International Tourists Arrival to Thailand: Forecasting by Non-Linear Model

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Abstract

The aim of this study is to provide non-linear forecasting models for prediction of the international tourist arrival to Thailand by using data from period 1998-2014(Feb.). The seasonal unit root test (HEGY-test extent version) was carried out to test this data. Based on this testing is found that the number of international tourist arrivals to Thailand was affected by seasonal unit root process for during period of this study. Therefore, both the MS-VAR model and AR model are employed to predict this data for future of Thailand. The empirical results from this research was concluded that in high seasonal period can be use AR (2)-MLE, AR (2)-MLE-bootstrapping, and AR(1)-ME-bootstrapping to predict the number of international tourist arrivals to Thailand for future years. However, in low seasonal period only AR(1)-ME-bootstrapping can be used to predict the number of international tourist arrival to Thailand for future years.

1. Introduction

In Thailand, The international tourism industry is played a more important role to develop the Thailand economy for long time ago until now. This industry has contributed income to GDP of Thailand more than decades. In 2012-2013, the revenue from international tourists has contributed income to Thailand economy equal to 10% of GDP by approximately (Department of Tourism, Ministry of Tourism and sport, Thailand).
Furthermore, in 2013 Thailand received the international tourists up to 26.7 million of people which gather than the international tourism targeting was announced by Thailand Government. Based on all of information was presented that the forecasting of the international tourists arrival to Thailand is very important way to get more information for future years.

The nonlinear forecasting models for the international tourists arrival to destination country have been a proposed in recently from many literatures. For example, the contributions by Law and Au (1999), Palmer et al. 2006, Prasert et al (2008), Shuang (2011), Ao (2011), and Chukiat (2012) have actively used these models. Unlike these articles, this research proposes to use the Markov Switching Vector Autoregressive model (MS-VAR model) to forecast the international tourist arrival to Thailand. Based on this technics has already propose by Chukiat, Prasert and Ranade, (2014) for during period of both high seasonal and low seasonal to predict the India’s tourism demand. The outcome from the results of this research may be important for the planners and policy makers to stimulate this industry in Thailand strongly.

2. The research framework and methodology

The research framework and statistical methodology of this paper was used to forecast the international tourist arrivals to Thailand such as unit root test, seasonal unit root test, AR-model, MS-model, bootstrapping approach, and maximum entropy bootstrapping approach. Based on both the research framework and methodology are presented follow below that:-

2.1 The research framework

![Diagram](Figure 1 presents the concept framework of non-linear model forecasting model for International tourist arrivals to Thailand)

2.2 The Unit Root test and the Seasonal Unit Root test

Based on PP-test (Phillips and Perron (1988)) and HEGY-test (Hylleberg et al, (1990)) were employed to detect the unit root process of the Thailand’s international tourism demand. The equation (1) is represented the PP-test and also the equation (2) is represented HEGY-test dealing with extent version for monthly data (Franses (1990) and Beaulieu and Miron (1993)). From equation (1) define that N denotes the number of observations, T denotes the number of times, $e_{i+1}$ is the error term and $\gamma$ a scalar equivalent to correlation matrix.

$$PP\text{-statistic then is given by } [T \sqrt{N (\gamma_{N,T}^{-1})}] / \sqrt{2} \rightarrow N(0,1) \quad (1)$$
\[
\Delta_{1,2}y_t = \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-1} + \pi_4 y_{3,t-2} \\
+ \pi_5 y_{4,t-1} + \pi_6 y_{4,t-2} + \pi_7 y_{5,t-1} + \pi_8 y_{5,t-2} + \pi_9 y_{6,t-1} + \pi_{10} y_{6,t-2} + \pi_{11} y_{7,t-1} \\
+ \pi_{12} y_{7,t-2} + \sum_{j=1}^{p} \alpha_j \Delta_{1,2}y_{t-j} + \epsilon_{1t}
\]

From equation (2) it can be able to explain more clearly by define that \( y_t \) = time series data and \( \pi_1, \beta, \gamma, \alpha \) are coefficient of the model. This testing has a null hypothesis is time series data has seasonal unit root process (against the hypotheses of stationary process). Based on two approach were used to test the numbers of International tourist arrivals to Thailand since 1998-2014 (Feb.) by monthly data.

2.3 Autoregressive-Linear model (AR-Linear Model)

The AR-Linear model was employed to forecast the International tourist arrivals to Thailand. This model was used extensively in this research by AR(m) model. The AR(m) was presented by equation (3).

\[
y_{t+s} = \Phi + \phi_0 y_t + \phi_1 y_{t-d} + \ldots + \phi_m y_{t-(m-1)d} + \epsilon_{t+s}
\]

The equation (3) is represented the AR(m) model and \( y_t \) is time series data at time \( t \), \( \Phi \) is a parameter and coefficient of \( y_t \) in the model. In addition, \( \epsilon \) is error term of this equation.

2.4 Markov Switching Vector Autoregressive Model (MS-VAR)

The basic of Markov Switching Autoregressive Model (MS-VAR) can be indicated in the equation (4)

\[
y_t = B_{s_t} Y_{t-1} + \epsilon_t
\]

and:

\[
\epsilon_t \approx N(O, \Sigma_{s_t})
\]

\[
\Sigma_{s_t} = \begin{bmatrix}
\sigma_{s_t}^2 & \sigma_{1,2,s_t} \\
\sigma_{1,2,s_t} & \sigma_{2,s_t}^2
\end{bmatrix}
\]

The equation (4) shown that \( S_t = 1,2 \) as well as \( S_t \) is represents the state of the Markov switching Vector Autoregressive model (MS-VAR model). Moreover, the equation (4) is implied two regimes for the both high seasonal and low seasonal of Thailand’s international tourism market. The first regime was represented the bull market or high seasonal of Thailand’s international tourism demand. Second regime was represents the bear market or low seasonal of Thailand’s international tourism demand.

2.5 AR-bootstrapping approach and AR-maximum entropy bootstrapping approach

Bradley Efron (1979), he was a first proposed the bootstrapping approach and this approach is a powerful technique to generate new data based on original data (re-sampling technique). Based on two states of Thailand’s International tourism market were predicted by the AR-bootstrap approach. (see equation (5)).

\[
y_t = \phi_1 z_{t-1} + \phi_2 z_{t-2} + \ldots + \phi_p z_{t-p} + \alpha_t
\]
and where

\[ \alpha_t = \hat{y}_t - y_t \]  

and where

\[ \alpha = \text{residuals}, \]

\[ y_{bt} = y_t + \alpha_{bt} \]  

The AR-bootstrapping approach based on re-sampling with replacement method. This method try to re-sampling with replacement the both the residuals and from equation (7) and equation (8) until the maximum number of bootstrapping is obtained. Moreover, the AR-maximum entropy bootstrapping approach also was employed to predict the International tourism market of Thailand for high seasonal of Thailand’s international tourism demand and for low seasonal of Thailand’s international tourism demand. This approach is very similarly with the AR-bootstrapping approach but the AR-maximum entropy bootstrapping approach try to minimizing the uncertainty of the error terms from AR-bootstrapping approach by equation (9).

\[ H_c = -\int p(x) \log \frac{p(x)}{m(x)} dx. \]  

Where \( H_c \) is negative of the Kullback-Leibler divergence, \( x \) is a continuous random variable, \( p(x) \) is the Probability of \( x \) and \( m(x) \) is a prior invariant measure for the variable. The maximum entropy bootstrap approach was first introduced by Vinod and Lacalle (2009).

3. Data description

Figure (2) demonstrate the international tourist arrivals in Thailand from 1998-2014 (Feb.) by the monthly data. This numbers of international tourists has a stationary process and also it was confirmed by Phillips-Perron unit root test. Moreover, the table (1) demonstrate the descriptive statistics of international tourist arrivals in Thailand during the period of 1998-2014 (Feb.).

**Table1.** The descriptive statistics for the international tourist numbers visited in Thailand during the periods of 1998-2014 (Feb.)

<table>
<thead>
<tr>
<th>Items</th>
<th>The international tourist numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1,165,203.</td>
</tr>
<tr>
<td>Median</td>
<td>1,051,729.</td>
</tr>
<tr>
<td>Maximum</td>
<td>2,598,015.</td>
</tr>
<tr>
<td>Minimum</td>
<td>362,490.0</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>462,709.5</td>
</tr>
<tr>
<td>Skewness</td>
<td>1.066074</td>
</tr>
</tbody>
</table>
4. Empirical results

4.1 The results of seasonal unit root test based on HEGY-test (extent version) for monthly data

From table (2) demonstrate the results of seasonal unit root test based on HEGY-Test (extent version). Based on this testing was confirmed that the number of international tourist arrivals in Thailand has a seasonal unit root process in period of during study. Consequently, It can be implied that international tourist visited to Thailand depend on season period more than they visit to Thailand for full year.

Table 2. The seasonal unit root test based on HEGY-test (extent version) for monthly data during the periods of 1998-2014 (Feb.)

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Frequency</th>
<th>Cycles per Year</th>
<th>t-Tests</th>
<th>F-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>π odd</td>
<td>π even</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>-3.10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>πi</td>
<td>6</td>
<td>-</td>
<td>1.06</td>
<td>-</td>
</tr>
<tr>
<td>πi/2</td>
<td>3 and 9</td>
<td>2.75</td>
<td>0.79</td>
<td>4.48</td>
</tr>
<tr>
<td>2πi/3</td>
<td>8 and 4</td>
<td>-1.45</td>
<td>4.83</td>
<td>13.11***</td>
</tr>
</tbody>
</table>
4.2 The results of MS-VAR for international tourist arrivals in Thailand

The result of the MS-VAR estimation for Thailand’s international tourism demand can be demonstrated in equation (10) and equation (11).

\[
y_t = 0.07y_{t-1} + \varepsilon_t \quad \text{(High Seasonal)} \tag{10}
\]

\[
y_t = 0.36y_{t-1} + \varepsilon_t \quad \text{(Low Seasonal)} \tag{11}
\]

From these equations they are clearly implied that the international tourism demand of Thailand goes up very slowly then suddenly it goes down. Form these equations are implied that the volatility of bull market (Thailand’s international tourism market for during period of high seasonal) is not greater than the volatility of bear market (Thailand’s international tourism market for during period of low seasonal). The transition matrix to control the probability of regimes-switching between two state can be shown in the matrix below:-

\[
P = \begin{bmatrix}
0.98^{***} & 0.37^{*} \\
0.01 & 0.63^{***}
\end{bmatrix} \tag{1A}
\]

\[
\sum_{s_t} = \begin{bmatrix}
\sigma_1^2 s_t & 0.012^{***} \\
0.067^{***} & \sigma_2^2 s_t
\end{bmatrix} \tag{1B}
\]

From the Markov chain with covariance matrix (matrix 1B) is indicated that the numbers of international tourist visits to Thailand has high correlation between the times. However, in low seasonal period gather than high seasonal period (see more details in appendix A).

4.3 The empirical result of approximation based on Fit-AR Model for during period of high seasonal in Thailand

Table (3) show the results of estimation based on three model such as such as AR (2) Maximum Likelihood Estimation Based, AR (2) Maximum Likelihood Bootstrap Based, and AR(1) Maximum Entropy Bootstrap Based. In terms of forecasting methods are referenced above to suggest that the number of international tourist arrival to Thailand will be able to predict by itself for future years. It means that in during period of high seasonal only second month will be able to predict the future of Thailand’s international tourism demand. However, based on AR (1) Maximum Entropy Bootstrap approach is suggested that at least one month will be able to predict the future of Thailand’s international tourism demand. (See more details in appendix A)
4.4 The empirical result of approximation based on Fit-AR Model for during period of low seasonal in Thailand

Table (4) show the results of estimation based on three model such as such as AR (1) Maximum Likelihood Estimation Based, AR (1) Maximum Likelihood Bootstrap Based, and AR(1) Maximum Entropy Bootstrap Based. In terms of forecasting methods are referenced above to suggest that the number of international tourist arrival to Thailand will not be able to predict by itself for future years. Based on these models cannot uses in during period of low seasonal to predict the Thailand’s international tourism demand. However, based on AR (1) Maximum Entropy Bootstrap approach is suggested that at least one month will be able to predict the future of Thailand’s international tourism demand. (See more details in appendix A)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi$</td>
<td>$0.1028^{***}$ ((0.0063))</td>
<td>$0.1028^{***}$ ((0.0063))</td>
<td>$1.086^*$ ((0.9393))</td>
</tr>
<tr>
<td>$\phi_{t-1}$</td>
<td>-0.082 ((0.094))</td>
<td>-0.0070 ((0.086))</td>
<td>[0.720 $^<em>$ $\leftrightarrow$ 0.945 $^{</em>**}$] (asymmetric around the zero)</td>
</tr>
<tr>
<td>$\phi_{t-2}$</td>
<td>-0.230 $^{**}$ ((0.094))</td>
<td>-0.0217 $^{**}$ ((0.09447))</td>
<td>-</td>
</tr>
<tr>
<td>$R^2$</td>
<td>6.767%</td>
<td>6.767%</td>
<td>82.34%</td>
</tr>
</tbody>
</table>

$^*$= significance level 0.01, $^{**}$= significance level 0.05, $^*$=significance level 0.10, SE= in parentheses

Source: From computed

Table (4)
The model selection for forecasting of Thailand’s international tourism demand based on Fit-AR Model for during period of low seasonal
### 7. Discussion and Conclusions

Based on the Non-linear various forecasting models for the number of international tourist arrival to Thailand were concluded that in high seasonal period can be use all of forecasting models have already demonstrated. However, in low seasonal period only AR(1) Maximum Entropy Bootstrap Based can be used to predict the number of international tourist arrival to Thailand. If these results are generalized for future years, it is suggested that both the Thailand government sector and private tourism industry sector should prepare to receive increasing number or decreasing number of international tourist arrivals to Thailand only in the specific period of forecasting. Remarkable, in low seasonal it very difficult to predict the number of international tourist arrival to Thailand based on AR(p)-model.

### Acknowledgements

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### References

3. Antonio Fabio Di Narzo, (2008), Nonlinear autoregressive time series models in R using tsDyn version 0.7, R package version 0.7
Appendix A

Figure(3) Markov Switching Vector Autoregressive Model (MS-VAR) of international tourists arrival to Thailand for during period of 1998-2014(Feb.)

Figure(4). The international tourist numbers visited Thailand from 1998-2014(Feb.) for during period of high seasonal

Figure(5). The international tourist numbers visited Thailand from 1998-2014(Feb.) for during period of low seasonal

From: The Tourism Authority of Thailand (TAT)