Decomposition Techniques on Forecasting Tourist Arrivals from Western European Countries to Sri Lanka

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Abstract

The forecasting tourist arrival is an essential discipline in planning, resource management, and other decision-making processes in micro and macro level. It facilitates to ensure the sustainable development by minimizing the risk to all aspects. There is a growth of arrivals from all the regions to Sri Lanka. Increasing of tourist arrivals could cause a positive or negative effect on the country. To get the maximum benefits from the positive impacts and to overcome the negative impacts, it is vital to forecast arrivals. This study focuses on identifying the highest tourist producing Western European countries and to forecast the arrivals from them. Monthly tourist arrival data from the UK, Germany, France, Netherland, and Italy for the period of, January 2008 to December 2014 was obtained from Sri Lanka Tourism Development Authority (SLTDA). Time Series plots and Auto-Correlation Functions (ACF) were used for pattern recognition of arrivals. It revealed that the arrivals have both trend and seasonal patterns. As such, the Decomposition Techniques were tested for forecasting arrivals. The Residual plots and the Anderson-Darling test were used as the goodness of fit tests in model validation. The residuals of both; additive and multiplicative models for all the countries were found normally distributed and independent. The best fitting model was selected by comparing the relative measurements of errors and the absolute measurements of errors. Measurement errors of all the fitted models were satisfactorily small. Among them, the models with least errors were selected for forecasting. It is concluded that the Additive Decomposition models are the most suitable models for forecasting arrivals from Western European countries. However, arrivals show wave-like patterns with the trend. The Circular Model is a newly introduced technique for modeling wave-like patterns. It is recommended to test the Circular Model on de-trended data to see whether the forecasting accuracy increases.

Keywords: Decomposition Techniques, Errors, Measurements

INTRODUCTION

Forecasting the future is one of the strongest cognitive desires of a modern human. This goal has resulted in scientifically-based forecasting models. For any organization, no other investment is an immediate and long-term influence on profitability, customer service, and productivity, then a good forecasting mechanism. Qualitative and Quantitative techniques are the two parts in forecasting. Qualitative forecasting is based on experience, judgment, knowledge (intuition) while quantitative forecasting is based on mathematical and statistical modeling.

Over the past years, international tourism in Sri Lanka has shown growth by volume and value. According to the Sri Lanka Tourism Development Authority (SLTDA) reports, international tourist arrivals have boomed to a new milestone of 1,527,153 arrivals in 2014, transcending all time high hits in the history which is an increase of 19.8% over 1,274,593 arrivals in the year 2013 (SLTDA, 2014). Sri Lankan tourism market comprises all the regions of the world. Among them, Western Europe remained as the major source market in the year 2014.

Research Problem

Statistical modeling plays a vital role in the field of Hospitality and Tourism, all over the world. It helps for prediction, control, and optimization. In Sri Lankan context, Diunugala (2012) Konarasinghe (2014) Kurukulasooriya and Lelwala (2014) Kodituwakku, Hettiarachchi, Wijesundara, Dias, and Karunaratne (2014) Konarasinghe (2016-a) and, Priyangika and Sooriyaarachchi (2016) have attempted to forecast the international tourist arrivals from all regions to Sri Lanka. Also, Konarasinghe (2016-b) has shown that the number of arrivals from the Western Europe is significantly different from the other regions. However, it was difficult to find any study focusing on forecasting arrivals region wise.

It is a known fact that the expectations of the tourists are not same for all the regions. As such it is necessary to forecast the number of arrivals region wise, in order to satisfy the expectations of the customers to obtain the optimum benefits to the country. On the view of the above, the study was focused on identifying suitable forecasting techniques to arrivals from Western Europe to Sri Lanka, as a starting point for forecasting arrivals region wise.

Objective of the study

Preliminary data analysis revealed that the arrivals from various countries of the Western Europe have both trend and seasonal patterns. The Decomposition techniques are capable of capturing both trend and seasonal patterns. As such, the objective of the study is as follows;

- To fit suitable Decomposition models to forecast the arrivals from the countries of the Western Europe.

Significance of the Study

Tourism is the third highest foreign income generator to the Sri Lankan economy (SLTDA, 2014). It provides diversification of benefits to Sri Lanka. Increasing of arrivals from Western Europe may cause positive or negative impacts to Sri Lanka. However, maximizing benefits and minimize the risk will depend on the effective forecasting system. It is essential in eliminating waste such as inventory, shortages and excesses and much more. Sri Lankan economy expected more benefits from Western European arrivals due to their highest per capita and purchasing power (Pasquali, 2016). The results of the study could be applied to forecasting arrivals from Western Europe. It facilitates to satisfy their expectations and other demand management within the Sri Lankan cultural and legal bound.

LITERATURE REVIEW

Literature review is focused on;

- Studies based on techniques used in forecasting tourist arrivals
- Studies based on forecasting tourist arrival to Sri Lanka

Studies based on Techniques used in Forecasting Tourist Arrivals

Univariate models were widely used for forecasting tourist arrivals. In addition, soft computing techniques, named Artificial Neural Network (ANN), Neurofuzzy also used for the purpose. Predicting monthly arrivals from UK and Germany to Spain was done by Díaz, Sbert and Nadal (2009). They examine the forecasting accuracy of a Genetic Programming (GP) versus other traditional univariate modeling approaches such as no-change model (NC), Moving Average (MA) and ARIMA. They concluded that the performance of GP is better than another univariate model. Jackman and Greenidge (2010), forecast arrivals from USA, UK, Canada and CARICOM to Barbados. The techniques employed were a Naïve model with Trend and Seasonal, Winter's 3-parameter model, and SARIMA models. The author confirmed that the Naïve model with Trend and Seasonal are better than other models. The Bulter conceptual destination life cycle and product lifecycle frameworks are used to develop an overall determinant model of Australian tourist arrivals were the purpose of the study of Nejad and Tularam (2010). They used logistic modeling approach. An optimized Singular Spectrum Analysis (SSA) introduces by Silva (2014) for forecasting tourism arrivals from U.S to U.K. The results compared with ARIMA, Exponential Smoothing (ETS) and Neural Networks (NN). He concluded that SSA performed better than other techniques. Saayman and Botha (2015) conducted a study to forecast total European arrivals, total African arrivals and then arrivals from the following countries: Lesotho, Zimbabwe, the UK, Germany and the USA to South Africa. They used seasonal Naïve and Seasonal Autoregressive Integrated Moving Average (SARIMA) forecasts of seasonal tourist arrivals with a structural break in the data, with alternative non-linear methods to determine the accuracy of the various methods. They conclude that the non-linear forecasts performed better than other methods and linear methods show some better performances in short-term forecasts when there are no structural changes in the time series. Kumar and Sharma (2016) successfully forecast tourist arrivals in Singapore by SARIMA model.

Studies Based on Forecasting Tourist Arrival to Sri Lanka

Forecasting tourist arrivals to Sri Lanka is a timely research area in present economic development. It is found that the Univariate Statistical techniques and Soft Computing techniques were used for the purpose in Sri Lankan context. Short-term tourist arrivals forecasted by Exponential Smoothing (Nisantha and Lelwala,2011). They concluded that Holt – Winter’s exponential smoothing model with multiplicative is the best model. Diunugala (2012) forecast arrivals from India, United Kingdom (UK), Germany, Maldives, France, Australia, Netherlands, United States of America (US), Japan and Italy during the period from January 1977 to April 2012. The Winter‟s Multiplicative Exponential Smoothing Method (WMESM) and Box and Jenkins Multiplicative SARIMA have been tested. The result shows that the WMESM is superior to SARIMA. Konarasinghe (2014) forecasted the trend of tourist arrivals. He tested three both Linear and Non – linear models. The result of this study shows that the univariate causal model is suitable for the purpose. Kurukulasooriya and Lelwala (2014) forecast tourist arrivals to Sri Lanka by using Classical time series decomposition approach. They concluded that decomposition multiplicative approach is the most suitable one. They used arrivals data after 2009 considering the end of civil war. Kodituwakku et al. (2014) forecasted arrivals to Sri Lanka monthly, quarterly and annually

Seasonal ARIMA and Holt-Winters exponential smoothing models used for forecasting. Their results confirmed that the SARIMA models performed better than other models in monthly, quarterly and annually. Forecasting arrivals after the post-war period were done by Konarasinghe (2016-a). The author used monthly arrival data after 2010 and tested Moving Average (MA) techniques, Exponential Smoothing (ES) techniques and Winter's Methods. The study recommended the Holt's Winter's three parameters multiplicative model for forecasting arrivals. Time series models; ARIMA and GARCH used for forecasting arrivals to Sri Lanka by Priyangika and Sooriyaarachchi (2016). They selected Hybrid SARIMA-GARCH as the best model.

Time series techniques are heavily used in tourist arrival forecasting horizon. Jackman and Greenidge (2010) Kodituwakku et al. (2014), and Kumar and Sharma (2016) confirmed that the SARIMA is the suitable model for forecasting tourist arrivals. Silva (2014) confirmed that SSA is better than ARIMA, Exponential Smoothing, and Neural Networks. Kodituwakku et al. (2014) suggested that the soft computing and Priyangika and Sooriyaarachchi (2016) confirmed that the hybrid techniques are more suitable in forecasting tourist arrivals to Sri Lanka.

The suitable models were hybrid SARIMA-GARCH, Smoothing techniques, SARIMA, ARIMA, Decomposition techniques and other linear and non – linear trend models. Most of the models were validated but rarely verified during the analysis process. Further, it has been observed that Decomposition techniques used only once to forecast arrivals from all regions. It was hard to find attempts for forecasting arrivals, region wise.

METHODOLOGY

Monthly tourist arrival data from the UK (GB), Germany (DE), France (FR), Netherland (NL), and Italy (IT) for the period of January 2008 to December 2014 was obtained from annual reports of 2008 -2014 published by SLTDA. Time series plots and Auto-Correlation Functions (ACF) were used for pattern identification and One way- Analysis of Variance (ANOVA) was used for mean comparison of tourist arrivals from selected countries. The Decomposition additive and multiplicative models were tested for forecasting. The Residual plots and Anderson -Darling tests were used as a model validation criterion. Forecasting ability of the models was assessed by three measurements of errors, namely; Mean Absolute

Percentage Error (MAPE), Mean Square Error (MSE) and Mean Absolute Deviation (MAD) in both model fitting and verification process.

Decomposition Techniques

In Decomposition, a time series is described using a multifactor model. The model is:

$$Y_t = f(T, C, S, e) \quad (1)$$

Where;

Y_t = Actual value of time series at time t

f = Mathematical function of

T = Trend

C = Cyclical influences

S = Seasonal influences

e = Error

Decomposition is to separate the time series into linear trend and seasonal components, as well as error, and provide forecasts. There are two general types of decomposition models; Additive and Multiplicative models. Multiplicative models can be used when the size of the seasonal pattern depends on the level of the data. This model assumes that as the data increase, so does the seasonal pattern. Most time series plots exhibit such a pattern. The multiplicative model is:

$$Y = T \times C \times S \times e \quad (2)$$

Additive model uses when the size of the seasonal pattern does not depend on the level of the data. In this model, the trend, seasonal, and error components are added. Model is as follows:

$$Y = T + C + S + e \quad (3)$$

Measurements of Errors

Three measurements of errors were used to assess the forecasting ability of models. Namely: Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE) and Mean Absolute Deviation (MAD) in both model fitting and verification process. Three measurements of errors as follows;

Mean Absolute Percentage Error (MAPE)

$$MAPE = \frac{1}{n}\sum \left| \left(\frac{Y_t - F_t}{Y_t}\right).100 \right| \qquad (4)$$

Mean Absolute Deviation (MAD)

$$MAD = \frac{1}{n}\sum \left| \left(Y_t - F_t\right) \right| \qquad (5)$$

Mean Square Error (MSE)

$$MSE = \frac{1}{n}\sum \left(Y_t - F_t\right)^2 \qquad (6)$$

Where; Y_t = Observed value of time t, F_t= Forecasted value of time t

DATA ANALYSIS

Data analysis is organized country wise as follows;

- Pattern recognition of tourist arrivals
- Forecasting tourist arrivals

Data analysis begins with the detection of outliers and adjusted all detected outliers from the data set. Outliers are the extremely large or small values of a data set. They were identified with the help of Box Plot (Figure 1). The study adopted the technique used by Konarasinghe, Abeynayak, and Gunaratne (2016), for outlier adjustment. That is, if the i^{th} value of a series is an outlier;

$$i^{th} value = [(i-1)^{th} value + (i-2)^{th} value + (i-3)^{th} value]/3$$

According to the Figure 1; arrival series from Netherlands and Italy have outliers

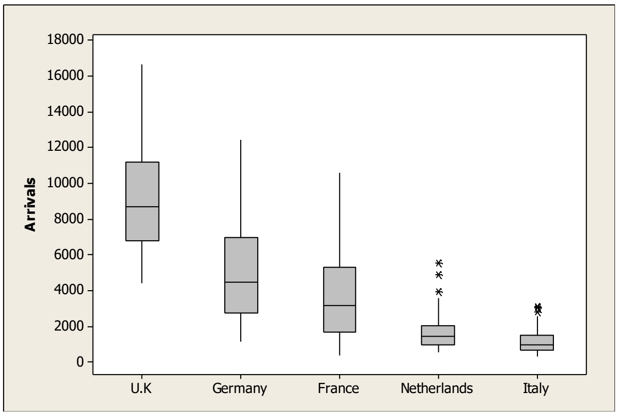

Figure 1: Box plot of U.K, Germany, France, Netherlands and Italy

Pattern Recognition of Tourist Arrivals

The pattern recognition of five countries from Western Europe was done.

Pattern Recognition of Tourist Arrivals from the UK:

Time series plot of arrivals (Figure 2), shows the tourist arrivals from the UK. The behavior of the series clearly shows that there is an increasing trend from the UK. But fluctuation of the series is very high, increasing with time. It can be observed after 2010.

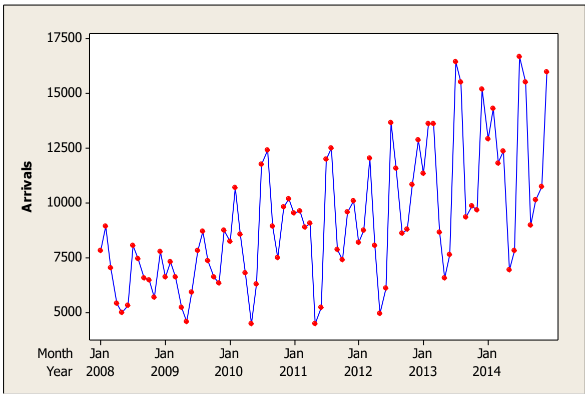

Figure 2: Time Series Plot of Tourist Arrivals from the UK

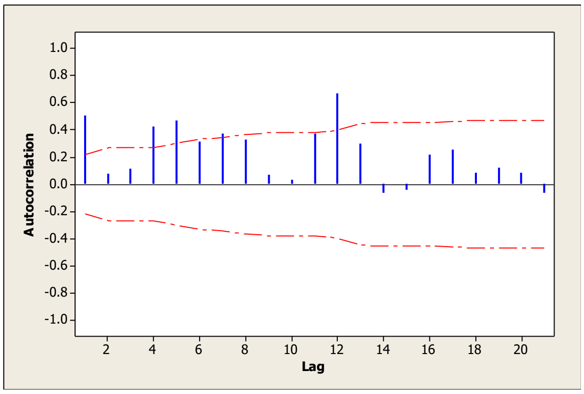

Figure 3: Autocorrelation Function for Tourist from the UK

The ACF used to test the seasonality of the series. Figure 3, ACF of arrivals from the UK suggests the seasonal behavior in arrivals. The Same procedure was repeated for the pattern recognition of arrivals from; Germany, France, Netherlands and Italy. It was clear that; arrivals from all these countries have an increasing trend with seasonal variation.

Forecasting Tourist Arrivals

Firstly, the Decomposition Multiplicative and Additive models run for the UK, with four seasons; season 1 is January - March, season 2 is April - June, season 3 is July - September and season 4 is October - December. For example; Figure 4 is the plots for the seasonal analysis of Multiplicative model;

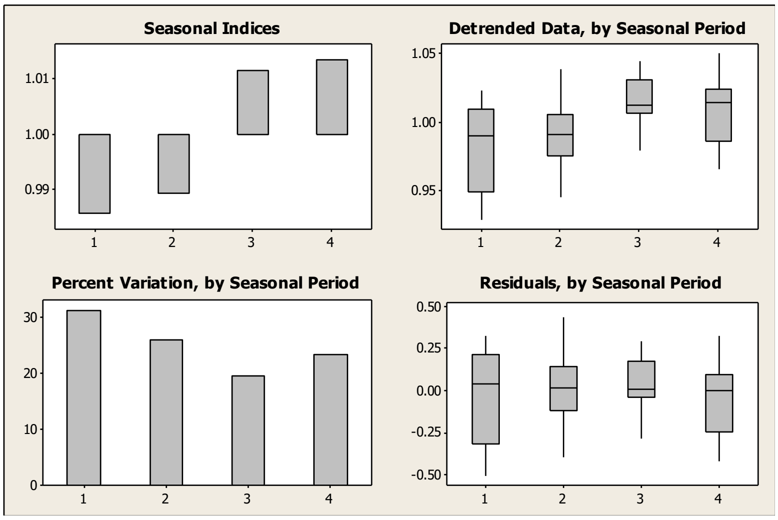

Figure 4: Seasonal Analysis- Multiplicative Model

According to the above Figure; returns of seasons 1 and 2 are below the average, while the returns of the other two seasons are above the average. Figure 5 is the Time Series decomposition plot of the Multiplicative model. It is clear that the pattern of fits is somewhat similar to the pattern of actual arrivals. Measurement errors of the model, MAPE, MSD, and MAD are satisfactorily small.

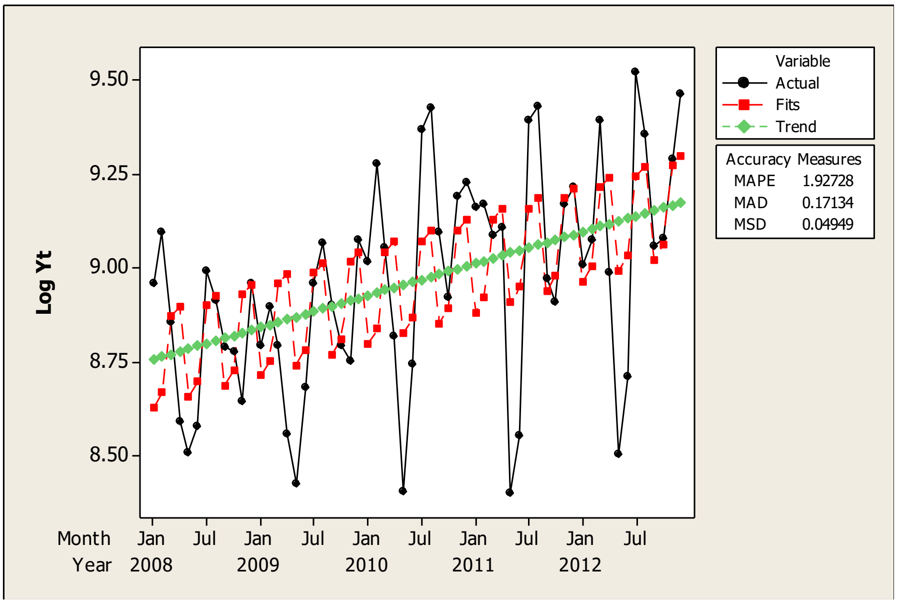

Figure 5: Time Series Decomposition Plot-Multiplicative Model

Figure 6 is the plots for the seasonal analysis of Additive model; Figure 7 is the Time Series decomposition plot of the Additive model;

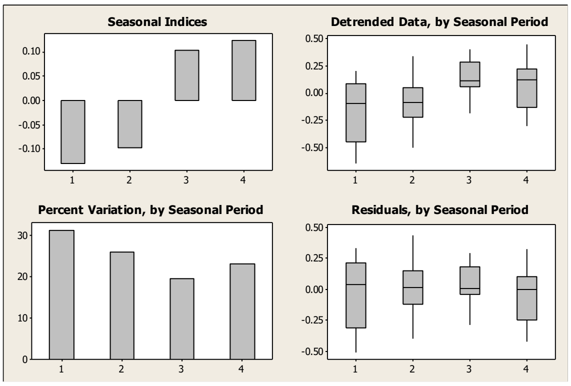

Figure 6: Seasonal Analysis- Additive Model

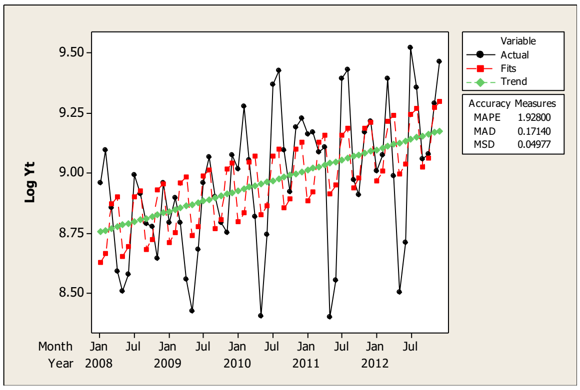

Figure7: Time Series Decomposition Plot-Additive Model

The summary of Multiplicative and Additive models for the UK is given in Table 2.

Table 2: Summary Results of Seasonal Indices for the UK

Multiplicative Model			Additive Model		
Trend Model	Season	Index	Trend Model	Season	Index
lnY_t= 8.74936 + 0.00708165t	1	-0.98551	lnY_t = 8.74774 + 0.00713964t	1	-0.128922
	2	-0.98930		2	-0.097494
	3	1.01155		3	0.103631
	4	1.01365		4	0.122785

According to the table 2, seasonal indices for the periods of 1 and 2 of the multiplicative model are -0.98551 and -0.98930. It means, the number of tourist arrivals for the seasons, 1 and 2 are (0.98551 and 0.98930) below the average number of tourist arrivals. Seasonal indices for the periods 3 and 4 are 1.01155 and 1.01365. It is clear that the number of arrivals for the seasons, 3 and 4 are above the average number of arrivals. The additive model also gave similar results.

The Residual plots of the fitted models and Anderson-Darling test were used for residual analysis. Figure 8 is the residual plot of the Multiplicative model; Figure 9 is the residual plot of the Additive model. It confirmed the independence of residual.

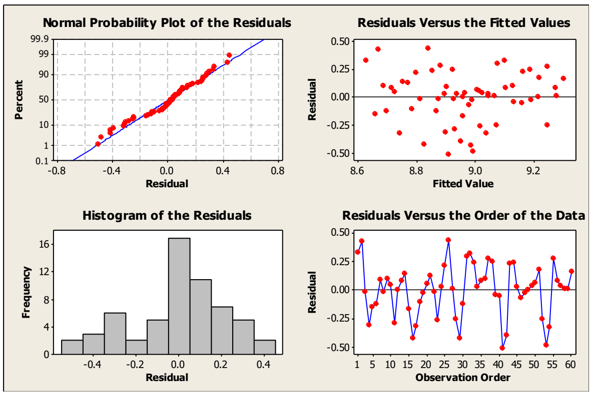

Figure 8: Residual Plot- Multiplicative

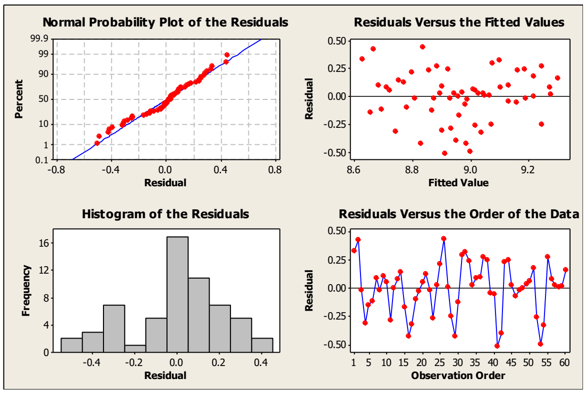

Figure 9: Residual Plot- Additive

The residuals of both models are normally distributed and independent. It confirms the model validation criterion. The next step was the model verification. The summary measures of the model fitting and verification of the multiplicative model are given in Table 3.

Table 3: Model Summary of Multiplicative Model of UK

Trend Model	Model Fitting		Model Verification	
$lnY_t = 8.74936 + 0.00708165t$	MAPE	1.92728	MAPE	2.88728
	MAD	0.17134	MAD	0.270274
	MSE	0.04949	MSE	0.0948912
	Normality	P = 0.064		
	Independence of Residuals	Yes		

The MAPE in model fitting and verification (1.92% and 2.88%) are very small. It confirms the high forecasting ability of the model. The MAD and MSE also confirm the same. The results of the model fitting and verification of the additive model are given in Table 4.

Table 4: Model Summary of Additive Model of UK

Trend Model	Model Fitting		Model Verification	
$lnY_t = 8.74774 +0 .00713964t$	MAPE	1.92800	MAPE	**2.87537**
	MAD	0.17140	MAD	0.269081
	MSE	0.04977	MSE	0.0934207
	Normality	P = 0.064		
	Independence of Residuals	Yes		

MAPE of the fitting is 1.92% and 2.87% in verification. MAD show the small deviation and MSE also shows low values. Accordingly; both the models are equally suitable for forecasting tourist arrivals from the UK. Figure 10 is the comparison of actual returns and fits of the Multiplicative model. Figure 11 is the comparison of actual returns and forecasts of the Multiplicative model.

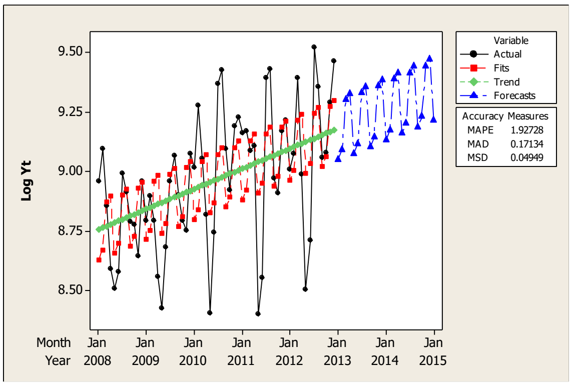

Figure 10: Time Series Plot of Actual Vs, Fits

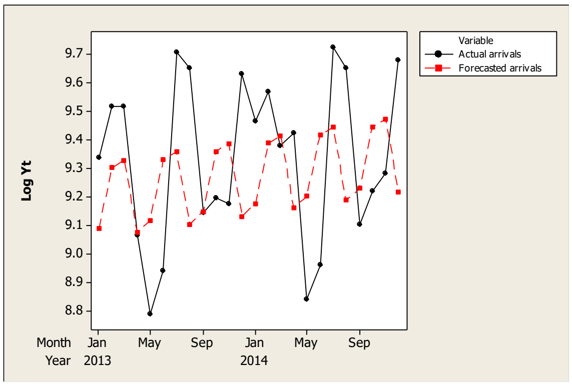

Figure 11: Time Series Plot of Actual Vs Forecast

The fits and forecast have a similar pattern with low fluctuation than actual. Plots of Multiplicative models also showed similar results. The Same procedure was repeated for the other countries. Summary results of the seasonal analysis of Multiplicative models are given in Table 5;

Table 5: Summary Results of Seasonal Indices of Multiplicative models

Country	Trend Model	Seasonal Indices			
		Season 1	Season 2	Season 3	Season 4
GB	$lnY_t = 8.74936 + 0.00708165t$	-0.98551	-0.98930	1.01155	1.01365
DE	$lnY_t = 7.57320 + 0.0188606t$	-0.97788	-0.99280	1.02611	1.00321
FR	$lnY_t = 6.55893 + 0.0361354t$	-0.96942	-0.99741	1.02756	1.00562
NL	$lnY_t = 6.76381 + 0.0137399t$	-0.98375	-0.99134	1.01901	1.00590
IT	$ln\ Y_t = 6.39498 + 0.0112420_t$	-0.98388	-0.99194	1.00798	1.01620

It can be seen that the seasonal indices for all the five countries are below the average in seasons 1 and 2, but above the average in seasons 3 and 4. Also, the values of the seasonal indices are almost equal to all the countries. Accordingly, the seasonal effect from all the countries of the Western Europe is the same. Summary results of the seasonal analysis of additive models are given in table 6;

Table 6: Summary Results of Seasonal Indices of Additive models

Country	Trend Model	Seasonal Indices			
		Season 1	Season 2	Season 3	Season 4
GB	lnY_t =8.74774 +0 .00713964t	-0.12892	-0.09749	0.10363	0.12279
DE	lnY_t =7.57122 + 0.0189226t	-0.18148	-0.05744	0.21523	0.02369
FR	lnY_t=6.55890 + 0.0361547t	-0.23002	-0.02746	0.22472	0.03276
NL	lnY_t=6.76249 + 0.0137953t	-0.11002	-0.06008	0.12959	0.04051
IT	$ln\ Y_t$ =6.39268 + 0.0113152t	-0.10915	-0.05149	0.05309	0.10755

It can be seen that the seasonal indices for all the five countries are below the average in seasons 1 and 2, but above the average in seasons 3 and 4. This behavior is similar to the Additive model, but the seasonal indices values of the Additive models are greater than those of the Multiplicative models in seasons 1 and 2; while they are smaller in seasons 3 and 4.

The residuals of both Multiplicative and Additive models are normally distributed and independent. It confirms the model validation criterion. The next step was the model verification. The summary measures of the model fitting and verification of the Multiplicative models are given in Table 7. The MSE and MAD of all the models are satisfactorily small in both model fitting and verification. The MAPE in model fitting in all the countries is below 5 %. But in verification, MAPE's of France and Netherlands exceeds 5%.

Table 7: Model Summary of Multiplicative Model

Country	Trend Model	Model Fitting			Verification		
		MAPE	MSE	MAD	MAPE	MSE	MAD
GB	lnY_t = 8.74936 +0.00708165t	1.92	0.05	0.17	2.88	0.09	0.27
DE	lnY_t = 7.57320 + 0.0188606t	3.38	0.12	0.27	3.58	1.51	0.31
FR	lnY_t= 6.55893 + 0.0361354t	4.09	0.14	0.30	7.57	0.68	0.65
NL	lnY_t= 6.76381 + 0.0137399t	4.60	0.16	0.33	6.35	0.30	0.45
IT	$ln\ Y_t$ = 6.39498 + 0.0112420t	4.78	0.15	0.32	3.63	0.11	0.25

The results of the model fitting and verification of the additive model is given in Table 8;

Table 8: Model Summary of Additive Model

Country	Trend Model	Model Fitting			Verification		
		MAPE	MSE	MAD	MAPE	MSE	MAD
GB	$lnY_t = 8.74774 + 0.00713964t$	1.92	0.05	0.17	2.87	0.09	0.26
DE	$lnY_t = 7.57122 + 0.0189226t$	3.39	0.12	0.27	3.52	0.30	0.30
FR	$lnY_t = 6.55890 + 0.0361547t$	4.06	0.14	0.30	7.54	0.66	0.62
NL	$lnY_t = 6.76249 + 0.0137953t$	4.59	0.15	0.32	6.35	0.30	0.45
IT	$ln\ Y_t = 6.39268 + 0.0113152t$	4.78	0.15	0.32	3.68	0.11	0.26

Measurements errors of Additive models are almost similar to those of Multiplicative models. As such, both Additive and Multiplicative models are equally good in forecasting.

DISCUSSION AND CONCLUSION

Forecasting tourist arrivals to various destinations is one of the wide spans of study area all over the world. Main strands for forecasting are; Statistical Techniques and Soft Computing techniques. Forecasting a total number of arrivals to Sri Lanka has done by many researches. However, it was difficult to find the studies based on forecasting arrivals region wise. As such, the study was forced on forecasting arrivals from the Western Europe; the highest contributor to the Sri Lankan tourism market.

The analysis of the study begins with pattern recognition of arrivals from Western European countries. It is clear that the series of arrivals have seasonal behavior with the trend. The study revealed that; both, Additive and Multiplicative Decomposition models are suitable for forecasting arrivals from Western European countries. Arrivals from Western Europe follow wave-like patterns with the trend. It may contain both seasonal and cyclical variation. But the Decomposition captures only the seasonal variation. The Circular Model is a recently developed univariate forecasting technique, which can be used to capture both seasonal and cyclical patterns. Therefore, it is recommended to test the Circular Model for de-trended data for better forecasting.

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