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International Tourists' Expenditure in Thailand: A Modelling the ARFIMA Approach

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ABSTRACT

Forecasting is an essential analytical tool in tourism policy and planning. This paper focuses on forecasting methods based on fractionally integrated moving average (ARFIMA(p,d,q) models. Secondary data were used to produce forecasts of international tourists' expenditure in Thailand during 2009-2010. The results of this research confirm that the best forecasting model specification based on the ARFIMA(p,d,q) method is ARFIMA(2,0.048,2). These methods predict that international tourist expenditure in Thailand during 2009-2010 will either slow down or be constant. If these results can be generalized for future years, then Thai governments at the national and provincial levels and the private tourism industry sector of Thailand will need to further develop both the tourism market and tourist products in Thailand.

1. Introduction

International tourist arrivals and 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. Policy makers 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, representing a 6.5% annual growth rate, despite wars, terrorism, tsunamis and other crises. The revenues generated from these arrivals have increased 11.2% annually during the same period and outgrew the world economy. Tourism accounts for 40% of all exports of services and revenues and its revenues have grown

more strongly than international trade. In 2005, tourism receipts of US$682 billion 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 and 4.4% of the country's national product (WTO, 2005). In fact international tourism is the fastest growing industry in Thailand. During 1997-2005, Thailand faced many challenges: the Asian Economic Crisis in 1997, the effect of September 11, 2001, the outbreaks of Severe Acute Respiratory Syndrome (SARS), the US-Iraqi War in 2003, and the Avian Influenza (Bird Flu), the Tsunami in 2004, and high oil prices in 2005. Still the country has continuously experienced growth in the number of tourists and revenues from the industry. The number of international tourists to Thailand increased from 7.22 million in 1997 to 13 million in 2005. Revenues increased in tandem from 299 billion baht in 1997 to 450 billion baht in 2005.

Thailand's tourism industry likely will suffer throughout 2009, with significant loss of revenue and loss of jobs, since in the third quarter of 2008 a severe worldwide recession dampened the desire to travel. Thailand has further suffered from political instability, a closure of Suvarnabhumi Airport (26 November 2008, by the Yellow Shirts protesters). A Red Shirt mob invaded the East Asia Summit in Pattaya on 11 April 2009, leading to cancellation of the summit, as world leaders scurried to safety. This was followed by violent riots the next day (during the Thai holiday Songkhran) and the declaration of a state of emergency by prime minister Abhisit Vejjajiva. The protesters withdrew and the state of emergency was lifted on 24 April. To make matters worse, flu cases emerged in March and April of 2009 in Mexico, with the official first announcement of the new H1N1 flu on 23 April. On 12 May, it was made public by Health Minister Witthaya Kaewparadai that two Thais who returned from Mexico had been infected with swine flu (they subsequently recovered). Based on information above have inspired to looking for the slowdown forecasting method for forecasting international tourists' s expenditure of Thailand in slowdown period of Thailand's international tourism industry.

Fong-Lin Chu (2008) used an ARFIMA(p,d,q) model to forecast the number of international tourists arrival in Singapore. He found that the ARFIMA model based on the concept of an economic slowdown forecasting method had not previously been used to forecast the international tourists expenditure arrivals to destination countries Consequently this paper would like to forecast the international tourists' expenditure of Thailand in during of economics slowdown period based on this model.

2. Research Aim and Objective

This research aims to predict the expenditure of international tourist arrivals to Thailand during the 24 month period of 2009-2010 and to seek the best model for forecasting the expenditure of those international tourist arrivals.

3. Scope of this research

The scope of this research focuses on secondary data during 2000-2010. The countries used for forecasting the expenditure of international tourist arrivals to Thailand included all the countries with a significant impact on the international tourism industry of Thailand (Source of Data: Immigration Bureau, Police Department.). The variables used in this research included both the numbers of

international tourist arrivals to Thailand from 2000-2008 and tourist expenditures from the same period to forecast arrivals and expenditures for the out of sample pistol 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 patterns may be present 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 (N. Rangaswamy, Prasert and Chukiat, 2006, 2009).

An ARFIMA(p,d,q) model was used to forecast the international tourists' expenditure, arrivals to Thailand during the period of 2009-2010. This model had never been used to forecast international tourist expenditures in Thailand previously.

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

$$Ø(B)Φ(B^s)(1-B)^d(1-B^s)^D Z_t = θ(B)ρ(B^s)a_t \quad (1J)$$

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
$Φ(B^s)$ = $(1- Φ_1B^s - \ldots\ldots - Φ_pB^s)$ is the seasonal AR operator
$θ(B)$ = $(1- θ_1B - \ldots\ldots - θ_qB^q)$ is the non-seasonal moving average(MA) operator
$ρ(B)$ = $(1- ρ_1B^s - \ldots\ldots - θ_QB^{Qs})$ 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) and Hosking (1981) 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 give by: (see equation 14E).

$$Ø(β)Δ^d y_t = δ + θ(β)\,ε_t \quad (14E)$$

with

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

and

$$θ(β) = 1- θ_1(β) - θ_2(β)^2 - \ldots\ldots- θ_q(β)^q$$

where

δ = constant term
(β) = moving-average operator at order q
$ε_t$ = error term of equation 14E
$Ø(β)$ = autoregressive operator at order p
$Δ^d y_t$ = 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 future values of the process
- The process is short memory for d=0 corresponding to a standard ARMA process

4.2 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 eventual outcomes is measure of accuracy in a fitted time series value in statistics, specifically trending. The mean absolute error (MAE) is presented by equation (1X).

$$\begin{aligned} \mathrm{MAE} &= \frac{1}{n}\sum_{i=1}^{n}|f_i - y_i| \\ &= \frac{1}{n}\sum_{i=1}^{n}|e_i|\,. \end{aligned} \qquad (1X)$$

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 weighting factors. The mean absolute error is a common measure of forecast error in time series analysis. This paper uses Mean Absolute Error (MAE) to measure the error of the international tourists' expenditure in Thailand for during period of 2009-2010 based on the ARFIMA forecasting method.

4.3 The Mean Absolute Percentage Error (MAPE)

The Mean Absolute Error (MAE) usually has is expressed accuracy by a percentage. The formula of MAPE be presented in equation (2X)

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

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 forecast point in time and divided again by the number of fitted points *n.* This makes it a percentage error so that one can compare the error of fitted time series that differ in level.

The advantages of the MAPE value are its ability to compare across different forecasting models, and its interpretation clarity (Fretchling, 1996). The guidelines for MAPE's interpretation are as follows: If the MAPE value is less than 10%, forecasting is "highly accurate" If the MAPE value is between 10%-20%, it is "good" If the MAPE value is between 20-50%, it is "reasonable". If the MAPE value is greater than 50%, forecasting is "inaccurate" (Lewis, 1982). The best models from ARFIMA(p,d,q) models were applied to actually forecast the international tourists 'expenditure in Thailand during 2009-2010.

4.4 Data Description

Table (1a) presents the number of international tourists, the average length of stay, the average of tourists' expenditure both per person and per day, and the revenue of international tourists arrival to Thailand during 1997-2006. In 1997 the number of international tourists arrival to Thailand was 7.22 million people who had an average length of stay of 8.33 day and incurred an average expenditure per day of 3,671.85 baht. Thailand received revenue from them were 220,754 million baht. By 2006 the number of international tourists arrival to Thailand was 13.82 million with length of stay of 8.62 days and average expenditure per day of 4,048.22 baht. In the same year Thailand received revenue from them were 482,319 million baht (see more detail of data in table (1a)).

Table 1a: Key indicators of international tourists arrival to Thailand during period of 1997-2006 (nominal terms)

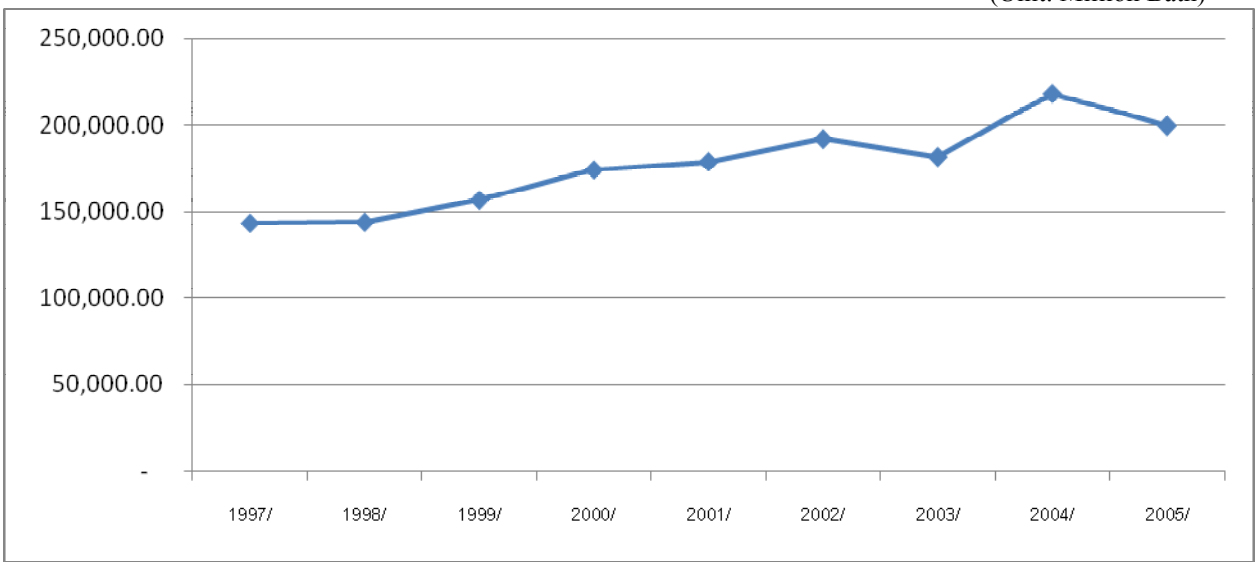
Year	Tourists		Average	Average Expenditure		Revenue	
	Number (Million)	Change from previous year (%)	Length of Stay (Days)	/person/day (Baht)	Change from previous year (%)	Million (Baht)	Change from previous year (%)
1997	7.22	0.41	8.33	3,671.87	-0.92	220,754	0.63
1998	7.76	7.53	8.4	3,712.93	1.12	242,177	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	-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 (b) shows the graphical of international tourists' expenditure in Thailand for during period of 1997-2005 by real terms. In 1997 the value of international tourists' expenditure in Thailand was 143,346.75 million baht. In 2002 the value of international tourists' expenditure in Thailand was 192,092.64 million baht. In 2003 the value of international tourists' expenditure in Thailand was 181,922.94 million baht. Moreover, in 2004 the value of international tourists' expenditure in Thailand was 218,262.35 million baht. This graphical showed that the value of international tourists' expenditure in Thailand grew up more than 100% from period of 1997-2006.

Figure (b): Graphical present the value of international tourists' expenditure in Thailand for during period of 1997-2006 (Real terms)

(Unit: Million Bath)



Source: Office of Tourism Development

5. Forecasting accuracy is based on the AIC (Akaike, 1973) in within-sample forecasts: (two year) of each ARFIMA model for forecasting international tourist expenditure of Thailand in during period of 2009 to 2010

Table 1 shows forecasting performance accuracy of the models based on ARFIMA models for forecasting international tourists' expenditure in Thailand during period 2009 to 2010. The value of AIC of each ARFIMA model was used to select the best of ARFIMA models for forecasting international tourists' expenditure in Thailand for this during period.

Table 1: Accuracy comparison in sample for different forecasting models based on ARFIMA method for during period of 2009 to 2010

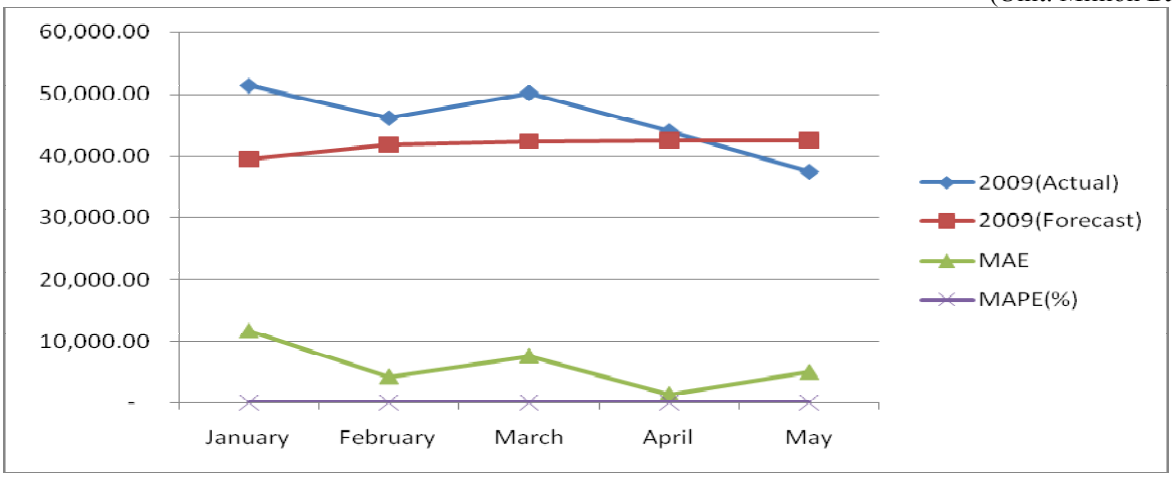
Number	Models of forecasting	AIC
1	ARFIMA(0,d,0) model, d = 0.493	10.586
2	ARFIMA(1,d,0) model, d = 0.439	10.386
3	ARFIMA(0,d,1) model, d = 0.471	10.348
4	ARFIMA(1,d,1) model, d = 0.466	10.365
5	ARFIMA(2,d,1) model, d = 0.443	10.361
6	ARFIMA(2,d,2) model, d = 0.048	10.347*
7	ARFIMA(3,d,2) model, d = 0.443	10.357

Source: computed
Note: *best specification

From table 1, the best model to forecast international tourists' expenditure in Thailand during the specified period is ARFIMA(2,0.048,2). The value of Akaike Criteria(AIC) = 10.347 as well as this model is best model among of these models because the value of AIC is less than other models(Torre, Didier and Lemoine,2007). Consequently ARFIMA(2,d,2) model was used for selection the best model for forecasting international tourists' expenditure in Thailand for this during period (see more detail at Table 2. and figure 1.).

Figure 1: Graphical presentation of forecasting international tourists' expenditure in Thailand for during period of 2009 based on ARFIMA(p,d,q)

(Unit: Million Bath)



Source: compute

Table 2: Forecast the expenditure of international tourist arrivals to Thailand during period of 2009 to 2010 based on ARFIMA(2,0.048,2). (MAE: Mean Absolute Error, MAPE(%): Mean Absolute Percentage Error)

(Unit: Million Bath)

Month/Year	2009(Actual)	2009(Forecast)	MAE	MAPE(%)
January	51,289.33	39,467.90	11,821.43	23.05
February	46,069.96	41,766.24	4,303.72	9.34
March	50,094.28	42,388.34	7,705.95	15.38
April	43,935.01	42,493.93	1,441.08	3.28
May	37,400.20	42,441.91	5,041.71	13.48
June		42,341.34		
July		42,225.79		
August		42,105.97		
September		41,985.50		
October		41,865.68		
November		41,747.07		
December		41,629.90		
Total	**228,788.79**	**502,459.57**	**6,062.78**	**12.91**
Month/Year	**2010(Actual)**	**2010(Forecast)**	**MAE**	**MAPE(%)**
January		41,514.29		
February		41,400.28		
March		41,287.90		
April		41,177.15		
May		41,068.03		
June		40,960.52		
July		40,854.61		

Source: compute

6. The conclusions of research and policy recommendations

This paper provides forecasting analysis of international tourists' expenditure in Thailand for during period of 2009 to 2010 based on the ARFIMA (p,d,q) method. The best ARFIMA models is the ARFIMA(2,0.048,2). Because model has a value of Akaike Criteria(AIC) = 10.347 which is very low lump and other ARFIMA models (see more detail at Torre, Didier and Lemoine,2007). And the ARFIMA (2,0.048,2) model predicts that in 2009 the expenditure of international tourists in Thailand will be 502,459.57 Million baht (see more information at table 2 and figure 1). Moreover, the value of Mean Absolute Error (MAE) is 6,062.78 million baht in during period of January – May, 2009. And also the value of Mean Absolute Percentage Error (MAPE(%)) is 12.91 % in the same of this during period (see more information at table 2 and figure 1).

Therefore the conclusion of this research show that next one and half year (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) told that in 2009 the number of international tourist will be constant or decrease because of negative impact factors effecting to international tourism industry of Thailand such as World economy slowdown, World's price of flue go up and fever's 2009.

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 both develop tourism market of Thailand more and develop tourism product in Thailand more too. In term of the tourism market development need to launch an active marketing campaign, promoting Thailand's exclusive culture and natural beauty through every channel especially the internet, and keep high quality of accommodation, restaurants, and services in tourism market of Thailand as well. In term of tourism product development need to keep on improving both the quality and management of tourist products in Thailand. Such as to develop tourist destinations in Thailand, provide educational of 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 safety and to protect the environment of tourist destinations. 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 the tourism products, keeping good accessibility to the tourism products, keeping a good image of tourism products, keeping the right price of tourism products and keeping the competitiveness of tourism products (Prasert and Chukiat , 2009)

References

Amato, J. D., 2005, Risk aversion and risk premia in the CDS market. BIS Quarterly Review, 55–67.

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

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.

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

Bell, W.R., and Hiller, S.C., 1983, Modelling time series with calendar variations. Journal of the American Statistical Association 78, 526-34.

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

Box, G. E. P. and Jenkins, G. M., 1976, Time Series Analysis: Forecasting and Control (rev. ed.), San Francisco: Holden-Day.

Chaitip, Chaiboonsri and N. Rangaswamy,(2009), "Forecasting with X-12-ARIMA : international tourist arrivals to India", Annals of the University of Petrosani, Economics, vol.IX. 2009, University of Petrosani, Romania:

Chaitip, P and Chaiboonsri, C., 2009, An Application of the LISERL Model for International Tourism Demand in Thailand. Humanity, Development and Cultural diversity, The 16 World Congress of The International Union of Anthropological and Ethnological Sciences (IUAES 2009) ,Yunnan University-Kunming , China: – July 27-31-2009.

Chaitip, P. and Chaiboonsri, C., 2009, Forecasting with X-12-ARIMA and ARFIMA: International Tourist Arrivals to India. Annals of the University of Petrosani, Economics 9, University of Petrosani, Romania, 107-128.

Chu, F.-L., 2008, A fractionally integrated autoregressive moving average approach to forecasting tourism demand. Tourism Management 29, 79–88.

Dhariwal, R., 2005, Tourist arrivals in India: how important are domestic disorders? Tourism Economics 11(2), 185-205.

Doornik, J.A. and Ooms, M., 1999, A Package for Estimating, Forecasting and Simulating Arfima Models: Arfima package 1.0 for Ox. Nuffield College, Oxford OX1 1NF, UK, Erasmus University, Rotterdam, The Netherlands.

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.

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

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

Frechtling, D.C., 1996, Practical Tourism Forecasting, Oxford: Butterworth-Heinemann.

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

Granger, C. W. J. and Joyeux, R., 1980, An introduction to long-memory time series models and fractional differencing. Journal of Time Series Analysis 1, 15–39.

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.

Hosking, J. R. M., 1981, Fractional differencing. Biometrika 68, 165–176.

Hurvich, C.M. and Tsay, C.L., 1989, Regression and time series modelling insmall samples. Biometrika 76, 297-307.

Lewis, C. D., 1982, Industrial and business forecasting methods. London: Butterworths.

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

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

Miller, D. M. and Willams, D., 2003, Shrinkage Estimators for Damping X-12-ARIMA Seasonal, discussion paper ,Virginia Commonwealth University USA.

Papatheodorou, A. and Song, H., 2005, International tourism forecasts: time-series analysis of world and regional data. Tourism Economics 9(1), 11-25.

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

Rangaswamy, N., Chaitip, P and Chaiboonsri, C., 2006, Time Series Forecasting : International Tourist Arrivals to Thailand. working paper No. 6/2006, LSD, Chiang-Mai.

Shu, C.,and Tsang, A., 2005, Adjusting for the Chinese New Year: An Operational Approach. External Department Hong Kong Monetary Authority, 21 pages

Thorp, J., 2003, Change of seasonal adjustment method to X-12-ARIMA. Monetary & Financial Statistics.

Torre, K., Didier, D., and Lemoine, L., 2007, Detection of long-range dependence and estimation of fractal exponents through ARFIMA modeling. British Journal of Mathematical and Statistical Psychology 60, 85–106.

Trimbur, T. M., 2006, Seasonal heteroskedasticity in Census Bureau

construction series. Statistical Research Division U.S. Census Bureau Washington DC. 20233-9100.

Tourism Council of Thailand (TCT), 2009, http:// www.thailandtourismcouncil.org/ home.php

U.S. Bureau of the Census, 1999, X-12-ARIMA Quick Reference for Unix. U.S. Department of Commerce, Washington, DC.

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.

U.S. Census Bureau, 2000, X-12-ARIMA Reference Manual. Version 0.2.7. Time Series Staff , Statistical Research, Division Room 3000-4, U.S. Census Bureau Washington, DC.

U.S. Census Bureau, 2002, X-12-ARIMA Reference Manual. Version 0.2.10.

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).