Name **Pruttipong Vichchulada, Thailand**

Course **Time series Project**

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Thai Baht exchange rate to US Dollar

Introduction

This study modeled of Thai Baht exchange rate to US Dollar from January 2005 to December 2012 using AR techniques. The models considered AR(1), AR(2) and AR(3). Various methods were used to determine which model provided the best fit. The best fitting model was then used to examine whether an AR model based only on data from January 2005 to an amount of month prior onwards performed better than one based on the whole period.

Data

The Data Source can be found from the website
http://www.bot.or.th/english/statistics/financialmarkets/exchangerate/_layouts/Application/ExchangeRate/ExchangeRate.aspx

Rates of Exchange of Commercial Banks in Bangkok Metropoils												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2005	38.75	38.48	38.61	39.53	39.84	40.92	41.76	41.19	41.05	40.91	41.12	41.07
2006	39.62	39.41	38.98	37.99	38.01	38.35	38	37.64	37.43	37.34	36.54	35.83
2007	35.97	35.74	35.06	34.87	34.62	34.58	33.71	34.2	34.26	34.17	33.88	33.7
2008	33.18	32.6	31.46	31.59	32.11	33.2	33.5	33.86	34.29	34.43	35.09	35.04
2009	34.92	35.32	35.78	35.46	34.57	34.14	34.05	34.02	33.83	33.41	33.28	33.23
2010	33.03	33.15	32.51	32.29	32.39	32.47	32.33	31.74	30.83	29.97	29.88	30.12
2011	30.58	30.72	30.37	30.05	30.24	30.52	30.07	29.88	30.42	30.89	30.96	31.22
2012	31.58	30.73	30.7	30.89	31.34	31.36	31.65	31.43	30.99	30.69	30.71	30.64

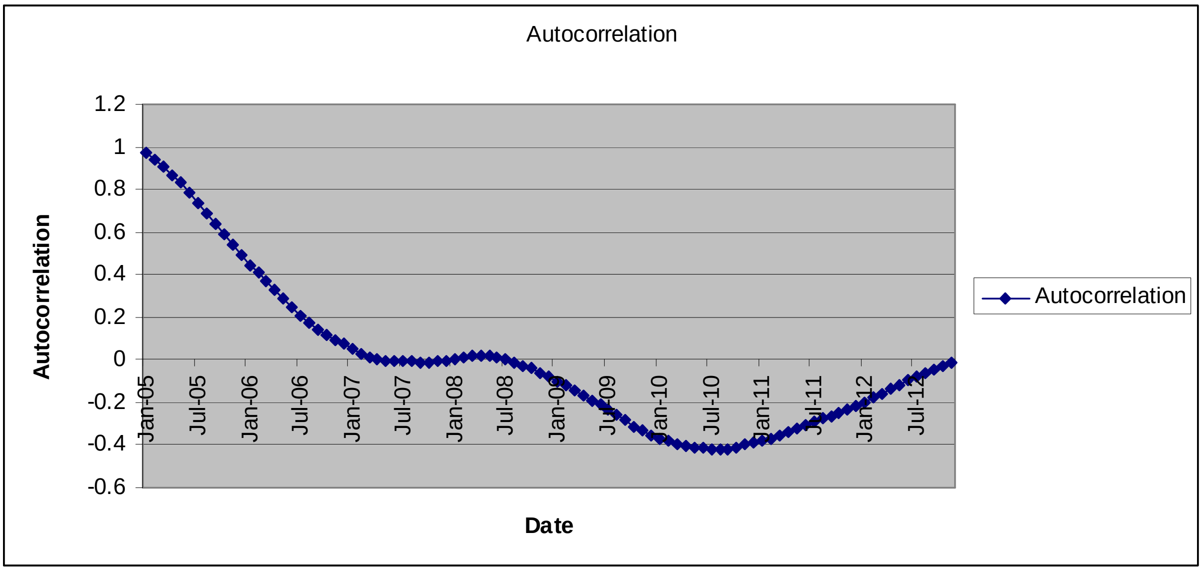
The full table of data is attached in Excel file "Data".

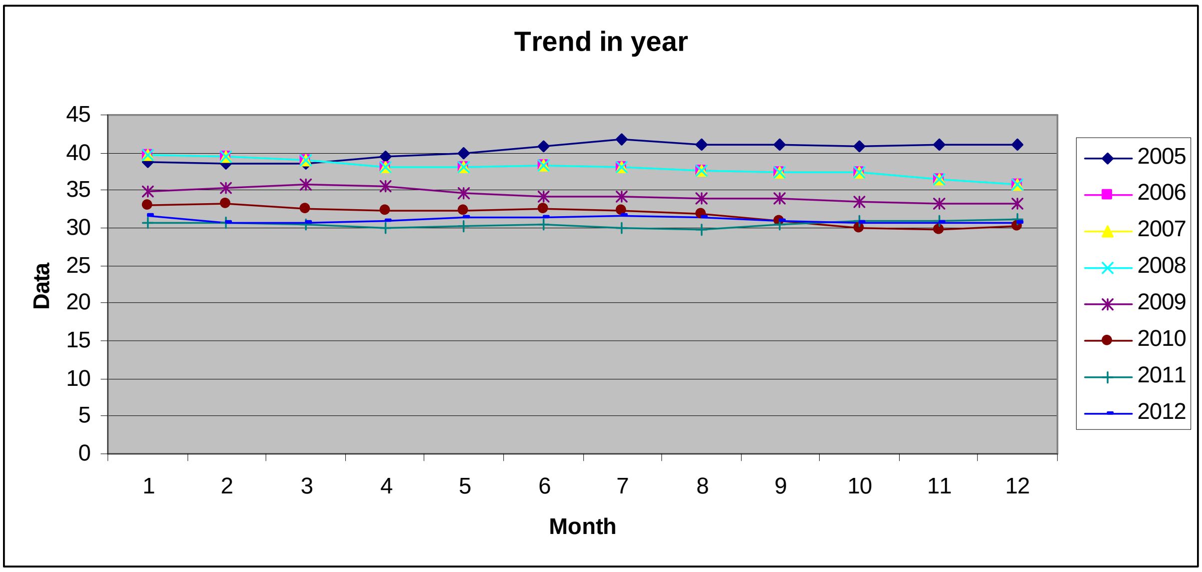
Finding a Stationary Series

To determine if the data, Thai Baht exchange rate to US Dollar, formed a stationary process, values were plotted for autocorrelation to see whether there is any shift for peak value and captured any trend in each year of data. Using the formula of autocorrelation;

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

The results are shown below;





From the graph above shown there is no shift value of auto correlation significantly and there is no trend in data each year, hence I conclude that the data is in stationary.

Fitting the AR (1) model

- As shown below, regressing the autoregressive with one parameter AR(1), means predicting the data using the prior month onwards, will obtain the result as follows;

Regression Statistics	
Multiple R	0.99006
R Square	0.98022
Adjusted R Square	0.980007
Standard Error	0.468951
Observations	95

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1013.513	1013.513	4608.657	4.96E-81
Residual	93	20.45209	0.219915		
Total	94	1033.965			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.382877	0.500005	0.765746	0.445767	-0.61003
Yt-1	0.98633	0.014529	67.88709	4.96E-81	0.957479

- The result are shown in Excel file sheet “AR(1)”.

Fitting the AR (2) model

- As shown below, regressing the autoregressive with two parameter AR(2), means predicting the data using the two month prior onwards, will obtain the result as follows;

Regression Statistics	
Multiple R	0.991132
R Square	0.982342
Adjusted R Square	0.981954
Standard Error	0.443831

Observations	94

ANOVA

	df	SS	MS	F
Regression	2	997.259	498.6295	2531.293
Residual	91	17.92574	0.196986	
Total	93	1015.185		

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.470829	0.47816	0.984667	0.327399
Yt-1	1.333735	0.098143	13.58966	1.27E-23
Yt-2	-0.34906	0.097774	-3.57011	0.000572

- The result are shown in Excel file sheet "AR(2)".

Fitting the AR (3) model

- As shown below, regressing the autoregressive with one parameter AR(3), means predicting the data using the three month prior onwards, will obtain the result as follows;

Regression Statistics	
Multiple R	0.991072
R Square	0.982223
Adjusted R Square	0.981624
Standard Error	0.445767
Observations	93

ANOVA

	df	SS	MS	F	Significance F
Regression	3	977.1537	325.7179	1639.176	9.88E-78
Residual	89	17.68504	0.198708		
Total	92	994.8387			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	0.482393	0.486437	0.991687	0.324039	-0.48415
Yt-1	1.36447	0.105304	12.95749	3.38E-22	1.155234
Yt-2	-0.4616	0.171609	-2.68983	0.008536	-0.80258
Yt-3	0.081223	0.10491	0.774211	0.440858	-0.12723

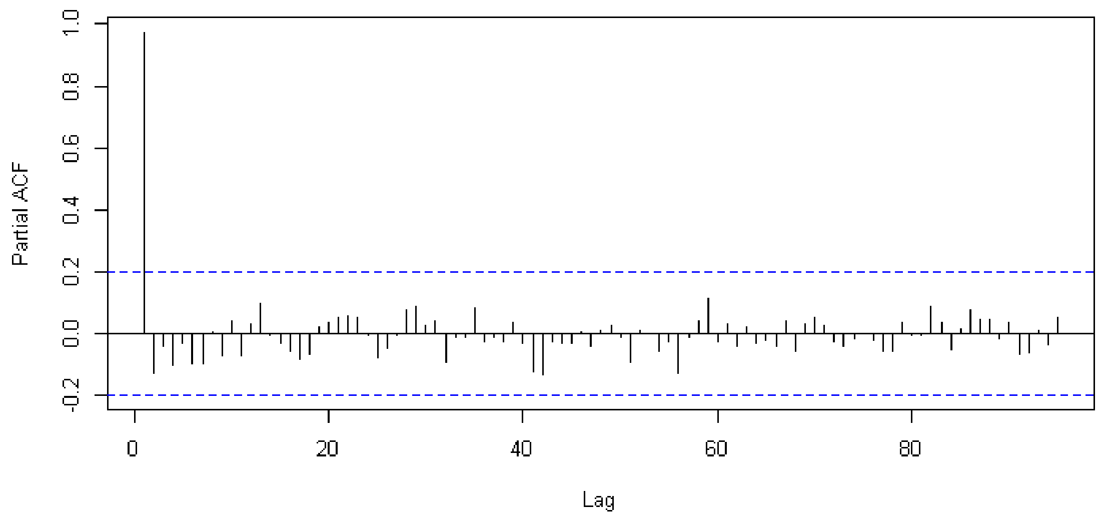
- The result are shown in Excel file sheet "AR(3)".

Comparison of models

Analyze three model, AR(1), AR(2) and AR(3), and sample Partial autocorrelation. We calculate partial aurtocorrelation function; this is to determine the appropriate model for Thai Baht exchange rate to US Dollar.
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 below. The graph displays the sample PACF for Thai Baht exchange rate to US Dollar 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 the 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 Thai Baht exchange rate to US Dollar.
The AR(1) model is

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

From the sum of all coefficient of each model, AR(1) is 0.98633, AR(2) is 1.333735-0.34906= 0.984675 and AR(3) = 1.36447-0.4616+0.081223 = 0.984093, all models obtain the sum of coefficient less than 1thus, the three models are stationary. And AR(2) coefficient turns to negative value, this confirm that the AR(1) model for the Thai Baht exchange rate to US Dollar fits the best with the fitted process is $Y_t = 0.98633Y_{t-1} - 0.382877$.

Conclusion

Of the three methods studied the AR (1) model provided the best fit to Thai Baht exchange rate to US Dollar from January 2005 to December 2012 with the fitted process is $Y_t = 0.98633Y_{t-1} - 0.382877$.