnett, A., Baker, P. & Dobson, A. (2012). Analysing Seasonal Data. *The R Journal*, 4(1): 5 -10

Baum, T. & Hagen, L. (1999). Responses in seasonality: the experiences of peripheral destinations. *International Journal of Tourism Research* 1(5):299 -312

Bofinger, H.C. (2009). *An Unsteady Course: Growth and Challenges in Africa's Air Transport Industry.* AICD Background Paper 16. Africa Region, World Bank, Washington, DC..

Box, G. & Jenkins, G. (1976). *Time Series Analysis: Forecasting and Control (revised edition).* Holden Day, San Francisco.

Busetti, F. & Harvey, A(2003). Seasonality Tests. *Journal of Business and Economic Statistics,* 21(3): 420-436

Campbell M. & Machin, D.(1993). *Medical Statistics, A Commonsense Approach*, 2nd ed., John Wiley & Sons, Chichester.

Chatfield, C. (1996). *The Analysis of Time Series*, 5th ed., Chapman & Hall, New York, NY.

Ching-Fu C. Yu-Hern, C. & Yu-Wei C.(2009). Seasonal ARIMA forecasting of inbound air travel arrivals to Taiwan. *Transportmetrica,* 5(2): 125-140

Christie, I. & Crompton, D. (2001). *Tourism in Africa.* Africa Region Working. Paper, Series No.12, The World Bank Washington DC.

Chu, T. & Glymour, C. (2008). Search for Additive Nonlinear Time Series Causal Models*. Journal of Machine Learning Research,* 9: 967-991

Deshpande, V. & Arýkan, M. (2012). The Impact of Airline Flight Schedules on Flight Delays. *Manufacturing & Service Operations Management,* 14(3):423-440

Dobre I., Alexandru A. (2008). *The impact of unemployment rate on the dimension of shadow economy in Spain: A Structural Equation Approach*, paper presented at International Conference on Applied Business and Economics. Thessaloniki ,Greece, 2 - 4 October 2008

Eita, J., Jordaan, A. & Jordaan, Y. (2011*).* An econometric analysis of the determinants impacting on businesses in the tourism industry. *African Journal of Business Management* 5(3):666-675

Greenidge, K. & Jackman, M. (2009). *Modelling and Forecasting Tourist Flows to Barbados Using Structural Time Series Models.* Paper presented at the Annual Review Seminar Research Department Central Bank of Barbados July 27-30, 2009

Helmut, L. & Fang., X. (2011). Forecasting Annual Inflation with Seasonal Monthly Data: Using Levels versus Logs of the Underlying Price Index. *Journal of Time Series Econometrics,* 3(1): 1941-1928

Ittig, P. (2004). Comparison of Efficient Seasonal Indexes. *Journal of Applied Mathematics and Decision Sciences,* 8(2): 87–105

Iwueze, I., Akpanta, A. & Iwu, H. (2008). Seasonal Analysis of Transformations of the Multiplicative Time Series Model. *Asian Journal of Matehematics and Statistics*, 1(2): 80 -89

Khadaroo, J. & Seetanah, B. (2007). Transport Infrastructure and Tourism Development.*Annals of Tourism Research,* 34(4): 1021–1032

Lee, H.& Balakrishnan, H. (2008). A Study of Tradeoffs in Scheduling Terminal-Area Operations. Proceedings of the IEEE. Available: http://www.mit.edu/~hamsa/pubs/LeeBalakrishnanProcIEEE08.pdf. Accessed 30/11/2014

Lewis, C. (1982). *International and Business Forecasting Methods.* London: Butterworths

Lyle, C. (2012). *Air Transport Challenges and Opportunities: A Tourism Perspective.* Representative of the World Tourism Organization to ICAO Caribbean Tourism Summit and Outlook Seminar.Montego Bay, Jamaica, 15 June 2012.

Maes, M., Cosyns, P.,Meltzer, H., De Meyer, F. & Peeters, D. (1993). Seasonality in violent suicide but not in nonviolent suicide or homicide. *Am J Psychiatry*, 150:1380–1385

Montgomery, D., Peck, E. &Vining, G. (2001). *Introduction to Linear Regression Analysis*. 3rd Edition, New York, New York: John Wiley & Sons

Nadal, J., Font, A. & Rossello, A. (2004), The economic determinants of seasonal patterns. *Annals of Tourism Research.* 31(3): 697-711.

Padhan, P. (2012), Use of Univariate Time Series Models for Forecasting Cement Productions in India, *International Research Journal of Finance and Economics*, 83: 167 – 179

Pavlyuk, D.(2012). Airport Benchmarking and Spatial Competition: A Critical Review. *Transport And Telecommunication,* 13(2): 123–137

Shen, S., Li, G. & Song, H. (2009). Effect of seasonality treatment on the forecasting performance of tourism demand models. *Tourism Economics* , 15 (4): 693–708

Song, H & Li, G. (2008). *Tourism Demand Modelling and Forecasting: A Review of Recent Research. Tourism Management,* 29 (2): 203 - 220

The International Civil Aviation (2011) Annual report. Doc 9975. Available at http://www.icao.int/publications/Documents/9975_en.pdf

UNWTO (2008). *Climate Change and Tourism: Responding to Global Challenges,* The World Tourism Organization and the United Nations Environment Program. Madrid, Spain

Wall, G. & Yan, M. (2003). Disaggregating visitor flows - the example of China. *Tourism Analysis,* 7(3/4): 191-205.

Wu, C. & Caves, R.. (2003). Flight Schedule Punctuality Control And Management: AStochastic Approach. *Transportation Planning and Technology,* 26(4): 313–330