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International Tourists' Expenditures in Thailand: A Modeling of the ARFIMA-FIGARCH Approach

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ABSTRACT

Forecasting is an essential analytical tool for tourism policy and planning. This paper focuses on forecasting methods based on ARFIMA(p,d,q)-FIGARCH(p,d,q). Secondary data was used to produce forecasts of international tourists' expenditures in Thailand for the period 2009–2010. The results of this research for this period confirms that the best forecasting method based on ARFIMA(p,d,q)-FIGARCH(p,d,q) method is the ARFIMA(1,-0.672,1)-FIGARCH(1,-0.180,1) method. Furthermore, this method predicts the expenditures of tourists in Thailand for the period of 2009–2010 will be constant or decline. If these results can be generalized for future years, then it suggests that both the Thailand government sector and also the private tourism industry sector of Thailand need to develop the tourism market of Thailand immediately, and also develop tourism products in Thailand.

1. Introduction

International tourist arrivals and international tourist receipts have traditionally been used as a benchmark to assess the overall importance of tourism worldwide and in specific countries. High international tourist arrivals 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 tourism plays in an economy in terms of both gross domestic product and foreign exchange generation. Policymakers may subsequently be convinced to assist tourism development and further increase profitability from tourism activities. Hence, it is not surprising that the majority of World Tourism Organization (WTO) statistics focus on these 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 consistently experienced positive surpluses in their trade account, increasing from US$6 billion in 1980 to US$62.2 billion in 1996 (UNCTAD, 1998). International tourist arrivals increased from 25 million in 1950 to 808 million in 2005, represented 6.5% annual growth rate, despite wars, terrorism, tsunamis and other crises. The revenue generated from these arrivals has increased 11.2% annually during the same period and outgrown the world economy. Tourism accounts for 40% of all exports of services and revenues from the industry, and its revenues have grown stronger than international trade. In 2005, tourism receipts were US$682 billion, which exceeded those from oil exports, food products, and automobiles (WTO, 2006).

Tourism is a very important industry to Thailand's economy. It contributes to Thailand's gross domestic product (GDP), affecting employment, investment, and foreign exchange earnings (TAT, 2006). In 2003, Thailand ranked 15th in international tourism receipts (US$7.9 billion), accounting for 1.7% of the world total, or 4.4% of the country's national product (WTO, 2005). International tourism is the fastest growing industry in Thailand. The country has continuously experienced growth in the number of tourists and revenue from the industry. The number of international tourists in Thailand increased from 7.22 million in 1997 to 13 million in 2005. The revenues increased from 299 billion baht in 1997 to 450 billion baht in 2005. During 1997–2005, Thailand faced many challenges. For example, the Asian Economic Crisis in 1997, the effects of September 11, 2001, the outbreak of Severe Acute Respiratory Syndrome (SARS), the beginning of the US-Iraqi War and the outbreak of Avian Influenza (Bird Flu), both in 2003, the tsunami in 2004, and high oil prices in 2005.

However, the international tourism industry of Thailand continues to demand interest from both Thailand's government sector, as well as the private sector of Thailand because the number of international tourists and their expenditures are going up every year. In 2006, the number of international tourists increased from 13.8 million to 14.4 million in 2007. Moreover, international tourists' expenditures in Thailand also increased from 482,319 million baht in 2006 to 502,497 million baht in 2007.

Forecasting is an essential analytical tool for tourism policy and planning. The new forecasting models are also interesting. Recently, Fong-Lin Chu (2008) used the ARFIMA(p,d,q) model to forecast the number of international tourists arrival in Singapore. From searching many articles, it has been found that the ARFIMA-FIGARCH model has not previously been used for forecasting the international tourists' expenditure or arrivals to destination countries. Consequently this paper will forecast international tourists' expenditures in Thailand for the period of 2009–2010.

2. Research Aim and Objective

This research aims to predict the expenditure of international tourists arriving in Thailand in the period of 2009–2010, and also to seek the best forecasting model for forecasting the international tourists' expenditures in Thailand during the same period.

3. Scope of this research

The scope of this research focuses on the period of 2000–2010, and most of the data was secondary data. The countries were used for forecasting the expenditure of international tourist arrivals to Thailand were all the countries that have impact on the international tourism industry of Thailand (Source of Data: Immigration Bureau, Police Department.). The variables used in this research were both the numbers of international tourist arrivals to Thailand from 2000–2008 and the expenditures by them from the same period to forecast for the period of 2009–2010.

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. Five highlighted patterns in a tourism time series are: (a) seasonality, (b) stationarity, (c) linear trends, (d) non-linear trends, 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 is best used for short-term to medium-term forecasting (N. Rangaswamy, Prasert and Chukiat, 2006, 2009).

In this paper, focus on forecasting a single variable approach as well as theses variables as both the number of international tourists arrival to Thailand for the period of 2000–2008 and the expenditure by them for the period of 2000–2008. Also, the ARFIMA-FIGARCH model was used to forecast the international tourists' expenditure arrival to Thailand during the period of 2009–2010. However, this model has not previously been used for forecasting the international tourists' expenditures in Thailand.

4.1 The general model of ARFIMA

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

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

where

B	=	the backshift operator ($B\, z_t$ - 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

ARFIMA models were proposed by Granger and Joyeux (1980). After that, Hosking (1981) also proposed this method to fit long-memory data. An autoregressive fractionally integrated moving-average (ARFIMA) process is ARFIMA(p,d,q) model as well, as it can be written by: (see equation 14E).

$$Ø(\beta)\Delta^d y_t = \delta + \theta(\beta)\,\varepsilon_t \quad (14E)$$

with

$$Ø(\beta) = 1- Ø_1\beta - Ø_2\beta^2 - \ldots\ldots - Ø_p\beta^p$$

and

$$\theta(\beta) = 1- \theta_1(\beta) - \theta_2(\beta)^2 - \ldots\ldots - \theta_q(\beta)^q$$

where

δ	=	constant term
$\theta(\beta)$	=	moving-average operator at order q
ε_t	=	error term of equation 14E
$Ø(\beta)$	=	The autoregressive operator at order p
$\Delta^d y_t$	=	differencing operator at order d of time series data y_t

- For *d within (0,0.5)*, the ARFIMA process is said to exhibit long memory or long range positive dependence
- For *d within (-0.5, 0)*, the process exhibits intermediate memory or long range negative dependence

- For *d within [0.5, 1)* the process is mean reverting and there is no long run impact to the future values of the process
- The process is short memory for d=0 corresponding to a standard ARMA process

4.2 The general model of FIGARCH

The simplest GARCH model is the GARCH(1,1) model: (see equation number 4H)

$$\sigma_t^{\,2} = \alpha_0 + \alpha_1 \mu^2_{\,t-1} + \lambda_1\sigma^2_{\,t-1} \quad (4H)$$

Now the variance of the error term has three components: a constant, last period's volatility (the ARCH term), and last period's variance (the GARCH term). In general, it could have any number of ARCH terms and any number of GARCH term and the GARCH (p,q) model refers to the following equation for $\sigma_t^{\,2}$:(see equation 5G)

$$\sigma_t^{\,2} = \alpha_0 + \alpha_1 \mu^2_{\,t-1} + \ldots\ldots\ldots + \alpha_p \mu^2_{\,t-p} + \lambda_1\sigma^2_{\,t-1} + \ldots\ldots + \lambda_q\sigma^2_{\,t-q} \quad (5G)$$

Baillie, et al. (1996) proposed the fractional integrated GARCH (FIGARCH) model to determine long memory in return volatility. The FIGARCH(p,d,m) process is defined as follows: (equation :1y)

$$(1- L)^d\, \Phi (L)\varepsilon^2_{\,t} = \omega + [1 - \beta(L)]\, \upsilon_t \quad (1y)$$

where $\upsilon_t = \varepsilon^2_t - \sigma^2_t$ and also the FIGARCH model derived from standard GARCH model with fractional difference operator, $(1- L)^d$. The FIGARCH(p,d,q) model is transformed standard GARCH when d = 0 and IGARCH model when d = 1.

4.3 The Mean Absolute Error (MAE)

In statistics, the Mean Absolute Error (MAE) is a quantity used to measure how close forecasts or predictions are to the eventual outcomes. The mean absolute error (MAE) is presented by equation (1X).

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|f_i - y_i\right| = \frac{1}{n}\sum_{i=1}^{n}\left|e_i\right| \quad (1X)$$

As the name suggests, the mean absolute error is an average of the absolute errors $e_i = f_i - y_i$, where f_i is the prediction and y_i is the true value. Note that alternative formulations may include relative frequencies as weight factors. The mean absolute error is a common measure of forecast error in time series analysis and also this paper use Mean Absolute Error (MAE) measure the error of the international tourists' expenditure in Thailand for during period of 2009-2010 based on concept of ARFIMA forecasting method.

4.4 The Mean Absolute Percentage Error (MAPE)

In statistics, the Mean Absolute Error (MAE) is measure of accuracy in a fitted time series value in statistics, specifically trending. It usually has been expressed accuracy by a percentage and the formula of MAPE be able to present in equation (2X)

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \quad (2X)$$

where A_t is the actual value and F_t is the forecast value.

The difference between A_t and F_t is divided by the actual value A_t again. The absolute value of this calculation is summed for every fitted or forecasted point in time and divided again by the number of fitted points *n.* This makes it a percentage error so one can compare the error of fitted time series that differ in level. And also this paper use MAPE measure of accuracy in international tourists' expenditure based on concept of ARFIMA forecasting method.

The guidelines for MAPE's interpretation are as follows: If the MAPE value is less than 10%, it is "highly accurate" forecasting. If the MAPE value is between 10%-20%, it is "good" forecasting. If the MAPE value is between 20-50%, it is "reasonable" forecasting. If the MAPE value is greater than 50%, it is "inaccurate" forecasting (Lewis, 1982).

4.5 Akaike Information Criterion (AIC)

Akaike's Information Criterion (AIC) was developed by Hirotugu Akaike (1974) and is a measure of the goodness of fit of an estimated statistical model. In the general case, it can be written in equation 3X and this equation is able to show that:

$$AIC = 2k - 2\ln(L) \qquad (3X)$$

where k is the number of parameters in the statistical model, and L is the maximize value of the likelihood function for the estimated model. The AIC is not a test of the model in the sense of hypothesis testing, rather it is a test between models - a tool for model selection. And the lowest AIC being the best model was selected.

4.6 Bayesian Information Criterion (BIC)

The Bayesian Information Criterion (BIC) or Schwarz Criterion (SBC) is a criterion for model selection among a class of parametric models with different numbers of parameters. In the general case, it can be written in equation 4X and this equation also be able to show below that:-

$$-2 \cdot \ln p(x \mid k) \approx BIC = -2 \cdot \ln l \qquad (4X)$$

where

n = the number of observations, or the sample size;

k = the number of free parameters to be estimated if the estimated model is a linear regression, k is the number of regressors, including the constant;

L = the maximized value of the likelihood function for the estimated model.

The BIC is not a test of the model in the sense of hypothesis testing, rather it is a test a models to determine which is the best modelas selected by the lowest BIC, or the model with the lower value of BIC is the one to be preferred.

4.7 Data Description

Table (1a) presents the data of Thailand's international tourism industry. For example, the number of international tourists, their average length of stay, the average of tourists' expenditures both per person and per day, and the revenue generated from international tourists' arrivals to Thailand during the period of 1997–2006. In 1997 the number of international tourists arrival to Thailand was 7.22 million people and most of them had an average length of stay of 8.33 days. Also, most of them had an average expenditure per day of 3,671.85 baht. Moreover, in the same year Thailand received revenue from them of 220,754 million baht. In 2000 the number of international tourists arrival to Thailand was 9.51 million people and most of them had an average length of stay in Thailand of 7.77 days. Also, most of them had an average expenditure per day of 3,861.19 baht. Moreover, in the same year Thailand received revenue from them of 285,272 million baht. In 2006 the number of international tourists arrival to Thailand was 13.82 million people and most of them had an average length of stay of 8.62 days. Also, most of them had average expenditures per day of 4,048.22 baht. Moreover, in the same year Thailand received revenue from them of 482,319 million baht (see more details of data in table (1a)).

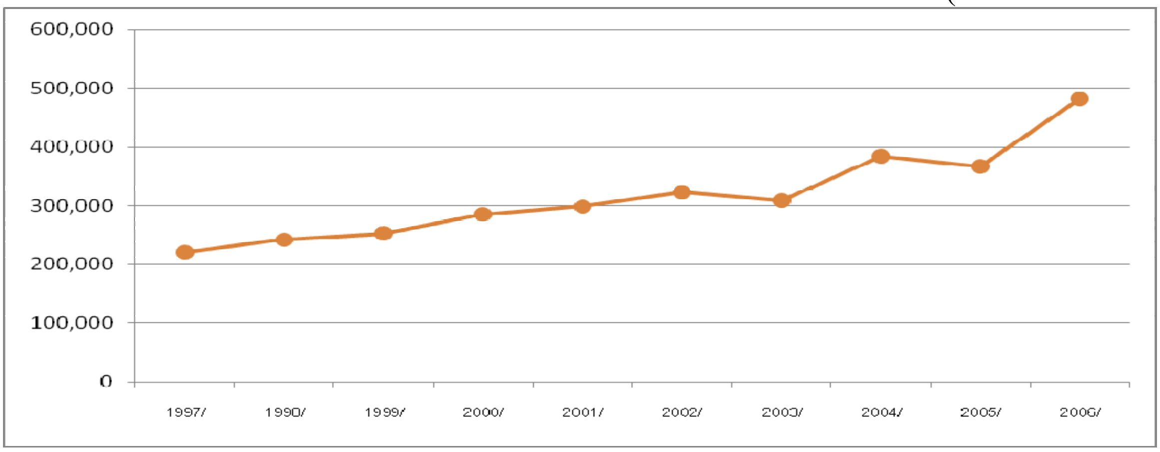
Table 1a: The important data of international tourist arrivals to Thailand during the period of 1997–2006

Year	Tourists		Average	Average Expenditure		Revenue	
	Number (Million)	Change (%)	Length of Stay (Days)	/person/day (Baht)	Change (%)	Million (Baht)	Change (%)
1997	7.22	0.41	8.33	3,671.87	-0.92	220,754	0.63
1998	7.76	7.53	8.4	3,712.93	1.12	242,177	9.7
1999	8.58	10.5	7.96	3,704.54	-0.23	253,018	4.48
2000	9.51	10.82	7.77	3,861.19	4.23	285,272	12.75
2001	10.06	5.82	7.93	3,748.00	-2.93	299,047	4.83
2002	10.8	7.33	7.98	3,753.74	0.15	323,484	8.17
2003	10.00	-7.36	8.19	3,774.50	0.55	309,269	-4.39
2004	11.65	16.46	8.13	4,057.85	7.51	384,360	24.28
2005	11.52	-1.15	8.2	3,890.13	-4.13	367,380	-4.42
2006	13.82	20.01	8.62	4,048.22	4.06	482,319	31.29

Source: Office of Tourism Development

Figure (a): Graphical presentation of the value of international tourists' expenditure in Thailand for the period of 1997–2006 (Nominal terms)

(Unit: Million Baht)

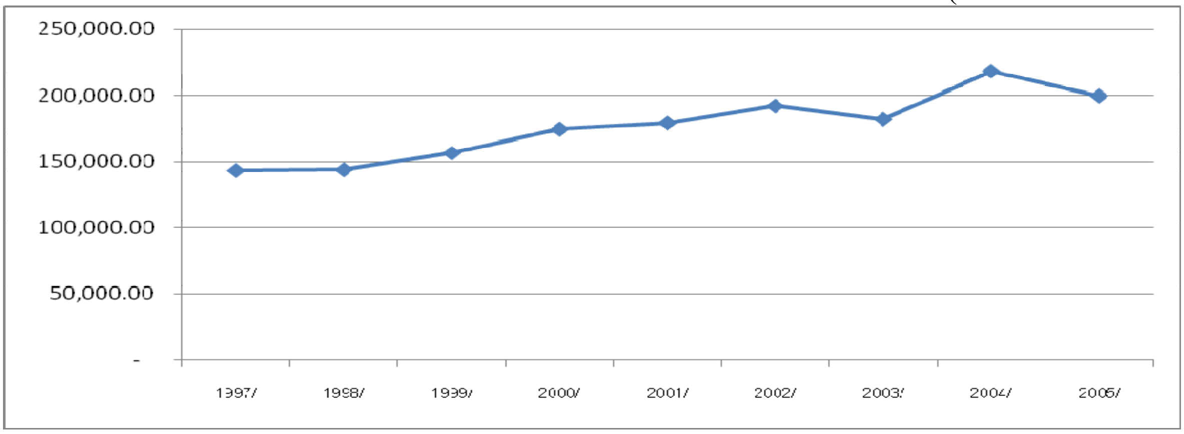


Source: Office of Tourism Development

Figure (a) shows the graphical representation of international tourists' expenditures in Thailand during the period of 1997–2006 by nominal tourists' expenditure. In 1997 the value of international tourists' expenditures in Thailand was 220,754 million baht, and in 2000 the value of international tourists' expenditures in Thailand was 285,272 million baht. Moreover, in 2006 the value of international tourists' expenditures in Thailand was 482,319 million baht. From this graphic, it is presented that the value of international tourists' expenditures in Thailand grew up more than 100% during the period of 1997–2006.

Figure (b): Graphical presentation of the value of international tourists'expenditures in Thailand during the period of 1997–2005 (Real terms)

(Unit: Million Baht)



Source: Office of Tourism Development

Figure (b) shows the graphical representation of international tourists' expenditures in Thailand for the period of 1997–2005 by real terms. In 1997 the value of international tourists' expenditures in Thailand was 143,346.75 million baht. In 2000 the value of international tourists' expenditures in Thailand was 174,371.64 million baht. In 2002 the value of international tourists' expenditures in Thailand was 192,092.64 million baht. In 2003 the value of international tourists' expenditures in Thailand was 181,922.94 million baht. Moreover, in 2004 the value of international tourists' expenditures in Thailand was 218,262.35 million baht. This graphics presents that the value of international tourists' expenditure in Thailand grew up more than 100% during the period of 1997–2005.

5. Forecasting models accuracy based on concepts of both the AIC (Akaike, 1973)and BIC (Bayesian Information Criterion)

Table 1 shows forecasting methods based on ARFIMA-FIGARCH models for forecasting international tourists' expenditures in Thailand period the of 2009 to 2010. The value of both AIC and BIC in each of ARFIMA-FIGARCH model was used for selection the best ARFIMA-FIGARCH model for forecasting international tourists' expenditures in Thailand for this period.

From table 1, the best model to forecast international tourists' expenditures in Thailand during the specified period is ARFIMA(1,-0.672,1)-FIGARCH(1,-0.180,1) and the value of Akaike Criteria(AIC) from this model is 7.10. Also the value of BIC from this model is 28.848. This model is the best model among these models because the values of both AIC and BIC are less than other models (Torre, Didier and Lemoine, 2007). Consequently, the ARFIMA(1,d,1)-FIGARCH(1,d,1) model was chosen for selection as the best model for forecasting international tourists' expenditures in Thailand for this period (see more details in Table 2 and Figure 1.).

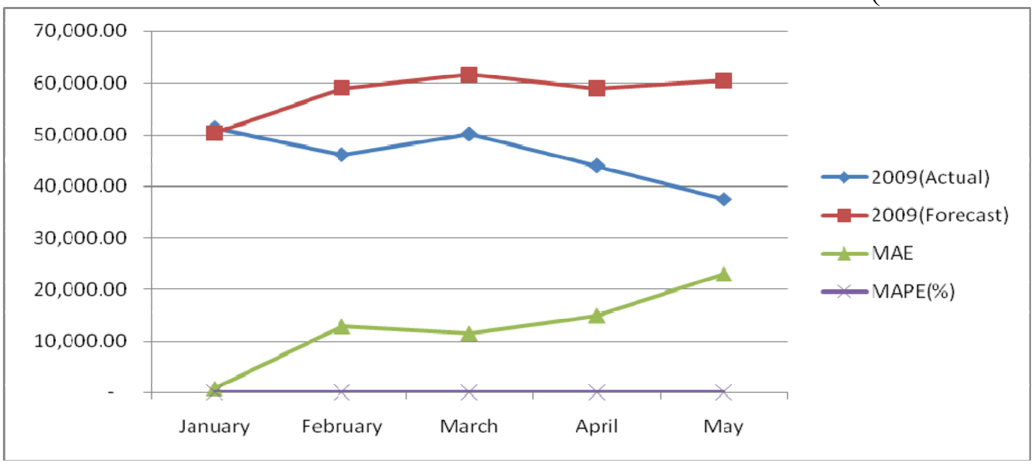
Table 1: Accuracy comparison in sample for different forecasting models based on concepts of both AIC criterion and BIC criterion.

Number	Models of forecasting	AIC	BIC
1	ARFIMA(1,d,1)-FIGARCH(1,d,1) d of ARFIMA = -0.672, d of FIGARCH = -0.180	7.100	28.848
2	ARFIMA(1,d,1)-FIGARCH(1,d,2) d of ARFIMA = -0.114, d of FIGARCH = -0.076	9.102	33.568
3	ARFIMA(1,d,2)-FIGARCH(1,d,1) d of ARFIMA = -0.680, d of FIGARCH = -0.140	9.066	33.532
4	ARFIMA(2,d,2)-FIGARCH(1,d,1) d of ARFIMA = -0.366, d of FIGARCH = -0.163	11.026	38.211

Source: computed

Figure 1: Graphical presentation of forecasting international tourists' expenditures in Thailand during 2009 based on ARFIMA-FIGARCH

(Unit: Million Baht)



Source: computed

Table 2: Forecast the expenditures of international tourist arrivals to Thailand during the period of 2009 to 2010 based on ARFIMA(1,-0.67,1)-FIGARCH(1,-0.18,1) (MAE: Mean Absolute Error, MAPE(%): Mean Absolute Percentage Error)

(Unit: Million Bath)

Month/Year	2009 (Actual)	2009 (Forecast)	MAE	MAPE (%)
January	51,289.33	50,396.32	893.01	1.74
February	46,069.96	59,045.36	12,975.40	28.16
March	50,094.28	61,707.85	11,613.57	23.18
April	43,935.01	58,964.93	15,029.92	34.21
May	37,400.20	60,547.96	23,147.76	61.89
June		57,433.63		
July		49,819.87		
August		47,754.59		
September		47,030.48		
October		51,924.80		
November		47,489.96		
December		36,220.29		
Total	**228,788.79**	**628,336.03**	**12,731.93**	**29.84**
Month/Year	**2010 (Actual)**	**2010 (Forecast)**	**MAE**	**MAPE (%)**
January		44,533.06		
February		43,785.36		
March		47,070.06		
April		51,546.47		
May		46,299.59		
June		50,342.92		
July		44,152.45		

Source: computed

6. The conclusions of research and policy recommendations

This paper provides forecasting analysis of international tourists' expenditures in Thailand for the period of 2009 to 2010 based on the ARFIMA-FIGARCH model. The best ARFIMA-FIGARCH model is the ARFIMA(1,-0.672,1)-FIGARCH(1,-0.180,1) model because this model has a value of Akaike Criteria(AIC) = 7.100 and the value of BIC = 28.848. The values of both AIC and BIC from this model are much lower than other models. Hence, this model has been selected to be the best model to forecast the international tourists' expenditures in Thailand for this period (see more details at Torre, Didier and Lemoine, 2007). The ARFIMA(1,-0.67,1)-FIGARCH(1, -0.18,1) model predicts that in 2009 the expenditures of international tourists in Thailand will be 628,336.03 Million baht (see more information in table 2 and figure 1). Moreover, the value of Mean Absolute Error (MAE) is 12,731.93 million baht in the period of January–May, 2009. Also the value of Mean Absolute Percentage Error (MAPE(%)) is 29.84 % in the same period (see more information in table 2 and figure 1).

Therefore, the conclusion of this research shows that in the next one and a half years (2009–2010) the expenditure of international tourists in Thailand will be constant. This result was similar with the information from Tourism Council of Thailand (TCT), which told that in 2009 the number of international tourists will be constant or decrease because of negative impact factors affecting the international tourism industry of Thailand, such as the world economic slowdown, the world's price of fuel going up, and the H1N1 fever of 2009.

If these results can be generalized for future years, then it suggests that both the Thai government sector and the private tourism industry sector need to develop the tourism market of Thailand more, and also develop tourism-related products in Thailand as well. In terms of the tourism market development needed to launch an active marketing campaign, promoting Thailand's exclusive culture and natural beauty through every channel especially the internet, and maintaining the high quality of accommodation, restaurants, and services in tourism market of Thailand will be important. In terms of tourism product development, there is a need to keep on improving both the quality and management of tourist products in Thailand. For example, to develop tourist destinations in Thailand, provide education about tourism to people in the tourism industry of Thailand, and decrease the negative image of tourist destinations in Thailand. Moreover, keeping tourist destinations clean, keeping tourist destinations beautiful, keeping tourist destinations safe, protecting the environment of tourist destinations are all necessary measures. The private tourism sector and the Thai government tourism sector should maintain good management of tourist destinations in Thailand, such as maintaining the amenities of tourism products, keeping good accessibility to the tourism products, keeping a good image of tourism products, keeping a reasonable price for tourism products, and keeping the competitiveness of tourism products (Chaitip and Chaiboonsri, 2009).

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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).

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G@RCH package version 4.2, object created on 1-11-2009

---- Database information ----
Sample: 1 - 112 (112 observations)
Frequency: 1
Variables: 1

Variable	#obs	#miss	type	min	mean	max	std.dev
Exp1	112	0	double	-0.6036	0.0038802	0.37929	0.13599

****
** SPECIFICATIONS **
****

Dependent variable : Exp1
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the mean

Variance Equation : FIGARCH (1, d, 1) model estimated with BBM's method (Truncation order : 1000).
No regressor in the variance
The distribution is a Gauss distribution.

Strong convergence using numerical derivatives
Log-likelihood = 85.6082
Please wait : Computing the Std Errors ...

Robust Standard Errors (Sandwich formula)

	Coefficient	**Std.Error**	**t-value**	**t-prob**
Cst(M)	0.005257	0.00088292	5.954	0.0000
d-Arfima	-0.672163	0.095933	-7.007	0.0000
AR(1)	-0.069824	0.22629	-0.3086	0.7583
MA(1)	0.766746	0.10807	7.095	0.0000
Cst(V)	0.020809	0.016708	1.245	0.2158
d-Figarch	-0.180564	0.17006	-1.062	0.2908
ARCH(Phi1)	0.614901	0.23156	2.655	0.0092
GARCH(Beta1)	0.058309	0.14971	0.3895	0.6977

No. Observations : 112 No. Parameters : 8
Mean (Y) : 0.00388 Variance (Y) : 0.01849
Skewness (Y) : -0.67910 Kurtosis (Y) : 5.96771
Log Likelihood : 85.608

The sample mean of squared residuals was used to start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.238873<0.614901<0.726855 and -0.00444532<0.0219259 valid).
=> See Bollerslev and Mikkelsen (1996) for more details.

Estimated Parameters Vector :
0.005257;-0.672163;-0.069824; 0.766746; 0.020809;-0.180564; 0.614901; 0.058309