FORECASTING TOURIST ARRIVALS FROM ASIAN COUNTRIES TO SRI LANKA

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Abstract— *Sri Lanka is considered as a wonderful tourist destination in the world. The Asian region is the leading tourist producer to Sri Lanka for many years. To gain maximum benefits and minimize the risk, forecasting of arrivals will be essential. Therefore, the current study focused on fitting a suitable model to forecast tourist arrivals from Asian countries to Sri Lanka. Monthly tourist arrival data from India, Maldives, China, and Japan for the period from, January 2008 to December 2014 was obtained from Sri Lanka Tourism Development Authority (SLTDA). Holt's Winters Three-Parameter Model was tested on forecasting arrivals from India, Maldives, and Japan. Four trend model; including three linear and one non-linear model were tested to forecast arrivals from China. Model selection criteria were Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Square Error (MSE). Residual plots and Anderson-Darling test were used for model validation. The results of the study show that Holt's Winters Three-Parameter additive model for forecasting arrivals from India, Maldives, and Japan has MAPE of 1.35%, 1.49%, and 4.6% respectively. Winter's multiplicative model has MAPE 1.32%, 1.36%, and 2.76% respectively for the above countries. The Quadratic trend model is the most suitable model for forecasting arrivals from China. The residuals of all selected models were normally distributed and independent. It was concluded that Winter's models and Quadratic trend models are suitable to forecast arrivals from India, Maldives China, and Japan. It is recommended to test Seasonal Auto Regressive Integrated Moving Average (SARIMA) and Circular model (C M) for better forecasting.*

Keywords— **Winter's Model, Quadratic Trend Model Mean Absolute Percentage Error**

I. INTRODUCTION

The tourism is the fast growing industry in Sri Lanka. It has been proved with the growth of tourist arrivals every year. The natural and anthropogenic beauty could be the attraction for tourism to Sri Lanka (Konarasinghe, 2014; (Konarasinghe and Deheragoda, 2013). Sri Lankan tourism market consists all regions in the world. The Asian region is the leading tourist producer to Sri Lankan tourism market. India, Maldives, China, and Japan are the leading tourist producers from Asia to Sri Lankan market (SLTDA, 2014).

A. Problem Statement

Prediction or forecasting is an essential planning tool that helps any industry to cope with the uncertainty of the future. Increasing of tourist arrivals shows the increasing of demand. Effective forecasting technique is an essential to managing the supply and demand. In view of the above, the current study was focused on identifying the suitable, statistical model for forecasting international tourist arrivals to Sri Lanka from Asian countries.

II. METHODOLOGY

Tourist arrivals from all countries from Asian region are the population of the study. Top four countries with the highest number of arrivals were selected. Arrivals from India, Maldives, China, and Japan are top four countries of the Asian region to Sri Lankan tourism market. Monthly tourist arrival data from January 2008 to December 2014 was obtained from annual statistical reports from 2008 to 2014, published by Sri Lanka Tourism Development Authority (SLTDA). Time series plots and Auto-Correlation Functions (ACF) were used for pattern identification. Several Trend models and Holt's Winter's three parameter multiplicative and additive models were used for model fitting. Residual plots and Anderson-Darling tests for residuals were used as the model validation criterion. Forecasting ability of the models was assessed by considering Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Square Error (MSE).

Auto-Correlation Functions (ACF)

Autocorrelation computes and plots the autocorrelations of a time series. Autocorrelation is the correlation between observations of a time series separated by k time units. The plot of autocorrelations is called the autocorrelation function or ACF (Stephen, 1998). Auto Correlation Function (ACF) was used test the stationary of the data series.

Trend Models

A trend model fits a general time series data and provides forecasts. These models fit trend when there is no seasonal component in the series (Stephen, 1998). Four trend models were tested with log transformation, including three linear and one non-linear model. They are;

Linear trend model: (1)

Quadratic trend model: (2)

Growth curve model: (3)

Pearl – Reed Logistic model: (4)

Holt's Winter's three parameter Models

This Method smoothes data by Holt-Winters exponential smoothing and provides short to medium-range forecasting. This can be used when both trend and seasonality are present, with these two components being either additive or multiplicative (Holt,1957). Winter's multiplicative model is;

Lt = □□(Yt □ St-p) + (1□□) [Lt-1 + Tt-1] (4-1)

Tt = β□[Lt □ Lt-1] + (1 □ β)Tt-1 (4-2)

St = γ□(Yt □ Lt)□□□(1□□□γ) St-p (4-3)

= (Lt-1 □□Tt-1) St-p (4-4)

Where,

Lt = is the level at time t, α is the weight for the level, Tt = is the trend at time t, β is the weight for the trend, St = is the seasonal component at time t, γ is the weight of the seasonal component, p = is the seasonal period, Yt = is the data value at time t, = is the fitted value, or one-period-ahead forecast, at time t.

Formulae of Winter's additive model is ;

L t= □□(Yt □ St-p) + (1□□□) [Lt-1 + Tt-1] (5-1)

Tt = β[Lt □ Lt-1] + (1 □ β)Tt-1 (5-2)

St = γ□(Yt □ Lt)□□□(1□□□γ) St-p (5-3)

= Lt-1 □□Tt-1 □ St-p (5-4)

Where,

Lt = is the level at time t, □ is the weight for the level,Tt = is the trend at time t, β is the weight for the trend, St = is the seasonal component at time t, γ is the weight of the seasonal component, p = is the seasonal period, Yt = is the data value at time t,

= is the fitted value, or one-period-ahead forecast, at time t.

Measurements of Forecasting Errors

One of the fundamental assumptions of statistical forecasting methods is that an actual value consists of forecast plus error; In other words, "Error = Actual value – Forecast". This error component is known as the residual. A good forecasting model should have a mean error of zero because it should over forecast and under forecast approximately the same (Stephen, 1998). Measuring errors are vital in the forecasting process. Measurements of errors are divided into two parts; Absolute measures of errors and Relative measures of errors.

III. RESULTS

Outliers are the extremely large or small values of a data set. They were identified with the help of Box Plot and replaced by moving an average of order three. That is, if the i^{th} value of a series is an outlier;

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

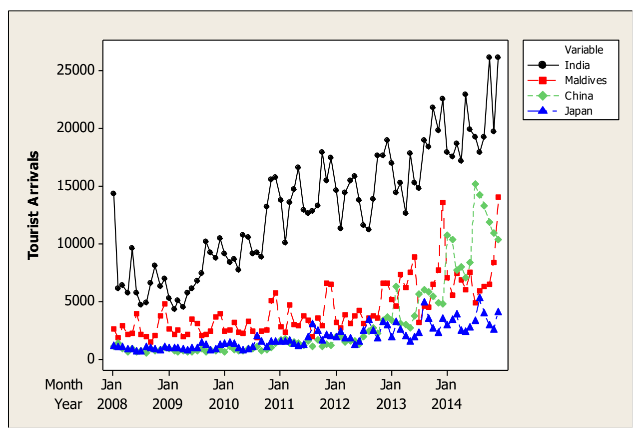

Figure 1. Time series plot of tourist arrivals

Figure1 shows the time series plot of tourist arrivals from India, Maldives, China, and Japan. The behavior of the series clearly shows that there is an increasing trend of arrivals from all four Asian countries.

A. Holt's Winter's three parameter Models

Holt's Winter's three parameter multiplicative and additive models were tested for various α (level), γ (trend) and δ (seasonal) values. The seasonal length was decided by decided by ACF to each country. The seasonal lengths are 4, 6, and 3 for India (IN), Maldives (MV) and Japan (JP).

The analysis starts with Holt's Winter's three parameter additive and multiplicative models for various α (level), γ (trend) and δ (seasonal) values, adopting trial and error methods.

Table 1. Additive Model Validating

Country/ Seasonal length	Model (α)	Model (γ)	Model (δ)	MAPE	MAD	Normality (P–value)	Correlation of Residuals
IN (4)	0.7	0.2	0.2	1.8	0.17	0.293	No
MV (6)	0.65	0.20	0.60	2.8	0.22	0.742	No
JP (3)	0.6	0.2	0.3	3.09	0.22	0.106	No

Table 1 shows the results of suitable fitting Winter's additive models for India, Maldives, and Japan.

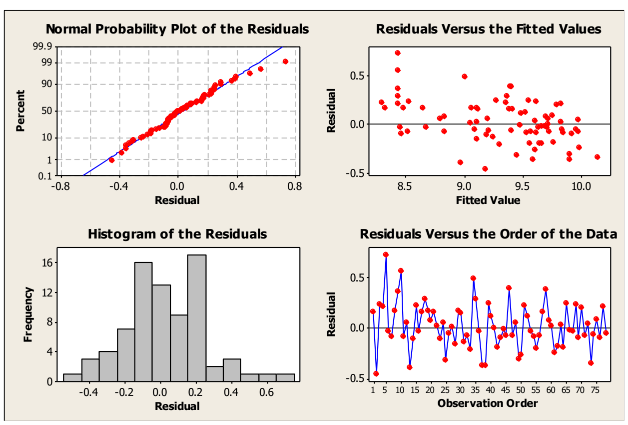

Figure 2. Residual Plots of Additive Model of Arrivals from India.

Figure 2 shows the residual plots, probability plot, and the histogram of residuals of arrivals from India. The residuals of the additive model of arrivals from India were normally distributed and Independent. Similarly; the Residuals of all additive models were normally distributed (P>α) and independent. Therefore, these models have satisfied model validation criterion.

The same procedure was repeated for the countries; Maldives and Japan.

Table 2 gives the results of model verification. The MAPE of all models were below 5%. Therefore, the Winter's models are suitable for forecasting tourist arrivals from India, Maldives, and Japan.

Table 2. Additive Model Verification

Country/ Seasonal length	Model (α)	Model (γ)	Model (δ)	MAPE	MAD
IN(4)	0.7	0.2	0.2	1.35	0.135
MV(6)	0.65	0.20	0.60	1.49	0.131
JP (3)	0.6	0.2	0.3	4.6	0.373

Figure 2 shows the actual arrivals fits and forecasts of tourist arrivals from India. The graph clearly shows that actual values and fitted values are close by;

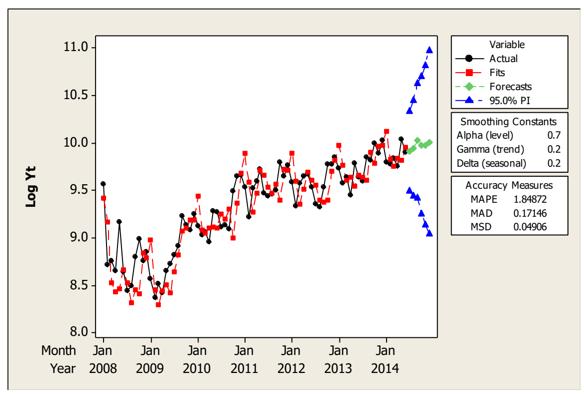

Figure 3. Actual arrivals, Fits, and Forecasts of additive model for Indian tourist arrivals

The second step of the analysis was testing Winter's multiplicative models. Validation results of Winter's multiplicative models are given in table 3.

Table 3. Multiplicative Model Validation

Country/ Seasonal length	Model (α)	Model (γ)	Model (δ)	MAPE	MAD	Normality (P–value)	Correlation of Residuals
IN (4)	0.999	0.111	0.111	1.8	0.16	0.688	No
MV(6)	0.45	0.20	0.60	2.80	0.22	0.865	No
JP (3)	0.5	0.1	0.1	2.85	0.20	0.111	No

The residuals of all multiplicative models were normally distributed (P>α) and independent.

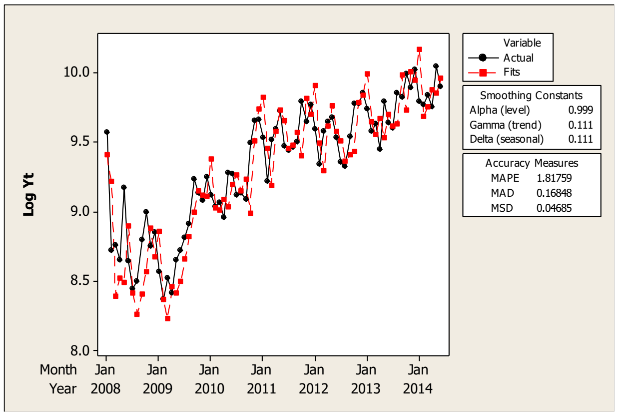

Figure 4. Actual arrivals Vs Fits of Multiplicative model for tourist arrivals from India

Figure 4 shows the actual arrivals and fits of tourist arrivals from India. The graph clearly shows that actual values and fitted values are close by. The same comparison of actual tourist arrivals and fitted was done for the other countries. Model verification results of multiplicative models are given in table 4. It is clear that multiplicative models have least measurement of errors than additive models. It confirmed, Winter's multiplicative models are suitable for forecasting tourist arrivals from the Asian region.

Table 4. Multiplicative Model Verification

Country/ Seasonal length	**Model (α)**	**Model (γ)**	**Model (δ)**	**MAPE**	**MAD**
IN (4)	0.99	0.111	0.111	1.32	0.132
MV(6)	0.45	0.20	0.60	1.36	0.120
JP(3)	0.50	0.1	0.1	2.76	0.225

B. Trend Models

Four trend models were tested to forecast tourist arrivals from China. Fitted models are given bellow;

$$\ln Y_t = 6.32 + 0.02t \qquad (6)$$

$$\ln Y_t = 6.75 - 0.02t - 0.000680939t^2 \qquad (7)$$

$$\ln Y_t = 6.35(1.00292^t) \qquad (8)$$

$$\ln Y_t = \frac{10^2}{15.35 + 0.13(1.05^t)} \qquad (9)$$

The results of model fitting and verification are in table 5. Quadratic Trend Model (7) has least MAPE's in model fitting and verification. The residual plot for a Quadratic model confirmed the normality and independence of residuals of the model.

Table 5 shows Linear, Quadratic, and Growth Curve models show the summary of model validation. The residual of these three models was normally distributed and independent shown by residual plots and Anderson-Darling test. The residuals of Pearl – Reed Logistic model were not normally distributed. It was clear that the Pearl – Reed Logistic model is not valid for forecasting.

Table 5. Model Summary

Model	**Model Fitting**		**Model Verification**	
Linear	MAPE	3.37	MAPE	8.22
	MAD	0.24	MAD	0.71
	MSE	0.08	MSE	0.55
	Normality	0.107		
Quadratic	MAPE	2.68	MAPE	5.28
	MAD	0.19	MAD	0.46
	MSE	0.05	MSE	0.29
	Normality	0.057		
Growth Curve	MAPE	3.33	MAPE	7.92
	MAD	0.23	MAD	0.68
	MSE	0.08	MSE	0.51
	Normality	0.108		
Pearl – Reed	MAPE	2.83		
	MAD	0.19		
	MSE	0.05		
	Normality	0.017		

Model summary of table 5 shows the results of model fitting and verification. The results revealed that Quadratic Trend Model has least MAPE's in model fitting and verification. The values were 2.6% and 5.2 % respectively. MAD and MSE also confirmed the smallest deviation compared with other trend models.

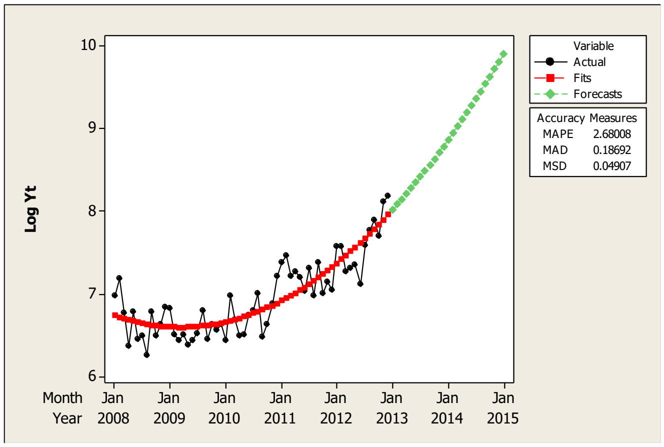

Figure 5. Quadratic Trend Model

Figure 5 is the fits and forecasting of Quadratic Trend Model. Figure 6 is the comparison of fitted models. It is clear that Linear and Growth curve trend models are underestimations of tourist arrivals. Quadratic trend model is closer to the actual tourist arrivals.

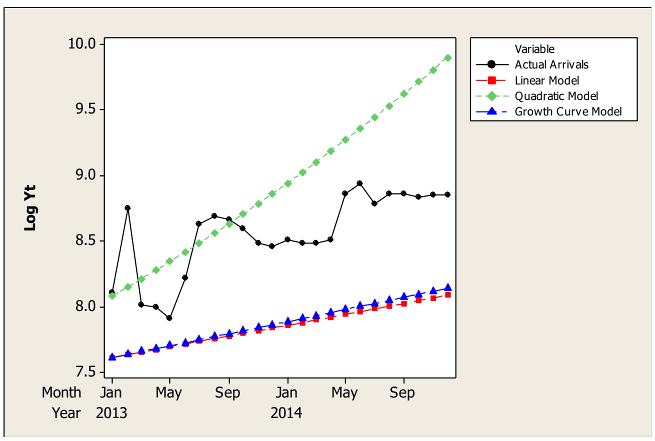

Figure 6. Comparison of Model Verifications

IV. CONCLUSION AND DISCUSSION

This study focused on fitting suitable models to forecasting tourist arrivals from Asian countries to Sri Lanka. The results of this study showed that the Winter's additive models for India, Maldives and Japan has MAPE of 1.3%, 1.4% and 4.6% respectively. The MAD of all models shows small deviations. Winter's multiplicative models for India, Maldives, Japan has MAPE of 1.32%, 1.36% and 2.76% respectively. The MAD of all models was small deviations.

Four trend models were used to forecasting arrivals from China. The results revealed that the Quadratic trend model with log transformation is suitable for forecasting tourist arrivals from China. It has MAPE of 2.6% and 5.2% of fitting and verification.

The results of this study will be a lighthouse for decision making and policy development in all levels related to recruiting employees, business expansions, and other resources management within the industry.

Winter's technique can be accurately used only for short-term forecasting. The data series were non-stationary; therefore, the ARIMA technique cannot be used for forecasting. It is recommended to test Seasonal Auto Regressive Integrated Moving Average (SARIMA) models on forecasting arrivals from India, Maldives, and Japan.

The Circular Model introduced by Konarasinghe, Abeynayake & Gunaratne (2016) would be suitable in forecasting arrivals as all the arrival series show fluctuations around the changing mean.

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