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Course **Time series Student Project**

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Foreign exchange rate Thai baht to Euro Modeling

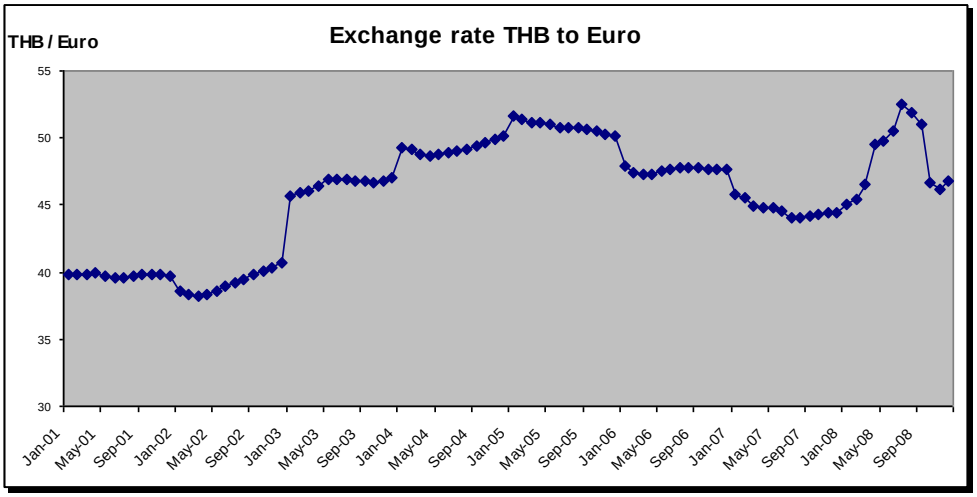
Introduction

There are many import and export business among Thailand and country in Europe. The foreign exchange rate is an important factors influent to gain and loss. It is fluctuating overtime. This is interesting to know the pattern of foreign exchange rate in Thai baht currency to Euro currency.

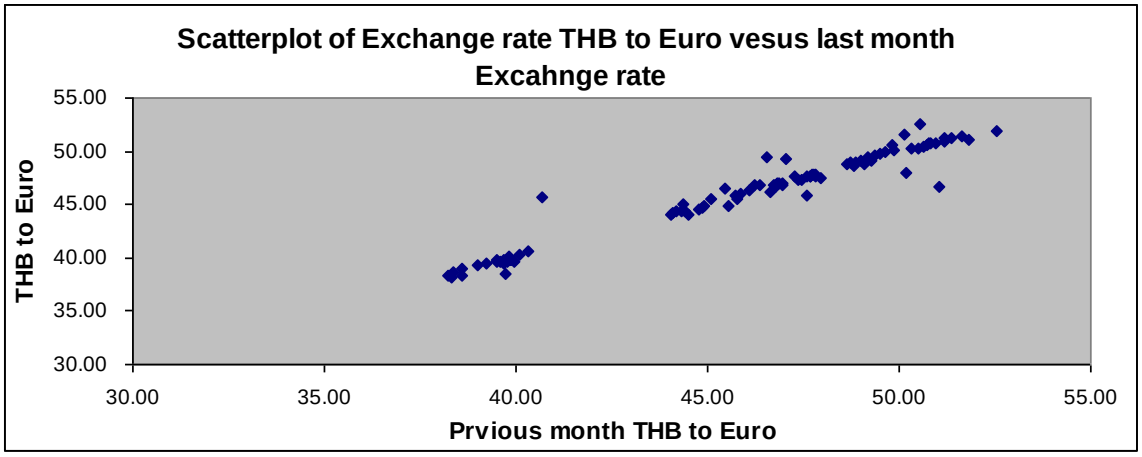
Data

The time series is the foreign exchange rate Thai baht to Euro from 2001 to 2008 at monthly (average month) from my company database. This should be based on the website http://www.bot.or.th/english/statistics/financialmarkets/exchangerate/_layouts/Application/ExchangeRate/ExchangeRate.aspx .

I examined monthly exchange rates. Sheet "data" in excel spreadsheet shows the monthly historical exchange rate THB to Euro during period year 2001-2008. The graph are shown in "chart1" excel spreadsheet and also shown below. The graph displays variation in Thai baht exchange to euro. In 2001 – 2002, the exchange rate is quite low and become higher after that and then drop again around 2006-2007.



For analysis and modeling purpose we are interested in whether or not consecutive period are related in some way. The graph below shows the scatter plot of the pair of consecutive value. The graph indicates that there is upward trend, the low values tend to be followed by low value and high value tends to be followed by high values. This could be an interesting time series.



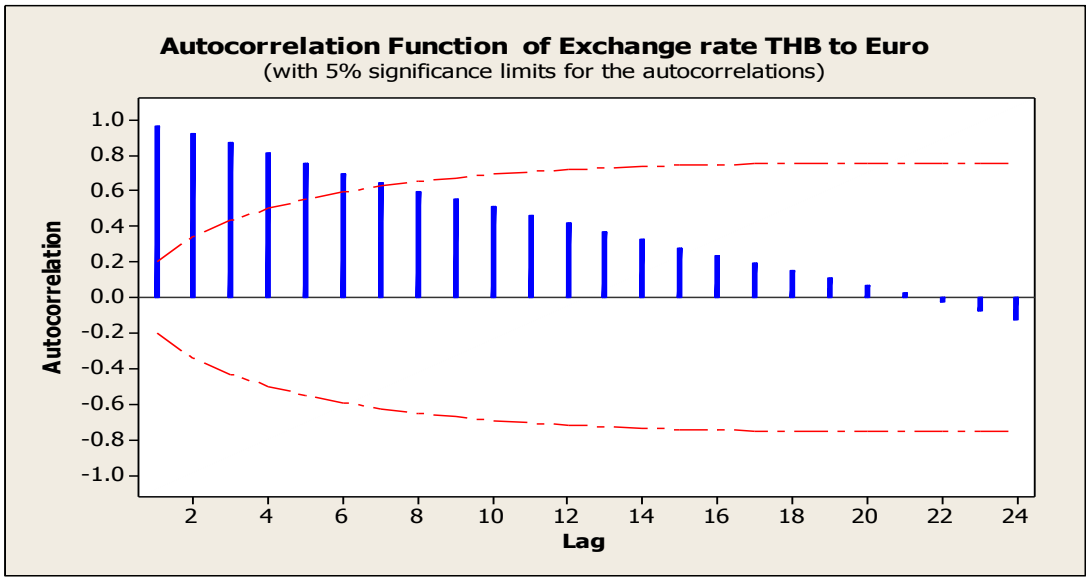
Sample Autocorrelation

We will fit the ARIMA process to the exchange rate THB to Euro time series to see if an autoregressive of moving average process explains our values. The important diagnostic tool for examine dependence is the sample autocorrelation. The autocorrelation are calculated by formula below

$$r_k = \frac{\sum_{t=k+1}^{n}\left(Y_t - \bar{Y}\right)\left(Y_{t-k} - \bar{Y}\right)}{\sum\left(Y_t - \bar{Y}\right)^2}$$

The results of calculation are shown in sheet "data" in excel spreadsheet and the correlogram are shown in "Chart3"

In the correlogram plot, the autocorrelation tends to decline gradually until negative. It seems to be stationary process. We expected that it might be autoregressive model.



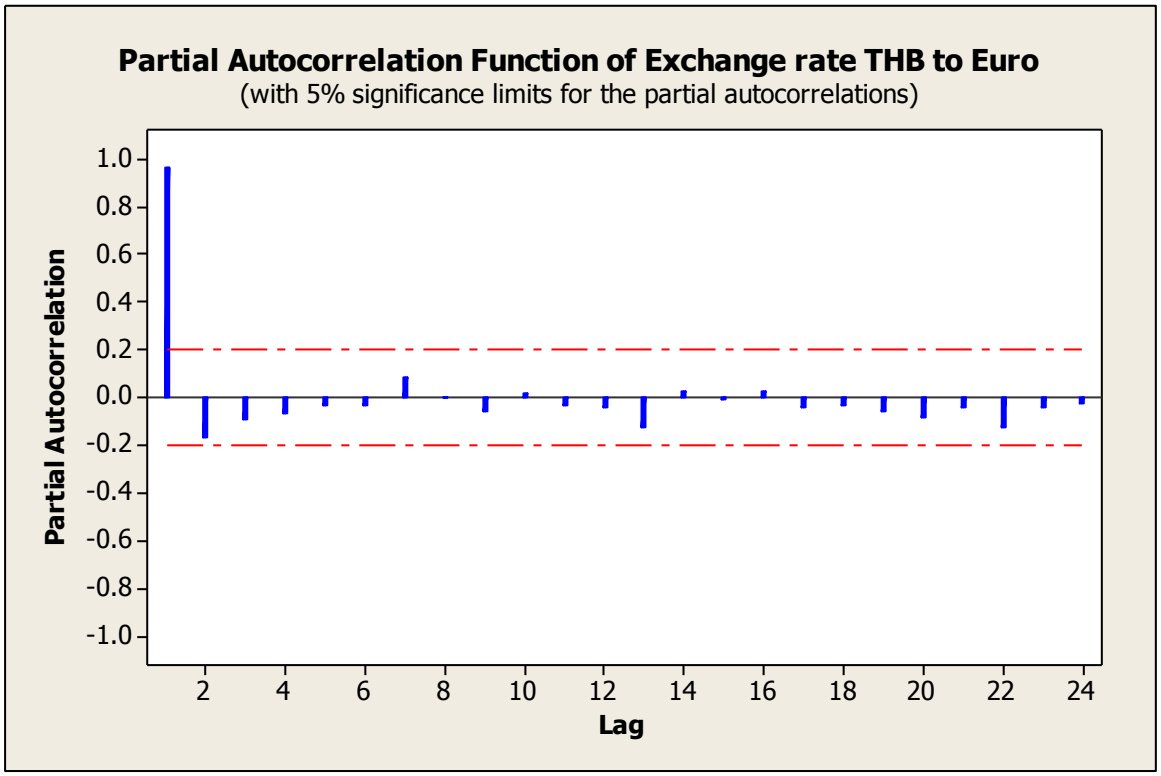
Sample Partial autocorrelation

We calculate partial aurtocorrelation function, this is to determine the appropriate model for foreign exchange THB to Euro.

The sample partial autocorrelation are calculated by the following formula

$$\phi_{kk} = \frac{r_k - \sum_{j=1}^{k-1} \phi_{k-1,j} r_{k-j}}{1 - \sum_{j=1}^{k-1} \phi_{k-1,j} r_j}$$

The graph is shown in sheet "chart4" in excel spreadsheet and also shown below. The graph displays the sample PACF for the exchange rate THB to Euro by lags. We can see that the PACF value at lag 1 is highly significant and after that it cut off and there is none of lag that higher than the critical bound (standard error). This is the pattern of AR(1)



Regarding to he autoregression order 1 model, PACF cuts off after lag 1 and ACF is infinite in extent, tails off. From the analysis given in these two plots taken together leads us to consider AR(1) model for the foreign exchange THB to Euro series.

The AR(1) model is

$$Y_t = \phi Y_{t-1} + e_t$$

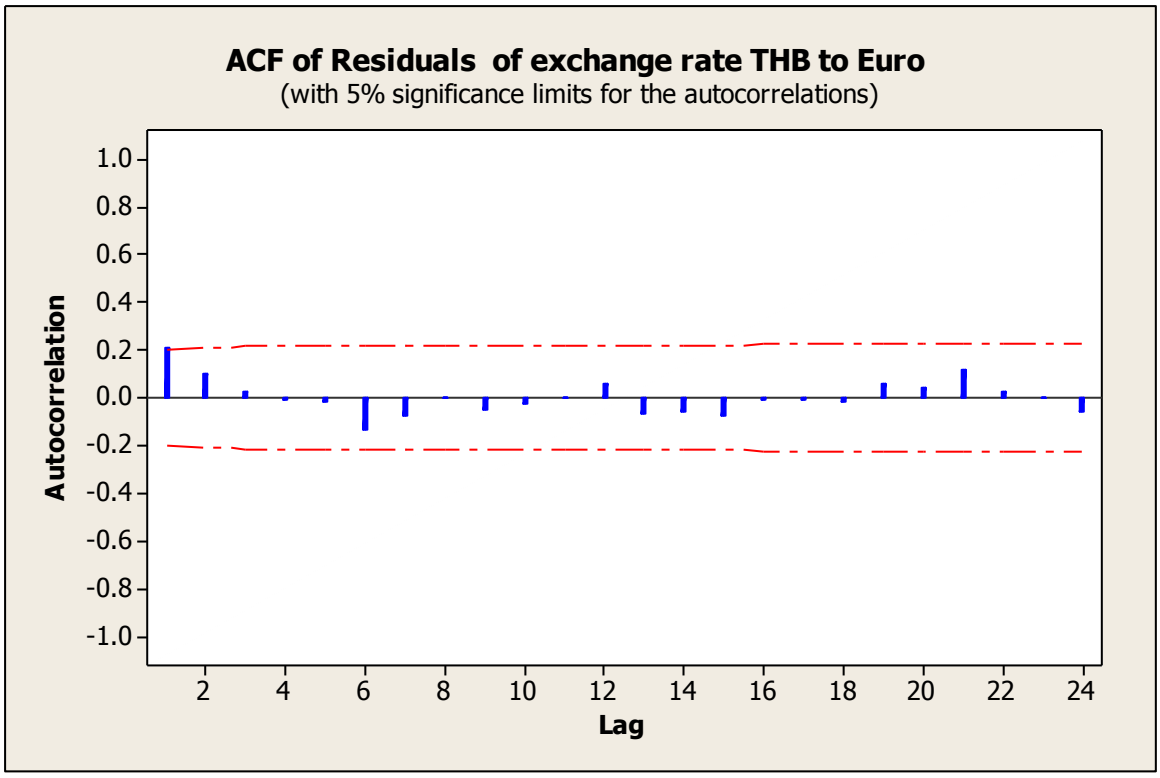
Then we will estimate the parameter. The minitab statistic software is used to estimate the model parameters. The fitted model ARIMA(1,0,0) results are shown in sheet "AR1" excel spreadsheet and displays below

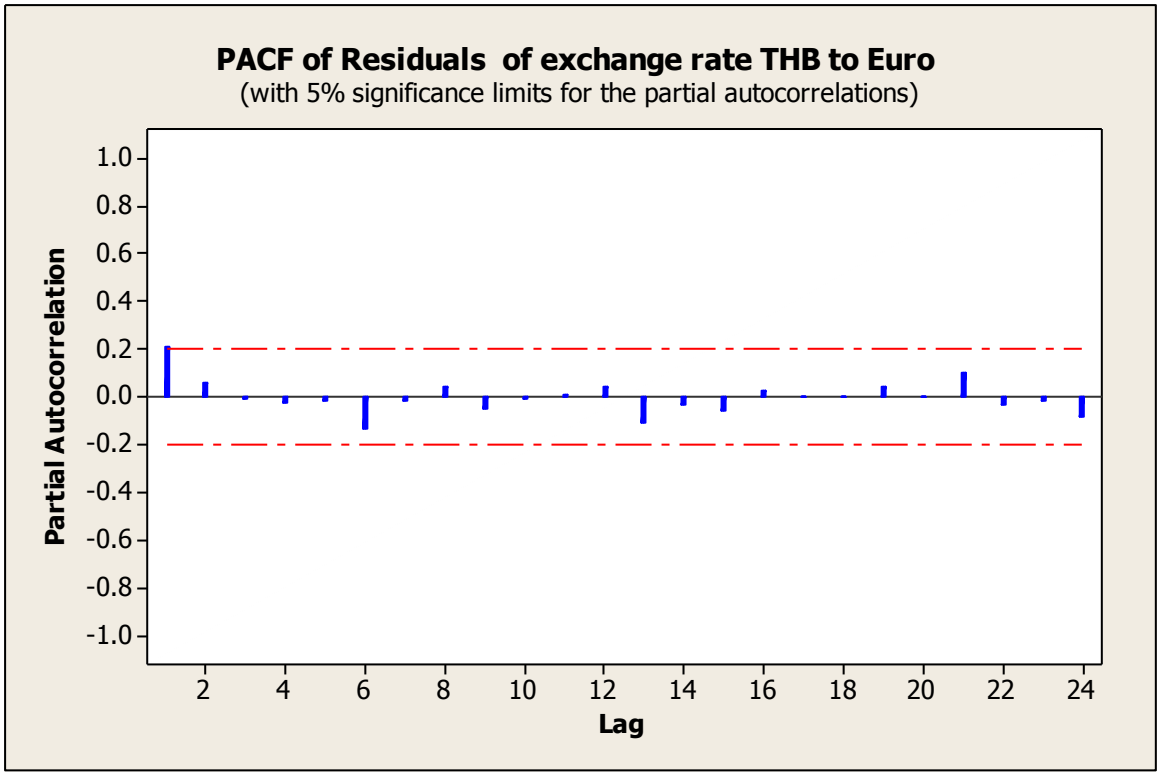
```
Final Estimates of Parameters

Type          Coef  SE Coef      T      P
AR   1      0.9864   0.0225  43.79  0.000
Constant   0.61317  0.09599   6.39  0.000
Mean        44.932    7.034


Number of observations:  96
Residuals:    SS =  80.2316 (backforecasts excluded)
              MS =  0.8535  DF = 94


Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag             12     24     36     48
Chi-Square     8.8   13.4   25.9   30.3
DF              10     22     34     46
P-Value     0.555  0.921  0.839  0.964
```

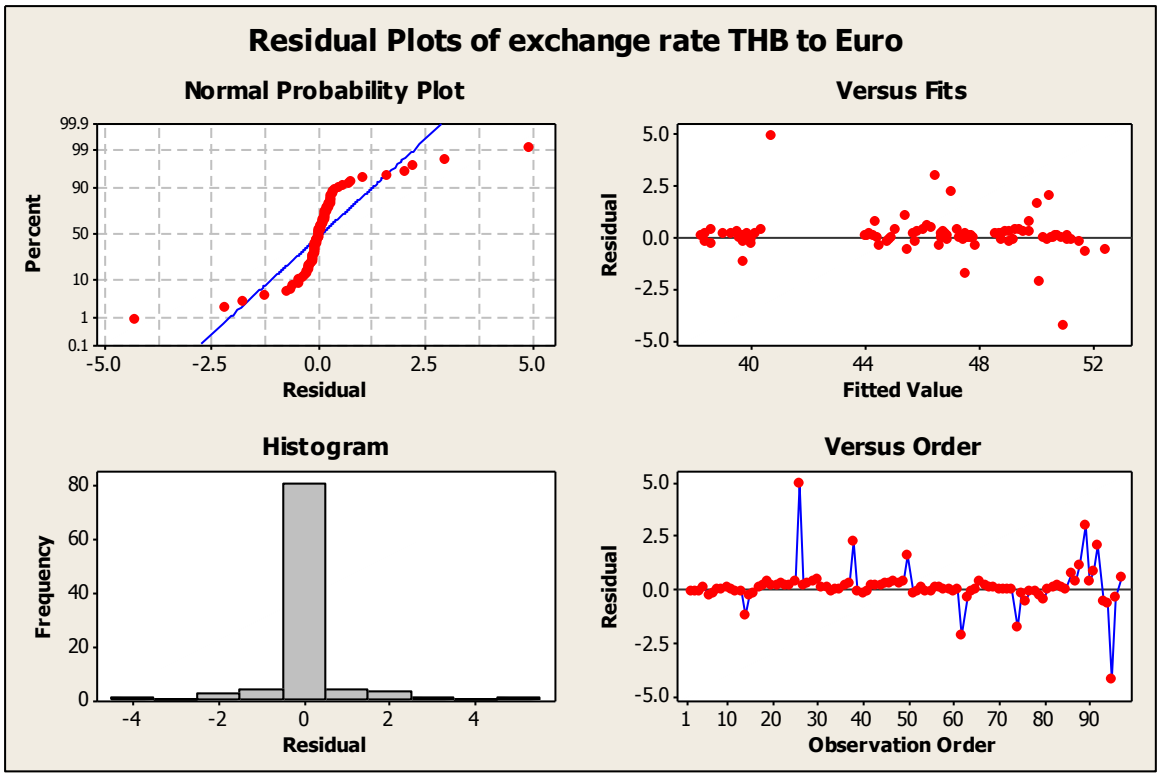
The fitted process is $Y_t = 0.61317 + 0.9864 * Y_{t-1} + e_t$

The ϕ of 0.9864 which is less than 1. This also indicates that the process is stationary.

The box-Pierce test whether the error terms are uncorrelated. From the analysis results Ljung-Box test statistic, all p-value is very high and above the significant level at 5%, so we have no evidence to reject the null hypothesis that the error terms are uncorrelated.


ACF of Residuals of exchange rate THB to Euro
(with 5% significance limits for the autocorrelations)
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
2
4
6
8
10
12
14
16
18
20
22
24
Lag


PACF of Residuals of exchange rate THB to Euro
(with 5% significance limits for the partial autocorrelations)
Partial Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
2
4
6
8
10
12
14
16
18
20
22
24
Lag



From the graph ACF of residuals and PACF of residuals, there is no evidence of autocorrelation in the residuals for this series.

From the graph of residuals plots, the residual doesn't seem like normal distribution. However, the residual is independent with the fit value, it doesn't show any trend. Overall, it would be fine for this model fitted.

Conclusion

The monthly exchange rate Thai baht to Euro from 2001 to 2008 are used for time series analysis. The analysis indicated that the appropriate model is AR(1). The fitted process for this series is $Y_t = 0.61317 + 0.9864 * Y_{t-1} + e_t$