Forecasting with X-12-ARIMA: International tourist arrivals to India and Thailand

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Abstract: Forecasting is an essential analytical tool in tourism policy and planning. This paper focuses on forecasting methods based on X-12-ARIMA seasonal adjustment and this method was developed by the Census Bureau in the United States. It has been continually improved since the 1960s, and it is used by many statistics agencies and central banks. The secondary data were used to produce forecasts of international tourist arrivals to India for 2007-2010 and also these data were used to produce forecasts of international tourist arrivals to Thailand for 2006-2010. From these period the results confirm that the best forecasting method based on the X-12-ARIMA seasonal adjustment is X-12-ARIMA(0,1,2)(0,1,1), X-12-ARIMA(0,1,1)(0,1,1) and X-12-ARIMA(2,1,0)(0,1,1) for India and the best forecasting method based on this method is X-12-ARIMA(0,1,1)(0,1,1) and X-12-ARIMA(2,1,0)(0,1,1) for Thailand. Furthermore this method predict that international tourism arrivals to India for 2007–2010 will growth at a positive rate as same as in this during period the number of international tourists arrival to India will be 5,079,651 million, 5,652,180 million, 6,224,480 million and 6,796,890 million, respectively. Also this method predict that international tourism arrivals to Thailand for 2006-2010 will growth at a positive rate as same as in this during period the number of international tourists arrival to Thailand will be 12,211,033 million, 12,699,532 million, 13,187,591 million, 13,674,669 million and 14,161,998 million, respectively. If these results can be generalized for future year, then it suggests that both the India government sector and the Thailand government sector also the private tourism industry sector of these country should prepare to receive increasing numbers of international tourist arrivals both to India and Thailand in this period.

Key words: India; Thailand, international tourism; X-12-ARIMA; the best forecasting methods;

1. Introduction

International tourist arrivals and international tourist receipts have traditionally been used as benchmark aggregate series to assess the overall importance of tourism worldwide and in specific countries. High international tourist arrival levels may be used in advertising campaigns and also in political discussions to legitimize and emphasize the success of a country in the international community. Similarly, sizeable international tourist receipts can be a good indicator of the role of tourism in an economy in term of both Gross Domestic Product and foreign exchange generation. Policy makers may subsequently be convinced to assist tourism development and further increase profitability from tourism activities. It is not surprising, therefore, that the majority of World Tourism Organization (WTO) statistics focus on these two time series reported as levels, annual changes and market shares (*Papatheodorou and Song* 2005). Furthermore The United Nations Conference on Trade and Development singled out tourism as the only sector in international trade in services for which developing countries had experienced positive surpluses in their trade account (UNCTAD, 1998). Tourism receipts in developing countries, valued at US$ 6 billion in 1980, reached an unprecedented US.$ 62.2 billion in 1996. The prognosis is that this surge will continue, a manifestation of the growing importance of tourism (*Narayan,* 2005). The above information emphasizes that international tourism can generate money for the economy of developing countries, such as India. In 2002, India 2.38 million international tourists and in the same year India received income from international tourism of 2,923 million US.$. And in 2004, the number of international tourists was 3.46 million and the income was 4,769 million US.$. This data shows that when the number of international tourists to India increases, then the income from international tourists to India also increases. Therefore, if the econometrics approach is able to forecast the number of international tourist arrivals to India, it will also be able to forecast the level of income from international tourists. Thus it is an essential analytical tool in tourism policy and planning.

In 2003, Thailand 10,082,109 million international tourists and in the same year Thailand received income from international tourism of 309,269 million baht. And in 2004, the number of international tourists was 11,737,413 million and the income was 384,359 million baht. This data shows that when the number of international tourists to Thailand increases, then the income from international tourists to Thailand also increases. Therefore, if the econometrics approach is able to forecast the number of international tourist arrivals to Thailand, it will also be able to forecast the level of income from international tourists. Thus it is an essential analytical tool in tourism policy and planning.

In a lot of articles to study about time series methods to forecast international tourism (in terms of tourist arrivals) for a particular country (*Richa,* 2005). An incomplete list of recent studies includes those by *Martin and Witt* (1987), *Chan* (1993), *Witt* et al. (1994), *Turner* et al. (1995, 1997), *Kulendran and King* (1997), *Chu* (1998), *Kim* (1999) and *Lim and McAleer* (2000a, 200b), *N. Rangaswamy, Prasert and Chukiat* (2006). Authors differ on the best method for tourism forecasting. For example, whereas *Martin and Witt* (1989) used simple autoregressive(AR) models, Lim and McAleer found that the Autoregressive Integrated Moving Average (ARIMA) forecast tourism arrivals more accurately, and N. Rangaswamy, Prasert and Chukiat found that the best methods to forecast international tourists arrivals to Thailand was both VAR model and SAIMA (p,d,q) (P,D,Q) model. it is impossible to reach a unanimous decision for any particular model, since forecasts are affected by a variety of factors, particularly the country/countries under consideration, the type of data and time span covered by the study.

Form above of reason this paper focus on the famous econometrics approach based on X-12-ARIMA for forecasting the number of international tourist arrival to India for the period 2007-2010 based on data from the period 2002-2006. And also this paper focus on this approach based on X-12-ARIMA for forecasting the number of international tourist arrival to Thailand for the period 2006-2010 based on data from the period 1997-2005.

2. Research Aim and Objective

This research aims to predict the number of international tourist arrivals to India and Thailand in the period 2006-2010 and to seek the best forecasting model for forecasting international tourist arrivals to India and Thailand in this period.

3. Scope of this research

The scope of this research is the period 1997–2010 and mostly the data was secondary data. The countries used for forecasting international tourist arrivals to India were all the countries of importance to the international tourism industry of both India and Thailand such as UK, USA, Canada, France, Sri Lanka, Germany, Japan, Malaysia, Australia, Italy, Singapore, Nepal, Netherlands, Korea, Spain and other country (source : India 's Tourism Organization and Thailand 's Tourism Organization). And the variables used in this research were the number of international tourist arrivals to India and Thailand from 1997–2005 to forecast for 2006–2010.

4. The research framework of tourism forecasting and forecasting methodology

Tourism forecasting methods can be divided into qualitative and quantitative methods and causal quantitative techniques. Regardless of the type of forecasting method used, the usefulness of any tourism demand forecasting model is really determined by the accuracy of the tourism forecasts that it can generate, as measured by comparison with actual tourism flows (*Mahmoud,* 1984). *Frechtling* (1996, 2001) highlighted five patterns in a tourism time series: (a) seasonality, (b) stationarity, (c) linear trend, (d) non-linear trend and (e) stepped series. The time series non-causal approach or forecasting a single variable approach is limited by the lack of explanatory variables and it also was best used for short-term to medium-term forecasting. Additionally, in this approach, it is assumed that the factors related to seasonality, trend and cycle are slow to change and can be extrapolated in the short term (*Kon and Turner,* 2005 and *N. Rangaswamy, Prasert and Chukiat,* 2006).

In this paper, focus on forecasting a single variable approach as well as this variable as international tourists arrival to India during period 2002–2006 and to Thailand 1997–2005. The X-12-ARIMA(p,d,q)(P,D,Q) method was used to forecast international tourist arrival to India during period 2007–2010 also this method was used to forecast international tourist arrival to Thailand during period 2006–2010. This method developed by the Census Bureau in the United States as well as it has been continually improved since the 1960s, and it is used by many statistics agencies and central banks (*Shu and Andrew* (2005)).

4.1 The X-12-ARIMA forecasting method

The X-12-ARIMA program is the primary method used for seasonal adjustment of government and economic time series in the United States, Canada, and the European Union (*Miller and Willianms* (2003). The package seasonal adjustment is X-12-ARIMA developed by the Census Bureau in the United States. It has been continually improved since the 1960s, and it is used by many statistics agencies and central banks (*Shu and Andrew* (2005)). As well as it is based on ratio-to-moving-average classical) decomposition (Macauley, F.R., 1930; also described in Makridakis, et. al.,1998) and includes a great number of improvements that have been developed through empirical testing over the years, with the X-12-ARIMA variant having being released in 1996. The X-12-ARIMA procedure makes adjustment for monthly or quarterly series. It consists of three steps that build upon one another (see more information at appendix C).

1. A regress-ARIMA model is built for the time series as well as this technique combines the tools of regression analysis with the ARIMA approach to pre-adjust various effects such as outliers, trading day and holiday effects.
2. Carries out the actual seasonal adjustment which decomposes the pre-adjusted series, *i.e.* the output

from the reg-ARIMA step, into three elements – trend, seasonal, and irregular components.

3. And the final step of the program tests the quality of seasonal adjustment.

4.2. The general model of X-12-ARIMA (Source: U.S. Census Bureau X-12-ARIMA Reference Manual version 0.2.7)

ARIMA models as discussed by Box and Jenkins(1976), are frequently used for seasonal time series. A general multiplicative seasonal ARIMA model for a time series Z_t can be written

$$Ø(B)\Phi(B^s)(1-B)^d(1-B^s)^D Z_t = \theta(B)\rho(B^s)a_t \text{ ------ (1J)}$$

where

B = the backshift operator ($B_{zt} - Z_{t-1}$)
S = the seasonal period
$Ø(B)$ = $(1- Ø_1B - \ldots\ldots - Ø_pB^P)$ is the non-seasonal AR operator
$\Phi(B^s)$ = $(1- \Phi_1B^s - \ldots\ldots - \Phi_pB^s)$ is the seasonal AR operator
$\theta(B)$ = $(1- \theta_1B - \ldots\ldots. - \theta_qB^q)$ is the non-seasonal moving average(MA operator
$\rho(B)$ = $(1- \rho_1B^s - \ldots\ldots. - \theta_QB^{Qs})$ is the seasonal moving average(MA) operator
$(1-B)^d(1-B^s)$ = non-seasonal differencing of order d and seasonal differencing of order D

A useful extension of ARIMA models results from the use of a time-varying mean function modeled via linear regression effects. More explicitly, suppose writ a linear regression equation for a time series Y_t as

The time series of regression error, is assumed to follow the ARIMA model (1J). Modelling Z_t as ARIMA address the fundamental problem with applying standard regression methodology to time series data, which is that standard regression assumes that the regression error (Z_t in(2J)) are uncorrelated over time. In fact, for time series data, the errors in (2J) will usually be auto correlated, and , moreover with often require differencing. Assuming Z_t is uncorrelated in such cases will typically lead to grossly invalid results the expression (1J) and (2J) taken together define the general regARIMA model allowed by the X-12-ARIMA program. Combining (1J) and (2J), the model can be written in a single equation as

$$Y_t = \Sigma \beta_i x_{i,t} + Z_t \text{ ------- (2J)}$$

where

Y_t = the (dependent) time series
$x_{i,t}$ = regression variables observed concurrently with Y_t
β_i = regression parameters
Z_t = $Y_t - \Sigma \beta_i x_{i,t}$

The regARIMA model (3J) can be thought of either as generalizing the pure ARIMA model (1J) to allow a regression mean function $\Sigma Ó_i \beta_i x_{i,t}$), or as generalizing the regression model (2J) to allow the errors Z_t to follow the ARIMA model (1J). In any case, notice that the regARIMA model implies that first the regression effect are subtracted from Y_t to get the zero mean series Z_t, then the error series Z_t is differenced to get a stationary series, say w_t , and w_t is then assumed to follow the stationary ARIMA model, $Ø(B)\Phi(B^s)w_t = \Theta(B)\rho(B^s)a_t$. Another way to write the regARIMA model (3J) is (see model 4J)

$$(1-B)^d(1-B^s)^D Y_t = \Sigma_i \beta_i (1-B)^d(1-B^s)^D x_{i,t} + w_t \text{ ------ (4J)}$$

where w_t follows the stationery ARIMA model just given. Equation (4J) emphasize that that the regression variables $x_{i,t}$ in the regARIMA model, as well as the series Y_t, are differenced by the ARIMA model differencing operator $(1-B)^d$ $(1-B^s)^D$. Notice that the regARIMA model as written in (3J) assumes that the regression variable $x_{i,t}$ affect the dependent series Y_t only at concurrent time points, i.e., model (3J) does not explicitly provide for lagged regression effects such as $\beta_i x_{i,t-1}$. lagged effects can be inclused by the X-12-ARIMA program.

5. The results of the research

The X-12-ARIMA seasonal adjustment method were employed in this paper for forecasting international tourists arrival to India for 2007-2010. A single variable as the number of international tourist arrivals to India was used to forecasting. The table 1 to table 4 present the best models of X-12-ARIMA to forecasting international tourists arrival to India in this period is selected based on the average absolute percentage error in within-sample forecast (three year). And the table 5 presentation forecasts of quaternary average percentage change in international tourist arrivals to India based on the best models of X-12-ARIMA(p,d,q)(P,D,Q) during the period 2007–2010.

5.1. Forecasting accuracy is based on the Average Absolute Percentage Error in within-sample forecasts: (three year) of each X-12-ARIMA model for forecasting international tourist arrivals to India for 2007–2010

Table 1 shows forecasting performance accuracy comparisons of the 5 models based on X-12-ARIMA seasonal adjustment method for forecasting international tourist arrivals to India for 2007. The value of Average Absolute Percentage Error(AAPE(%)) in within-sample forecasts: (three year) of each X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to India for this period.

Table 1: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2007

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	10.95
2	X-12-ARIMA(0,1,2)(0,1,1)	7.21
3	X-12-ARIMA(2,1,0)(0,1,1)	9.99
4	X-12-ARIMA(0,2,2)(0,1,1)	26.21
5	X-12-ARIMA(2,1,2)(0,1,1)	11.41

Form: computed

Form table 1, the best model to forecasting international tourist arrivals to India during the specified period is X-12-ARIMA(0,1,2)(0,1,1). Because the AAPE(%) of this model is lower than the other models such as X-12-ARIMA(0,1,1)(0,1,1), X-12-ARIMA(2,1,0)(0,1,1), X-12-ARIMA(0,2,2)(0,1,1) and X-12-ARIMA(2,1,2)(0,1,1). Table 2 shows forecasting performance accuracy comparisons of the 5 models based on X-12-ARIMA seasonal adjustment method for forecasting international tourist arrivals to India for 2008. The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of each X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to India for this period.

Table 2: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2008

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	6.07
2	X-12-ARIMA(0,1,2)(0,1,1)	4.05
3	X-12-ARIMA(2,1,0)(0,1,1)	6.46
4	X-12-ARIMA(0,2,2)(0,1,1)	11.24
5	X-12-ARIMA(2,1,2)(0,1,1)	7.00

Form: computed

Form table 2, the best model to forecasting international tourist arrivals to India during the specified period is X-12-ARIMA (0,1,2) (0,1,1). Because the AAPE(%) of this model is lower than the other models such as X-12-ARIMA (0,1,1) (0,1,1), X-12-ARIMA (2,1,0) (0,1,1), X-12-ARIMA (0,2,2) (0,1,1) and X-12-ARIMA (2,1,2)(0,1,1). Table 3 shows forecasting performance accuracy comparisons of the 5 models based on X-12-ARIMA seasonal adjustment method for forecasting international tourist arrivals to India for 2009. The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of each X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to India for this period.

Table 3: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2009

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	2.13
2	X-12-ARIMA(0,1,2)(0,1,1)	1.46
3	X-12-ARIMA(2,1,0)(0,1,1)	2.20
4	X-12-ARIMA(0,2,2)(0,1,1)	9.03
5	X-12-ARIMA(2,1,2)(0,1,1)	3.84

Form: computed

Form table 3, the best model to forecasting international tourist arrivals to India during the specified period is X-12-ARIMA(0,1,1)(0,1,1). Because the AAPE(%) of this model is lower than the other models such as X-12-ARIMA(2,2,0)(0,1,1), X-12-ARIMA(0,2,2)(0,1,1) and X-12-ARIMA(2,1,2)(0,1,1). But X-12-ARIMA(0,1,2)(0,1,1) was not selected to the best model for forecasting because this model has been found that evidence of non-seasonal over differencing (see more information at U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.10*. and appendix B). Table 4 shows forecasting performance accuracy comparisons of the 5 models based on X-12-ARIMA seasonal adjustment method for forecasting international tourist arrivals to India for 2010. The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of each X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to India for this period.

Table 4: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2010

Number	Models of forecasting (Three Year)	AAPE(%)
1	X-12-ARIMA(0,1,1)(0,1,1)	0.33
2	X-12-ARIMA(0,1,2)(0,1,1)	0.70
3	X-12-ARIMA(2,1,0)(0,1,1)	0.81
4	X-12-ARIMA(0,2,2)(0,1,1)	24.48
5	X-12-ARIMA(2,1,2)(0,1,1)	1.11

Form: computed

Form table 4, the best model to forecasting international tourist arrivals to India during the specified period is X-12-ARIMA(2,1,0)(0,1,1). Because the AAPE(%) of this model is lower than the other models both X-12-ARIMA(0,2,2)(0,1,1) and X-12-ARIMA(2,1,2)(0,1,1).But X-12-ARIMA (0,1,1) (0,1,1) and X-12-RIMA(0,1,2)(0,1,1) were not selected to the best model for forecasting because these models have been found that evidence of non-seasonal over differencing (see more information at U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.10*.and appendix B).

5.2 *The empirical results of forecasting international tourist arrivals to India for 2007–2010 by quaternary growth rate*

Table 5 presents the results of forecasting by the best of X-12-ARIMA(p,d,q)(P,D,Q) models for 2007-2010. Mostly first quaternary average percentage change, second quaternary average percentage change and third quaternary average percentage change in international tourist arrivals to India are negative. And mostly fourth quaternary average percentage change in international tourist arrivals to India are positive. Furthermore the quaternary average percentage change per year are positive as well as the quaternary average percentage change per year equally between 1.30% and 2.00% during this period.

Table 5: Forecasts of quaternary average percentage change in international tourist arrivals to India based on the best of X-12-ARIMA(p,d,q)(P,D,Q) models during the period 2007–2010.

Year	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)	Average per Year
2007	-5.07	-9.03	-0.07	22.01	1.96
2008	-4.59	-8.16	-0.01	19.58	1.68
2009	-4.21	-7.45	-0.12	17.66	1.47
2010	-3.89	-6.85	-0.13	16.09	1.30

From: computed

From this table the X-12-ARIMA method forecasting that the high season of international tourism industry in India should be fourth quaternary of each year during the period 2007-2010. This empirical results similarity with previously empirical results from India's tourism organization. And the future based on this method show that international tourism industry in India (the period 2007–2010) will be a good business for India's government and privet business sectors.

5.3 *Forecasting accuracy is based on the Average Absolute Percentage Error in within-sample forecasts: (five year) of each X-12-ARIMA model for forecasting international tourist arrivals to Thailand for 2006–2010*

Table 6 shows forecasting performance accuracy of the 1 models based on X-12-ARIMA seasonal adjustment method for forecasting international tourist arrivals to Thailand for 2006. The value of Average Absolute Percentage Error (AAPE (%)) in within-sample forecasts: (three year) of each X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to Thailand for this period.

Table 6: The Accuracy forecasting models based on X-12-ARIMA seasonal adjustment method for 2006.

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	14.93

Form: computed

Form table 6, the best model to forecasting international tourist arrivals to Thailand during the specified period is X-12-ARIMA(0,1,1)(0,1,1). The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to Thailand for this period.

Table 7: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2007.

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	5.07

Form: computed

Form table 7, the best model to forecasting international tourist arrivals to Thailand during the specified period is X-12-ARIMA (0,1,1)(0,1,1). The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to Thailand for this period.

Table 8: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2008

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	2.14

Form: computed

Form table 8, the best model to forecasting international tourist arrivals to Thailand during the specified period is X-12-ARIMA (0,1,1)(0,1,1). The value of Average Absolute Percentage Error in within-sample forecasts: (three year) of X-12-ARIMA model was used for selection the best of X-12-ARIMA models for forecasting international tourist arrivals to Thailand for this period.

Table 9: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2009

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	0.07
2	X-12-ARIMA(0,1,2)(0,1,1)	0.14
3	X-12-ARIMA(2,1,0)(0,1,1)	0.11

Form: computed

Form table 9, the best model to forecasting international tourist arrivals to Thailand during the specified period is X-12-ARIMA(2,1,0)(0,1,1). Because the AAPE(%) of this model is lower than the model X-12-ARIMA(0,1,2)(0,1,1). But X-12-ARIMA(0,1,1)(0,1,1) was not selected to the best model for forecasting because this model has been found that Ljung-Box Q chi-square probability < 5.00% (see more information at U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.10.*).

Table 10: Accuracy comparison in sample for different forecasting models based on X-12-ARIMA seasonal adjustment method for 2010

Number	Models of forecasting	AAPE(%) (Three Year)
1	X-12-ARIMA(0,1,1)(0,1,1)	0.03
2	X-12-ARIMA(0,1,2)(0,1,1)	0.08
3	X-12-ARIMA(2,1,0)(0,1,1)	0.01

Form: computed

Form table 10, the best model to forecasting international tourist arrivals to Thailand during the specified period is X-12-ARIMA(2,1,0)(0,1,1). Because the AAPE(%) of this model is lower than the other models such as X-12-ARIMA(0,1,1)(0,1,1) and X-12-ARIMA(0,1,2)(0,1,1) (see more information at U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.10.*).

6. The conclusions of research and policy recommendations

This paper provides forecasting analysis of international tourist arrivals to India for 2007-2010 based on the X-12-ARIMA seasonal adjustment method. The best X-12-ARIMA models are the X-12-ARIMA(0,1,2)(0,1,1), the X-12-ARIMA (0,1,1) (0,1,1) and the X-12-ARIMA (2,1,0) (0,1,1). Because of these models have a value of average absolute percentage error (AAPE(%)) are very low than other X-12-ARIMA models (see more detail at U.S. Census Bureau. X-12-ARIMA Reference Manual, Version 0.2.10. and appendix B). And the X-12-ARIMA (0,1,2)(0,1,1) model predicts that both in 2007 the number of international tourists arrival to India will be 5,079,651 million and in 2008 the number of international tourists to India will be 6,224,480 million. Furthermore the X-12-ARIMA (0,1,1) (0,1,1) model predicts that in 2009 the number of international tourists arrival to India will be 6,224,480 million and X-12-ARIMA(2,1,0)(0,1,1) predicts that in 2010 the number of international tourist to India will be 6,796,890 million (see more information at appendix A, table 11 and figure 1).

Therefore the conclusion of this research is that for the next four years, the number of international tourists to India will continue to increase. This result was similar with the results of previous empirical studies of forecasting the international tourist receipts for the world, Asia and Thailand (*Papatheodorou and Song,* 2005), (*Jo Chau Vu and Lindsay W. Turner,* 2006) and (*N. Rangaswamy, Prasert and Chukiat,* 2006) which indicate that the number of international tourists in these area will have positive growth rates for 2007–2010.

If these results can be generalized for future years, then it suggests that both the Indian government sector and the private tourism industry sector need to prepare for increased numbers of international tourists to India for 2007–2010 and should ensure that there are adequate numbers of hotels, transportation, tourist destinations, tourist police units and airports, and that there is an adequate budget allocated for developing facilities and human resources and for addressing the environmental impact of increased tourism.

This paper also provides forecasting analysis of international tourist arrivals to Thailand for 2006–2010 based on the X-12-ARIMA seasonal adjustment method. The best X-12-ARIMA models are both the X-12-ARIMA (0,1,1) (0,1,1) and the X-12-ARIMA (2,1,0) (0,1,1). Because of these models have a value of average absolute percentage error (AAPE(%)) are very low than other X-12-ARIMA models (see more detail at U.S. Census Bureau. X-12-ARIMA Reference Manual, Version 0.2.10.). And the X-12-ARIMA (0,1,1) (0,1,1) model predicts that in 2006 the number of international tourists arrival to Thailand will be 12,211,033 million, in 2007 the number of international tourists to Thailand will be 12,699,532 million and in 2008 the number of international tourists to Thailand will be 13,187,591 million. Furthermore the X-12-ARIMA (2,1,0) (0,1,1) model predicts that in 2009 the number of international tourists arrival to Thailand will be 13,674,669 million and also this model predicts that in 2010 the number of international tourist to Thailand will be 14,161,998 million (see more information at appendix D, table 12 and figure 2).

Therefore the conclusion of this research is that for the next five years, the number of international tourists to Thailand will continue to increase. This result was similar with the results of previous empirical studies of forecasting the international tourist receipts for the world, Asia and Thailand (*Papatheodorou and Song,* 2005), (*Jo Chau Vu and Lindsay W. Turner,* 2006) and (*N. Rangaswamy, Prasert and Chukiat,* 2006) which indicate that the number of international tourists in these area will have positive growth rates for 2007–2010.

If these results can be generalized for future years, then it suggests that both the Thailand government sector and the private tourism industry sector need to prepare for increased numbers of international tourists to Thailand for 2006–2010 and should ensure that there are adequate numbers of hotels, transportation, tourist destinations, tourist police units and airports, and that there is an adequate budget allocated for developing facilities and human resources and for addressing the environmental impact of increased tourism.

Bibliography

Macauley, F.R. (1930): The smoothing of time series. National Bureau of Economic Research.

Bell, W.R., and Hiller, S.C. (1983): 'Modelling time series with calendar variations,' *Journal of the American Statistical Association*, 78, 526–34.

Hurvich, C.M. and Tsay, C.L. (1989): 'Regression and time series modelling in small samples,' *Biometrika*, 76, 297–307.

Makridakis, S., Wheelwright, S.C., and Hyndman, R. J. (1998): *Forecasting Methods and Applications, Third Edition*, John Wiley and Sons.

Findley, D. F., Monsell, B. C., Bell, W. R., Otto, M. C., and Chen, B. C. (1998): "New Capabilities and Methods of the X-12-ARIMA Seasonal Adjustment Program," *Journal of Business and Economic Statistics*, 16, 127–176 (with Discussion).

U.S. Bureau of the Census (1999): *X-12-ARIMA Reference Manual*, U.S. Department of Commerce, Washington, DC, [ftp://ftp.census.gov/pub/ts/x12a/].

U.S. Bureau of the Census (1999): "X-12-ARIMA Seasonal Adjustment Program," [ftp://ftp.census.gov/pub/ts/x12a/].

U.S. Bureau of the Census (1999): *X-12-ARIMA Quick Reference for Unix*, U.S. Department of Commerce, Washington, DC, [ftp://ftp.census.gov/pub/ts/x12a/].

U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.*7. Time Series Staff , Statistical Research, Division Room 3000-4, U.S. Census Bureau Washington, DC 20233-9100. email address x12@census.gov , (May 16, 2000)

Hood, C.C. (2000a): "X-12-Graph: A SAS/GRAPH® Program for X-12-ARIMA Output, User's Guide for X-12-Graph Interactive for PC/Windows, Version 1.2," U.S. Census Bureau: Washington, DC.

Hood, C.C. (2000b): "X-12-Graph: A SAS/GRAPH® Program for X-12-ARIMA Output, User's Guide for X-12-Graph Batch, Version 1.2," U.S. Census Bureau: Washington, DC.

Hood, C.C. (2000c): "The SAS Interface for X-12-ARIMA, User's Guide, Version 1.0," U.S. Census Bureau: Washington, DC.

U.S. Census Bureau. *X-12-ARIMA Reference Manual, Version 0.2.10*. (Available online:http://www.census.gov/srd/www/x12a/x12down_pc.html, accessed November 22, 2002)

Armstrong, J.S. and Collopy, F. Speculations about seasonal factors. (Available online: http://hops.wharton.upenn.edu/forecast/, accessed November 22, 2002)

Don M. Miller and Dan Willams(2003): "Shrinkage Estimators for Damping X-12-ARIMA Seasonal" discussion paper ,Virginia Commonwealth University USA.

John Thorp. (2003). "Change of seasonal adjustment method to X-12-ARIMA". Monetary & Financial Statistics.

Bell, W., (2004): On RegComponent time series models and their applications. In A. Harvey et al. (eds), State space and unobserved components models : Theory and applications, Cambridge : Cambridge University Press.

Proietti, T. (2004): Seasonal specific structural Time Series, Studies in Nonlinear Dynamics & Econometrics, 8 (2), Article 16.

Findley, D.F., K.C. Wills and B.C. Monsell (2004): 'Seasonal adjustment perspectives on "Damping seasonal factors: shrinkage estimators for the X-12-ARIMA program", *International Journal of Forecasting*,20, 551–556.

Bell, W., and Trimbur T., (2005): Seasonal heteroskedasticity in time series: modeling, estimation, and testing. Working paper.

Chang Shu and Andrew Tsang (2005): "Adjusting for the Chinese New Year: An Operational Approach". External Department Hong Kong Monetary Authority.

Amato, J D (2005): "Risk aversion and risk premia in the CDS market", *BIS Quarterly Review*, December, pp 55–67.

Bollerslev, T, M Gibson and H Zhou (2005): *Dynamic estimation of volatility risk premia and investor risk aversion from option-implied and realized volatilities*, working paper.

Fornari, F (2005): "The rise and fall of US dollar interest rate volatility: evidence from swaptions", *BIS Quarterly Review*, September, pp 87–97.

Gai, P and N Vause (2005): "Measuring investors' risk appetite", *Bank of England Working Paper Series*, no 283.

Thomas M. Trimbur. (2006): "Seasonal heteroskedasticity in Census Bureau construction series". Statistical Research Division U.S. Census Bureau Washington DC. 20233–9100.

Up to date documentation of the X-12-ARIMA program (2006), and the program itself, are on the US Census Bureau's website (www.census.gov/srd/www/x12a).

N. Rangaswamy, Parsert and Chukiat (2006): "Time Series Forecasting: International Tourist Arrivals to Thailand" working paper No. 6/2006, LSD, Chiang-Mai.

Richa Dhariwal.(2005): "Tourist arrivals in India: how important are domestic disorders?", Tourism Economics, Vol. 11(2), pp 185–205.

Appendix A

Extension experimental results of forecasting international tourist arrivals to India for 2007-2010 based on X-12-ARIMA forecasting method

Table 11. Forecast the number of international tourist arrivals to India for 2006–2010 based on the X-12-ARIMA(0,1,2)(0,1,1), X-12-ARIMA(0,1,1)(0,1,1) and X-12-ARIMA(2,1,0)(0,1,1)

Year/Month	2007	2008	2009	2010
Jan	505,575.00	552,962.00	600,570.00	648,269.00
Feb	476,527.00	524,294.00	571,992.00	619,692.00
Mar	455,593.00	503,356.00	551,054.00	598,756.00
Apr	372,654.00	420,243.00	467,944.00	515,644.00
May	311,258.00	359,061.00	406,759.00	454,460.00
Jun	334,873.00	382,714.00	430,412.00	478,113.00
Jul	379,481.00	427,242.00	474,946.00	522,648.00
Aug	357,028.00	404,795.00	452,494.00	500,195.00
Sep	329,832.00	377,699.00	425,396.00	473,097.00
Oct	442,002.00	489,717.00	537,416.00	585,117.00
Nov	520,081.00	567,781.00	615,480.00	663,181.00
Dec	594,747.00	642,316.00	690,017.00	737,718.00
Total	**5,079,651.00**	**5,652,180.00**	**6,224,480.00**	**6,796,890.00**

Form computed.

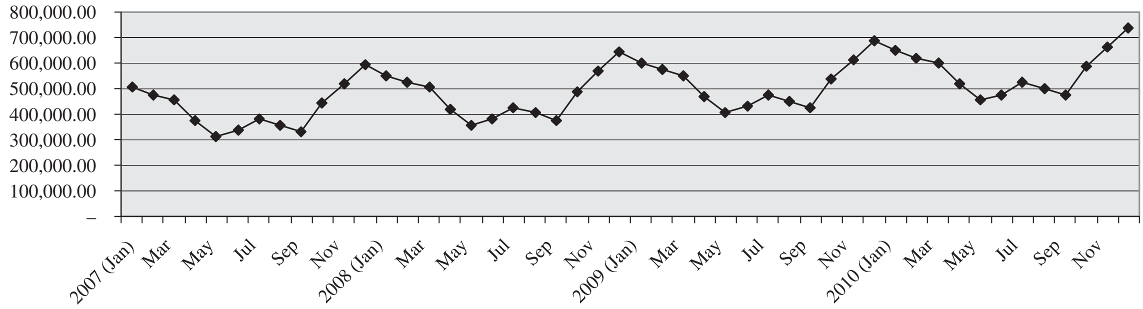


Figure 1. Graphical presentation of forecasting international tourist arrivals to India for 2007–2010 based on X-12-ARIMA(0,1,2)(0,1,1), X-12-ARIMA(0,1,1)(0,1,1) and X-12-ARIMA(2,1,0)(0,1,1)

Form computed.

Appendix B.

The totally empirical results of this research based on X-12-ARIMA monthly seasonal adjustment Method, Release Version 0.2.9

```
                U. S. Department of Commerce, U. S. Census Bureau
                  X-12-ARIMA monthly seasonal adjustment Method,
                            Release Version 0.2.9
                            (forecasting for 2007)

                             Model  1: (0 1 1)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  5.35   Last-1 year: 16.85   Last-2 year: 10.67
Last three years:  10.95

Chi Square Probability:   6.06%

Nonseasonal MA parameter estimates: 0.270
Seasonal MA parameter estimates:    0.062

                             Model  2: (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  3.13   Last-1 year:  8.42   Last-2 year: 10.18
Last three years:  7.24

Chi Square Probability:  44.09%

Nonseasonal MA parameter estimates: 0.272  0.469
Seasonal MA parameter estimates:    0.033

                             Model  3: (2 1 0)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  4.73   Last-1 year: 14.87   Last-2 year: 10.37
Last three years:  9.99

Chi Square Probability:  44.36%

Nonseasonal AR parameter estimates:-0.165 -0.318
Seasonal MA parameter estimates:    0.028

                             Model  4: (0 2 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  7.12   Last-1 year: 11.04   Last-2 year: 60.49
Last three years:  26.21

Chi Square Probability:   1.44%

Nonseasonal MA parameter estimates: 1.207 -0.207
Seasonal MA parameter estimates:    0.061


MODEL  4 REJECTED:
Average forecast error > 15.00%
Ljung-Box Q chi-square probability <  5.00%
Evidence of nonseasonal overdifferencing.
```

```
                             Model  5: (2 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  3.43   Last-1 year:  7.07   Last-2 year: 23.72
Last three years:  11.41

Chi Square Probability:  29.04%

Nonseasonal AR parameter estimates:  -0.209  0.408
Nonseasonal MA parameter estimates:   0.058  0.941
Seasonal MA parameter estimates:      0.075


MODEL  5 REJECTED:
Evidence of nonseasonal overdifferencing.


                        The model chosen is (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  3.13   Last-1 year:  8.42   Last-2 year: 10.18
Last three years:  7.24


ARIMA Model: (0 1 2)(0 1 1)
 Nonseasonal differences: 1
 Seasonal differences:    1
                              Standard
Parameter          Estimate     Errors
--------------------------------------
Nonseasonal MA
 Lag 1            0.2721     0.13440
 Lag 2            0.4686     0.13348

Seasonal MA
 Lag 12           0.0325     0.13360

Variance          0.31002E+09
--------------------------------------

Likelihood Statistics
---------------------------------------------------
Effective number of observations (nefobs)        47
Number of parameters estimated (np)               4
Log likelihood (L)                       -526.5756
AIC                                       1061.1511
AICC (F-corrected-AIC)                    1062.1035
Hannan Quinn                              1063.9360
BIC                                       1068.5517
---------------------------------------------------
FORECASTING
Origin 2006.Dec
Number       12
```

```
Forecasts and Standard Errors
  ----------------------------
                      Standard
    Date    Forecast     Error
  ----------------------------
  2007.Jan 505575.59 17607.376
  2007.Feb 476527.28 21778.487
  2007.Mar 455593.82 22251.983
  2007.Apr 372654.64 22715.613
  2007.May 311258.26 23169.966
  2007.Jun 334877.00 23615.580
  2007.Jul 379481.39 24052.940
  2007.Aug 357028.77 24482.488
  2007.Sep 329832.10 24904.628
  2007.Oct 442002.26 25319.731
  2007.Nov 520081.28 25728.138
  2007.Dec 594747.31 26130.162
  ----------------------------

 Confidence intervals with coverage probability (0.95000)
  --------------------------------------
    Date       Lower  Forecast     Upper
  --------------------------------------
  2007.Jan 471065.76 505575.59 540085.41
  2007.Feb 433842.23 476527.28 519212.33
  2007.Mar 411980.73 455593.82 499206.90
  2007.Apr 328132.86 372654.64 417176.43
  2007.May 265845.96 311258.26 356670.56
  2007.Jun 288591.32 334877.00 381162.69
  2007.Jul 332338.49 379481.39 426624.29
  2007.Aug 309043.98 357028.77 405013.57
  2007.Sep 281019.92 329832.10 378644.27
  2007.Oct 392376.50 442002.26 491628.02
  2007.Nov 469655.05 520081.28 570507.50
  2007.Dec 543533.14 594747.31 645961.49
  --------------------------------------

                 U. S. Department of Commerce, U. S. Census Bureau
                  X-12-ARIMA monthly seasonal adjustment Method,
                          Release Version 0.2.9
                          (forecasting for 2008)

Model  1: (0 1 1)(0 1 1)
 Average absolute percentage error in within-sample forecasts:
 Last year:  1.67   Last-1 year:  2.91   Last-2 year: 13.61
 Last three years:  6.07

 Chi Square Probability:   5.25%

 Nonseasonal MA parameter estimates:   0.520
 Seasonal MA parameter estimates:     -0.197
```

```
                              Model  2: (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.49   Last-1 year:  3.07   Last-2 year:  8.59
Last three years:  4.05
Chi Square Probability:  21.99%

Nonseasonal MA parameter estimates:   0.349  0.493
Seasonal MA parameter estimates:     -0.068


                              Model  3: (2 1 0)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  2.40   Last-1 year:  3.04   Last-2 year: 13.94
Last three years:  6.46

Chi Square Probability:   6.97%

Nonseasonal AR parameter estimates:  -0.277 -0.418
Seasonal MA parameter estimates:     -0.144


                              Model  4: (0 2 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  3.87   Last-1 year:  5.10   Last-2 year: 24.76
Last three years:  11.24

Chi Square Probability:   5.75%

Nonseasonal MA parameter estimates:   1.449 -0.449
Seasonal MA parameter estimates:     -0.182


MODEL  4 REJECTED:
Evidence of nonseasonal overdifferencing.


                              Model  5: (2 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  2.85   Last-1 year:  3.20   Last-2 year: 14.94
Last three years:  7.00

Chi Square Probability:   6.53%

Nonseasonal AR parameter estimates:  -0.307 -0.530
Nonseasonal MA parameter estimates:  -0.047 -0.137
Seasonal MA parameter estimates:     -0.146


                         The model chosen is (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.49   Last-1 year:  3.07   Last-2 year:  8.59
Last three years:  4.05

ARIMA Model: (0 1 2)(0 1 1)
 Nonseasonal differences: 1
 Seasonal differences:    1
```

```
                              Standard
Parameter          Estimate     Errors
--------------------------------------
Nonseasonal MA
 Lag 1             0.3488      0.12816
 Lag 2             0.4929      0.12352

Seasonal MA
 Lag 12           -0.0683      0.12396

Variance           0.19600E+09


-----------------------------------------------------
Likelihood Statistics
-----------------------------------------------------
Effective number of observations (nefobs)          47
Number of parameters estimated (np)                 4
Log likelihood (L)                          -515.9986
AIC                                         1039.9973
AICC (F-corrected-AIC)                      1040.9497
Hannan Quinn                                1042.7822
BIC                                         1047.3979
-----------------------------------------------------
FORECASTING
Origin 2007.Dec
Number       12
Forecasts and Standard Errors
------------------------------
            Standard
   Date    Forecast     Error
------------------------------
 2008.Jan 552962.42 14000.107
 2008.Feb 524294.89 16707.016
 2008.Mar 503356.98 16853.472
 2008.Apr 420243.65 16998.667
 2008.May 359061.36 17142.632
 2008.Jun 382714.41 17285.398
 2008.Jul 427242.66 17426.994
 2008.Aug 404795.34 17567.449
 2008.Sep 377699.56 17706.790
 2008.Oct 489717.98 17845.043
 2008.Nov 567781.19 17982.233
 2008.Dec 642316.83 18118.384
------------------------------

Confidence intervals with coverage probability (0.95000)
 ---------------------------------------
   Date       Lower  Forecast     Upper
 ---------------------------------------
 2008.Jan 525522.71 552962.42 580402.12
 2008.Feb 491549.74 524294.89 557040.04
 2008.Mar 470324.78 503356.98 536389.18
 2008.Apr 386926.88 420243.65 453560.43
 2008.May 325462.42 359061.36 392660.30
 2008.Jun 348835.66 382714.41 416593.17
 2008.Jul 393086.38 427242.66 461398.94
```

```
 2008.Aug 370363.77 404795.34 439226.91
 2008.Sep 342994.89 377699.56 412404.23
 2008.Oct 454742.34 489717.98 524693.62
 2008.Nov 532536.66 567781.19 603025.72
 2008.Dec 606805.45 642316.83 677828.21
 --------------------------------------

                U. S. Department of Commerce, U. S. Census Bureau
                 X-12-ARIMA monthly seasonal adjustment Method,
                            Release Version 0.2.9
                           (forecasting for 2009)

                            Model  1: (0 1 1)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.19   Last-1 year:  2.26   Last-2 year:  3.94
Last three years:  2.13

Chi Square Probability:  13.89%

Nonseasonal MA parameter estimates:   0.404
Seasonal MA parameter estimates:     -0.075


                            Model  2: (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.39   Last-1 year:  1.21   Last-2 year:  2.78
Last three years:  1.46

Chi Square Probability:  18.13%

Nonseasonal MA parameter estimates:   0.583  0.376
Seasonal MA parameter estimates:     -0.136


MODEL  2 REJECTED:
Evidence of nonseasonal overdifferencing.

                            Model  3: (2 1 0)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.27   Last-1 year:  2.53   Last-2 year:  3.79
Last three years:  2.20

Chi Square Probability:  18.34%

Nonseasonal AR parameter estimates:  -0.354 -0.259
Seasonal MA parameter estimates:     -0.098


                            Model  4: (0 2 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  2.61   Last-1 year:  9.56   Last-2 year: 14.92
Last three years:  9.03

Chi Square Probability:  24.21%

Nonseasonal MA parameter estimates:   1.355 -0.356
Seasonal MA parameter estimates:     -0.066
```

```
MODEL  4 REJECTED:
Evidence of nonseasonal overdifferencing.

                           Model  5: (2 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  1.14   Last-1 year:  2.95   Last-2 year:  7.44
Last three years:  3.84

Chi Square Probability:   9.92%

Nonseasonal AR parameter estimates:  -0.125  0.279
Nonseasonal MA parameter estimates:   0.400  0.600
Seasonal MA parameter estimates:     -0.054

MODEL  5 REJECTED:
Evidence of nonseasonal overdifferencing.

                        The model chosen is (0 1 1)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.19   Last-1 year:  2.26   Last-2 year:  3.94
Last three years:  2.13

 ARIMA Model: (0 1 1)(0 1 1)
 Nonseasonal differences: 1
 Seasonal differences:    1

                              Standard
Parameter          Estimate     Errors
--------------------------------------
Nonseasonal MA
 Lag 1             0.4041      0.13425

Seasonal MA
 Lag 12           -0.0747      0.11898

Variance           0.12095E+09
---------------------------------------------------
Likelihood Statistics
---------------------------------------------------
Effective number of observations (nefobs)        47
Number of parameters estimated (np)               3
Log likelihood (L)                        -504.1679
AIC                                       1014.3358
AICC (F-corrected-AIC)                    1014.8939
Hannan Quinn                              1016.4244
BIC                                       1019.8862
---------------------------------------------------
FORECASTING
Origin 2008.Dec
Number    12
Forecasts and Standard Errors
```

Date	Forecast	Standard Error
2009.Jan	600570.38	10997.542
2009.Feb	571992.85	12801.973
2009.Mar	551054.82	14381.762
2009.Apr	467944.12	15804.419
2009.May	406759.56	17109.186
2009.Jun	430412.13	18321.267
2009.Jul	474941.12	19457.991
2009.Aug	452494.08	20531.877
2009.Sep	425396.83	21552.321
2009.Oct	537416.58	22526.587
2009.Nov	615480.75	23460.429
2009.Dec	690017.19	24358.495

Confidence intervals with coverage probability (0.95000)

Date	Lower	Forecast	Upper
2009.Jan	579015.59	600570.38	622125.16
2009.Feb	546901.45	571992.85	597084.26
2009.Mar	522867.08	551054.82	579242.56
2009.Apr	436968.03	467944.12	498920.21
2009.May	373226.17	406759.56	440292.94
2009.Jun	394503.11	430412.13	466321.15
2009.Jul	436804.16	474941.12	513078.08
2009.Aug	412252.34	452494.08	492735.82
2009.Sep	383155.05	425396.83	467638.60
2009.Oct	493265.28	537416.58	581567.88
2009.Nov	569499.15	615480.75	661462.34
2009.Dec	642275.42	690017.19	737758.96

U. S. Department of Commerce, U. S. Census Bureau
X-12-ARIMA monthly seasonal adjustment Method,
Release Version 0.2.9
(forecasting for 2010)

Model 1: (0 1 1)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year: 0.09 Last-1 year: 0.06 Last-2 year: 0.84
Last three years: 0.33

Chi Square Probability: 85.72%

Nonseasonal MA parameter estimates: 0.965
Seasonal MA parameter estimates: -0.132

MODEL 1 REJECTED:
Evidence of nonseasonal overdifferencing.

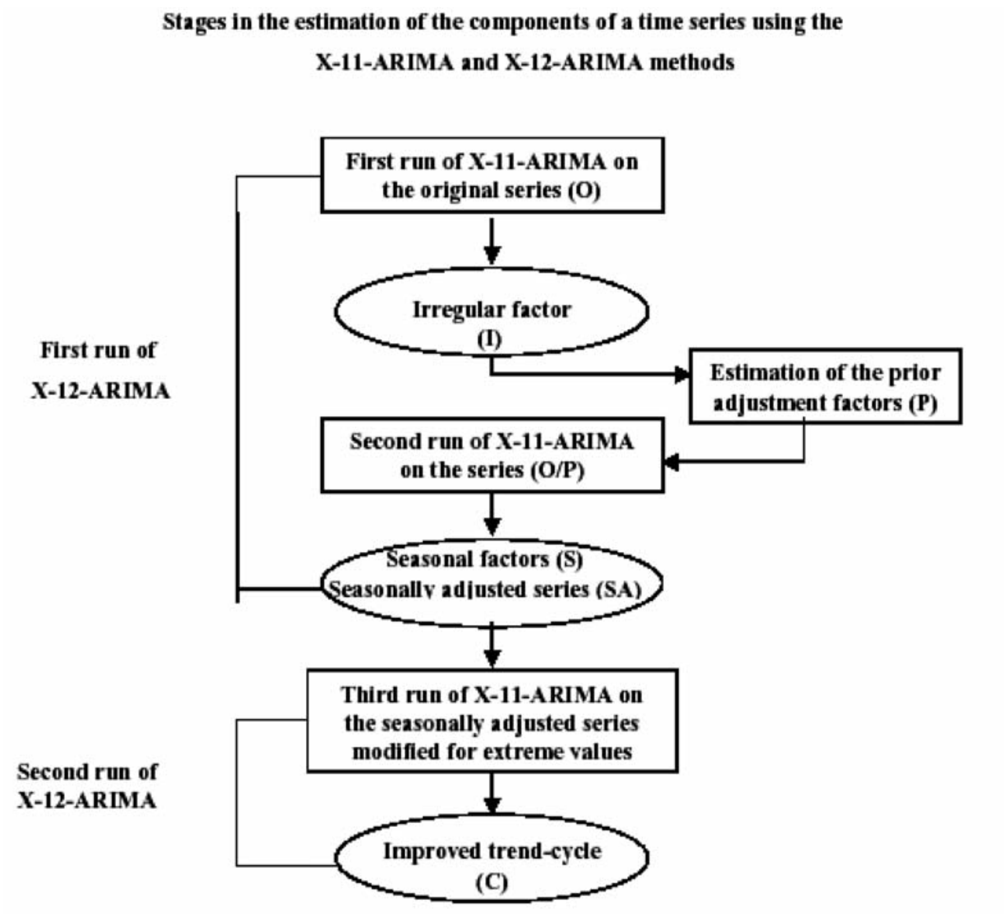
```
                             Model  2: (0 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.31   Last-1 year:  0.88   Last-2 year:  0.92
Last three years:  0.70

Chi Square Probability:  99.37%

Nonseasonal MA parameter estimates:   0.599  0.401
Seasonal MA parameter estimates:     -0.160


MODEL  2 REJECTED:
Evidence of nonseasonal overdifferencing.


                             Model  3: (2 1 0)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.01   Last-1 year:  0.11   Last-2 year:  2.32
Last three years:  0.81

Chi Square Probability:  50.71%

Nonseasonal AR parameter estimates:  -0.419 -0.439
Seasonal MA parameter estimates:     -0.037


                             Model  4: (0 2 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  5.94   Last-1 year: 13.30   Last-2 year: 24.20
Last three years:  14.48

Chi Square Probability:  87.84%

Nonseasonal MA parameter estimates:   1.582 -0.582
Seasonal MA parameter estimates:     -0.195


MODEL  4 REJECTED:
Evidence of nonseasonal overdifferencing.

                             Model  5: (2 1 2)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.51   Last-1 year:  0.93   Last-2 year:  1.90
Last three years:  1.11

Chi Square Probability:  99.05%

Nonseasonal AR parameter estimates:  -0.144  0.029
Nonseasonal MA parameter estimates:   0.476  0.524
Seasonal MA parameter estimates:     -0.090


MODEL  5 REJECTED:
Evidence of nonseasonal overdifferencing.
```

```
                        The model chosen is (2 1 0)(0 1 1)
Average absolute percentage error in within-sample forecasts:
Last year:  0.01   Last-1 year:  0.11   Last-2 year:  2.32
Last three years:  0.81


ARIMA Model: (2 1 0)(0 1 1)
 Nonseasonal differences: 1
 Seasonal differences:    1
                              Standard
Parameter          Estimate     Errors
--------------------------------------
Nonseasonal AR
 Lag 1         -0.4190        0.13491
 Lag 2         -0.4387        0.12953

Seasonal MA
 Lag 12        -0.0365         0.10768

Variance        0.53534E+08
--------------------------------------

Likelihood Statistics
---------------------------------------------------
Effective number of observations (nefobs)        47
Number of parameters estimated (np)               4
Log likelihood (L)                        -485.1577
AIC                                        978.3155
AICC (F-corrected-AIC)                     979.2679
Hannan Quinn                               981.1004
BIC                                        985.7161
---------------------------------------------------



FORECASTING
Origin 2009.Dec
Number    12

Forecasts and Standard Errors
-----------------------------
                     Standard
   Date    Forecast     Error
-----------------------------
 2010.Jan 648269.68  7316.689
 2010.Feb 619692.61  8462.123
 2010.Mar 598756.11  8775.874
 2010.Apr 515646.30  9851.984
 2010.May 454460.38 10798.313
 2010.Jun 478113.64 11351.488
 2010.Jul 522648.08 12006.262
 2010.Aug 500195.70 12700.832
 2010.Sep 473097.56 13276.013
 2010.Oct 585117.84 13831.327
 2010.Nov 663181.81 14396.828
 2010.Dec 737718.97 14926.396
 ----------------------------
```

Confidence intervals with coverage probability (0.95000)

Date	Lower	Forecast	Upper
2010.Jan	633929.23	648269.68	662610.12
2010.Feb	603107.15	619692.61	636278.07
2010.Mar	581555.71	598756.11	615956.50
2010.Apr	496336.76	515646.30	534955.83
2010.May	433296.08	454460.38	475624.68
2010.Jun	455865.14	478113.64	500362.15
2010.Jul	499116.24	522648.08	546179.93
2010.Aug	475302.53	500195.70	525088.88
2010.Sep	447077.05	473097.56	499118.06
2010.Oct	558008.93	585117.84	612226.74
2010.Nov	634964.55	663181.81	691399.07
2010.Dec	708463.77	737718.97	766974.17

Appendix C.



Source : From Israel's Central Bureau of statistics

Appendix D

Extension experimental results of forecasting international tourist arrivals to Thailand for 2006-2010 based on X-12-ARIMA forecasting method

Table 12. Forecast the number of international tourist arrivals to India for 2006- 2010 based on the X-12-ARIMA(0,1,1)(0,1,1) and X-12 ARIMA(2,1,0)(0,1,1)

Year/Month	2006	2007	2008	2009	2010
Jan	1,043,095.00	1,084,464.77	1,125,396.40	1,165,972.74	1,206,634.43
Feb	991,404.00	1,032,742.73	1,073,676.63	1,114,210.56	1,154,870.13
Mar	984,573.70	1,025,540.71	1,066,323.64	1,106,893.81	1,147,523.39
Apr	861,304.20	902,144.53	942,877.10	983,458.43	1,024,080.81
May	834,200.10	874,728.26	915,331.49	955,929.38	996,527.96
Jun	918,156.00	958,554.97	999,101.72	1,039,709.47	1,080,297.16
Jul	1,065,703.00	1,106,124.09	1,146,676.84	1,187,284.24	1,227,872.88
Aug	1,096,558.00	1,137,013.97	1,177,579.65	1,218,184.73	1,258,775.63
Sep	963,674.90	1,004,276.62	1,044,903.55	1,085,499.00	1,126,101.12
Oct	1,047,093.00	1,087,477.69	1,128,014.30	1,168,624.08	1,209,209.62
Nov	1,157,672.00	1,198,198.59	1,238,792.75	1,279,393.44	1,319,989.46
Dec	1,247,600.00	1,288,265.65	1,328,917.58	1,369,509.16	1,410,115.76
Total	12,211,033.90	12,699,532.58	13,187,591.65	13,674,669.04	14,161,998.35

Form computed.

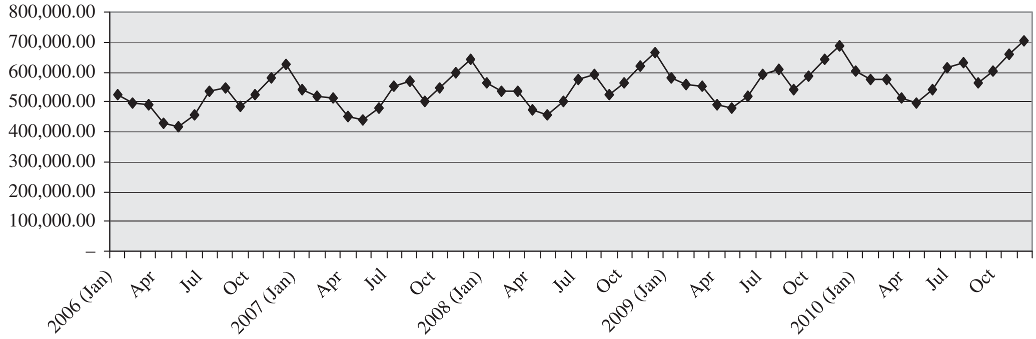


Figure 2. Graphical presentation of forecasting international tourist arrivals to Thailand for 2006-2010 based on X-12-ARIMA(0,1,1)(0,1,1)and X-12-ARIMA(2,1,0)(0,1,1)

Form computed .