The Thailand Econometrics Society, Vol. 2, No. 2 (January 2010), 253 - 263

International Tourist arrivals in Thailand: Forecasting with ARFIMA-FIGARCH Approach

Kanchana Chokethaworn[a], Thanes Sriwichailamphan[a], Songsak Sriboonchitta[a], Chukiat Chaiboonsri[b], Jittaporn Sriboonjit[c] and Prasert Chaitip[a]

[a] Assoc. Prof., Faculty of Economics, Chiang Mai University, Chiang Mai, Thailand

[b]Researcher at Economic Research Park, Faculty of Economics, Chiang Mai University, Chiang Mai, Thailand

[c] Assistant. Prof., Faculty of commerce and accountancy, Thammassat University, Thailand

ARTICLE INFO

Keywords:

Thailand
ARFIMA-FIGARCH method
International Tourists

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 the number of international tourist arrivals to Thailand for the period of 2009–2010. Research results during this period confirm that the best forecasting method based on the ARFIMA(p,d,q)-FIGARCH(p,d,q) model is ARFIMA(1,-0.45,1)-FIGARCH(1,-0.07,1). Furthermore, this model predicts that the number of international tourist arrivals in Thailand for the period of 2009–2010 will not go up or be constant. If these results can be generalized for future years, then it suggests that both the Thai 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 urgently.

1. Introduction

Tourism is a very important industry to Thailand's economy. It contributes significantly 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 revenues from the industry. The number of international tourists in Thailand increased from 7.22 million in 1997 to 11.52 million in 2005. The revenues also increased, from 299 billion baht in 1997 to 450 billion baht in 2005. Moreover, the number of international tourists in Thailand increased from 11.52 million in 2005 to 13.8 million in 2006. The revenues increased from 367 billion baht in 2005 to 482 billion baht in 2006.

During the period of 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 in 2003, the outbreak of avian influenza (bird flu), the tsunami in 2004, and escalating oil prices in 2005.

Furthermore, Thailand's tourism industry likely will suffer throughout 2009 with significant a loss of revenue and loss of jobs, as in the middle of 2008 a severe worldwide recession dampened the desire to travel.

Thailand has also suffered from political instability, including the closure of Suvarnabhumi Airport (beginning 26 November 2008, by the "Yellow Shirt" protesters). A "Red Shirt" mob invaded the East Asia Summit in Pattaya on 11 April 2009, leading to a cancellation of the summit, with world leaders scurried away to safety. This was followed by violent riots the next day (during 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. On top of all that, swine 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 and subsequently recovered. Whether a real pandemic lies ahead is still unclear. However, it seems this new flu strain is less lethal than initially suspected.

Those involved with the international tourism industry of Thailand are interested in both the Thai government and the private tourism 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, the international tourists' expenditure 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 many articles it was found that the ARFIMA-FIGARCH model had not previously been used for forecasting the number of international tourist arrivals to destination countries. Consequently this paper would like to forecast the number of international tourist arrivals to Thailand during period of 2009–2010.

2. Research Aim and Objective

This research paper aims to predict the number of international tourist arrivals to Thailand during the period of 2009–2010 and also to seek the best forecasting model for forecasting the number of international tourist arrivals to Thailand during the same period.

3. Scope of this research

The scope of this research focuses on the period of 1998–2010 and most of the data used for analysis is secondary data. The countries used for forecasting are those of importance to Thailand's international tourism industry (Source of Data: Immigration Bureau, Police Department.). The variable used in this research is the number of international tourist arrivals to Thailand during the period of 1998–2008 to forecast for the period of 2009–2010.

4. The research framework for 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 are highlighted 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).

In this paper, focus on forecasting a single variable approach as well as this variable was used to forecast the number of international tourists arrival to Thailand during the period of 1998–2008. Also, the ARFIMA-FIGARCH model was used to forecast the number of international tourists arrival to Thailand during the period of 2009–2010. However, this model has not previously been used for forecasting the number of international tourist arrivals to 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)Φ(Bs)(1-B)d(1-Bs)DZt = (B)ρ(Bs)at (1J)

where

B	=	the backshift operator (B $_{zt}$ - Z $_{t-1}$)
S	=	the seasonal period
Ø(B)	=	$(1- Ø_1B - …… - Ø_pB^p)$ is the non-seasonal AR operator
$Φ(B^s)$	=	$(1- Φ_1B^s - …… - Φ_pB^s)$ is the seasonal AR operator
θ(B)	=	$(1- θ_1B - ……. - θ_qB^q)$ is the non-seasonal moving average(MA) operator
ρ(B)	=	$(1- ρ_1B^s - ……. - θ_QB^{Qs})$ 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). Following 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 given by: (see equation 14E).

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

with

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

and

$θ(β) = 1- θ_1(β) - θ_2(β)^2 - …….- θ_q(β)^q$

where

δ	=	constant term
θ(β)	=	moving-average operator at order q
$ε_t$	=	error term of equation 14E
Ø(β)	=	The 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 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)

$$σ_t^2 = α_0 + α_1 μ^2_{t-1} + λ_1σ^2_{t-1} \quad (4H)$$

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

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

Baillie, et al. (1996) proposed a fractional integrated GARCH (FIGARCH) model to determine long memory in return volatility. The FIGARCH(p,d,q) 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 Data Description

Table (1a) and figure (b) present 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 of international tourists arrivals to Thailand during the period of 1997–2006. In 1997 the number of international tourists arriving to Thailand was 7.22 million people and most of them had an average length of stay in Thailand of 8.33 days. Also, they 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. In addition, they 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 they had an average length of stay in Thailand of 8.62 days. They had an average expenditure 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)).

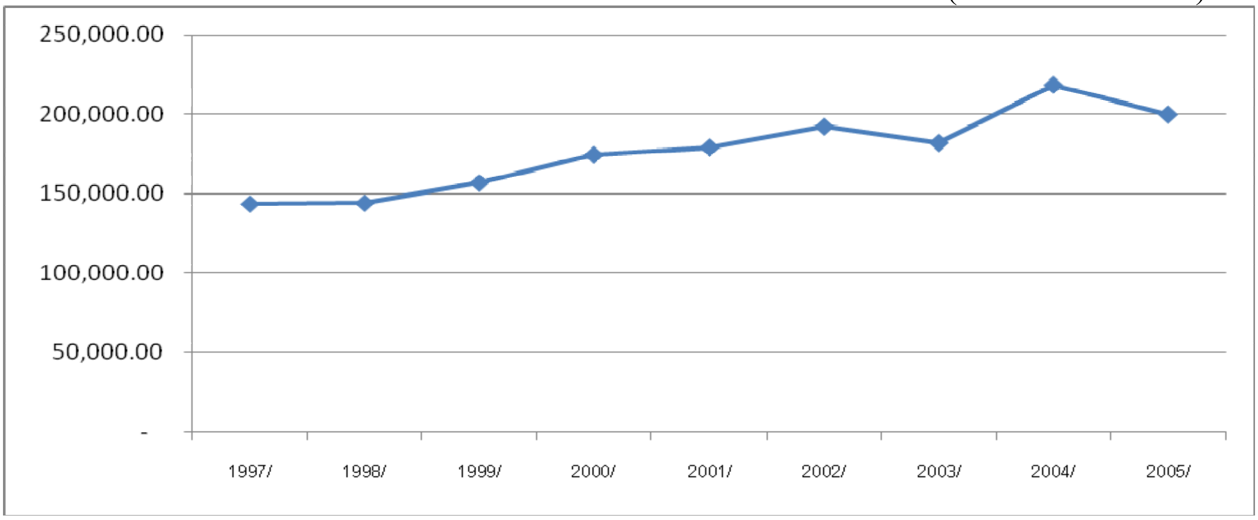
Table 1a: Presenting the important data of international tourist arrivals to Thailand during the period of 1997–2006

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

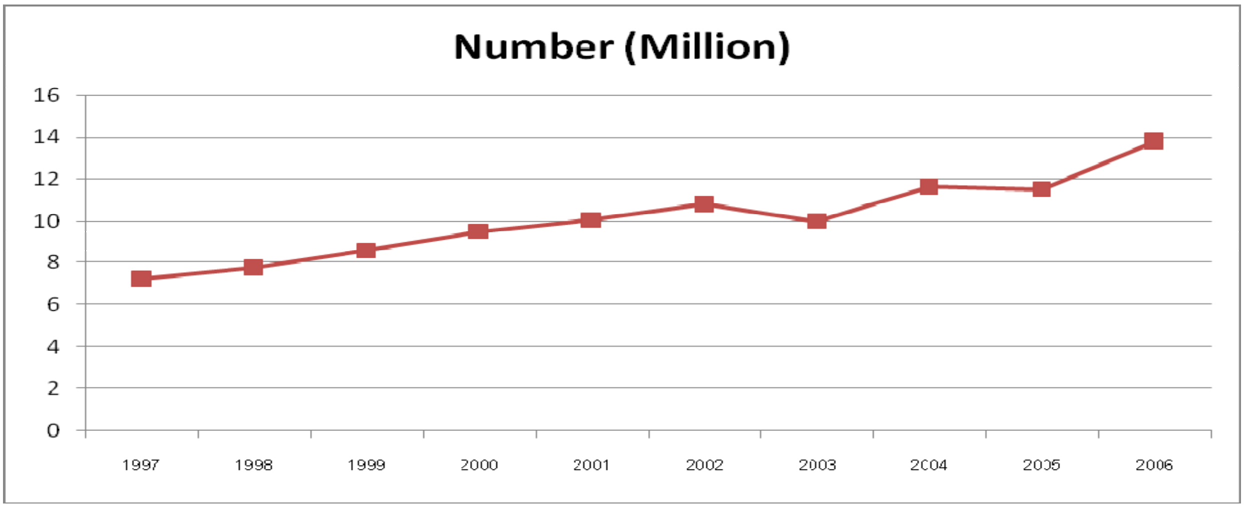
Figure (a): Graphical present the value of international tourists' expenditure in Thailand for during period of 1997-2005 (Real terms)

(Unit: Million Bath)



Source: Office of Tourism Development

Figure (b): Graphical present the number of international tourists arrival in Thailand for during period of 1997-2006.



Source: Office of Tourism Development

In figure (a) shown that 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 and also in 2000 the value of international tourists' expenditure in Thailand was 174,371.64 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. From this graphical presented that the value of international tourists' expenditure in Thailand grew up more than 100% from period of 1997-2005.

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

Table 1 shows the forecasting method based on ARFIMA-FIGARCH models for forecasting the number of international tourist arrivals in Thailand during the period of 2009 to 2010. The value of both AIC and BIC in each of ARFIMA-FIGARCH models was used for selecting the best ARFIMA-FIGARCH model for forecasting the number of international tourist arrivals in Thailand for this period.

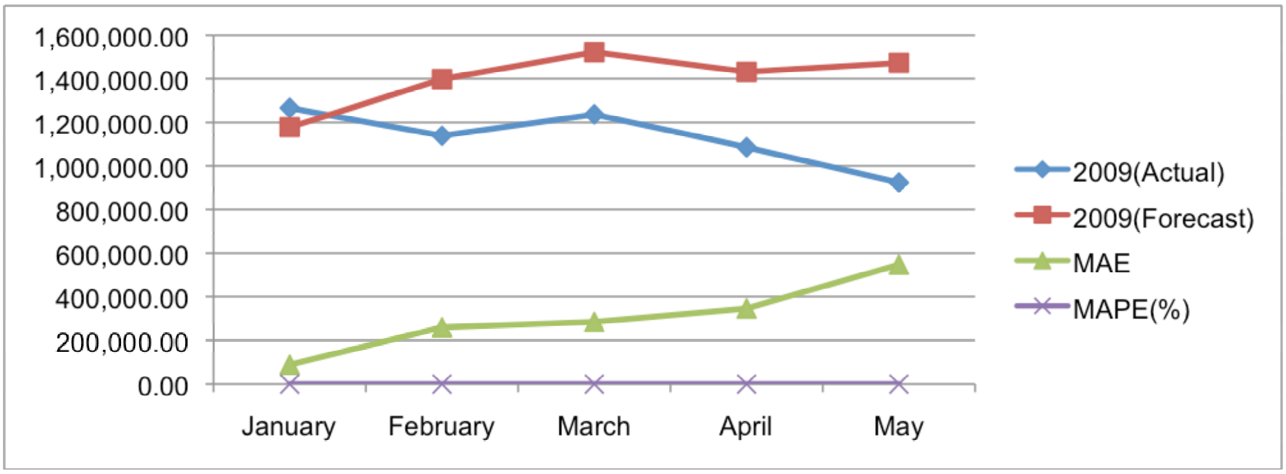
Table 1: Accuracy comparison in samples for different forecasting models based on concepts of both AIC criterion and BIC criterion

Number	Models of forecasting	AIC	BIC
1	ARFIMA(1,d,1)-FIGARCH(1,d,1) d of ARFIMA = -0.458 , d of FIGARCH = -0.078	4.664	25.053
2	ARFIMA(1,d,2)-FIGARCH(1,d,1) d of ARFIMA = 0.271 , d of FIGARCH = -0.133	6.598	29.899
3	ARFIMA(1,d,3)-FIGARCH(1,d,1) d of ARFIMA = 0.164, d of FIGARCH = -0.143	8.587	34.801
4	ARFIMA(3,d,3)-FIGARCH(1,d,1) d of ARFIMA = 0.271, d of FIGARCH = -0.072	12.533	39.659

Source: computed

From table 1, the best model to forecast the number of international tourist arrivals in Thailand during the specified period is ARFIMA(1,-0.458,1)-FIGARCH(1,-0.078,1) and the value of Akaike Criteria(AIC) from this model is 4.66. Also the value of BIC from this model is 25.05. This model is the best model of all of these models because the value of both AIC and BIC is less than other models (Torre, Didier and Lemoine, 2007). Consequently, the ARFIMA(1,d,1)-FIGARCH(1,d,1) model was used for forecasting the number of international tourist arrivals in Thailand for this period (see more details in Table 2 and figure 1).

Figure 1: Graphical presentation of forecast for the number of international tourist arrivals in Thailand for the period of 2009 based on ARFIMA-FIGARCH



Source: compute

Table 2: Forecast of the number of international tourist arrivals to Thailand during the period of 2009 to 2010 based on ARFIMA(1,-0.458,1)-FIGARCH(1,-0.078,1) (MAE: Mean Absolute Error, MAPE(%): Mean Absolute Percentage Error)

Month/Year	2009(Actual)	2009(Forecast)	MAE	MAPE(%)
January	1,267,029.00	1,178,170.00	88,859.00	7.01
February	1,138,092.00	1,397,645.65	259,553.65	22.81
March	1,237,507.00	1,521,877.47	284,370.47	22.98
April	1,085,351.00	1,431,083.54	345,732.54	31.85
May	923,918.00	1,472,160.04	548,242.04	59.34
June		1,397,874.60		
July		1,213,473.46		
August		1,163,847.31		
September		1,146,743.07		
October		1,266,587.85		
November		1,158,808.41		
December		884,082.71		
Total	**5,651,897.00**	**15,232,354.09**	**305,351.54**	**28.80**
Month/Year	**2010(Actual)**	**2010(Forecast)**	**MAE**	**MAPE(%)**
January		1,087,277.41		
February		1,069,279.90		
March		1,149,748.35		
April		1,259,342.54		
May		1,131,364.22		
June		1,230,374.84		
July		1,079,251.17		

Source: computed

6. The conclusions of research and policy recommendations

This paper provides forecasting analysis of the numbers of international tourist arrivals to Thailand for the period of 2009 to 2010 based on the ARFIMA-FIGARCH model. The best ARFIMA-FIGARCH model is the ARFIMA(1,-0.458,1)-FIGARCH(1,-0.078,1) model because this model has a value of Akaike Criteria(AIC) = 4.664 and the value of BIC = 25.053. The value of both AIC and BIC from this model is much lower than that of other models. Hence, this model has been selected to be the best model to forecast the number of international tourist arrivals to Thailand for a specific period (see more details in Torre, Didier and Lemoine, 2007). The ARFIMA(1,-0.458,1)-FIGARCH(1,-0.078,1) model predicts that in 2009 the number of international tourist arrivals to Thailand will be 15.2 million people (see more information in table 2 and figure 1). Moreover, the value of Mean Absolute Error (MAE) is 0.3 million people in the period of January–May, 2009. Also, the value of Mean Absolute Percentage Error (MAPE(%)) is 28.80% for the same period (see more information in table 2 and figure 1).

Therefore, the conclusion of this research is that in the next one and half years (2009–2010), the number of international tourist arrivals to Thailand will not go up. This result was similar to the information provide by the 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 economy slowdown, the world's price of fuel going up, and the 2009 H1N1 flu virus.

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 develop the tourism market of Thailand more, and also develop tourism products in Thailand. In terms 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 keeping high quality accommodations, restaurants, and services in the tourism market of Thailand as well. 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. (Chaitip and Chaiboonsri, 2009).

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G@RCH package version 4.2, object created on 2-12-2009

---- Database information ----
Sample: 1 - 136 (136 observations)
Frequency: 1
Variables: 1

Variable	#obs	#miss	type	min	mean	max	std.dev
Num	136	0	double	-0.6036	0.0068796	0.60416	0.13972

****
** SPECIFICATIONS **
****
Dependent variable : Num
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the mean
Variance Equation : FIGARCH (1, d, 1) model estimated with Chung's method.
No regressor in the variance
The distribution is a Gauss distribution.

Strong convergence using numerical derivatives
Log-likelihood = 106.458
Please wait : Computing the Std Errors ...

Robust Standard Errors (Sandwich formula)

	Coefficient	Std.Error	t-value	t-prob
d-Arfima	-0.458993	0.067778	-6.772	0.0000
AR(1)	-0.010997	0.12995	-0.08462	0.9327
MA(1)	0.667414	0.10835	6.160	0.0000
Cst(V)	0.014302	0.0036983	3.867	0.0002
d-Figarch	-0.078466	0.18299	-0.4288	0.6688
ARCH(Phi1)	0.616362	0.22335	2.760	0.0066
GARCH(Beta1)	0.104104	0.16381	0.6355	0.5262

No. Observations : 136 No . Parameters : 7
Mean (Y) : 0.00688 Variance (Y) : 0.01952
Skewness (Y) : 0.01871 Kurtosis (Y) : 6.93072
Log Likelihood : 106.458

The sample mean of squared residuals was used to start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
not observed.
=> See Chung (1999), Appendix A, for more details.

Estimated Parameters Vector :
-0.458993;-0.010997; 0.667414; 0.014302;-0.078466; 0.616362; 0.104104