Time Series – SPRING 2011
Student Project
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Economic Growth Rate in Taiwan (R.O.C.)

Introduction

In Macroeconomics, the results of economic activities during a particular period in a country are usually measured by the "total output". Gross domestic product (GDP) was first developed by Simon Kuznets for a US Congress report in 1934. GDP refers to the market value of all final goods and services produced within a country in a given period. GDP per capita is often considered an indicator of a country's standard of living.

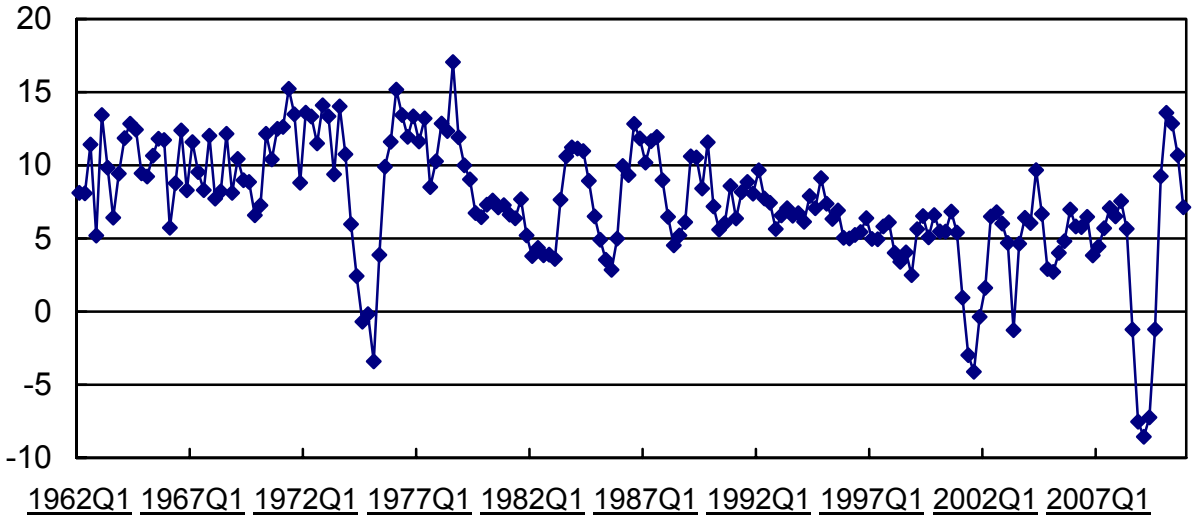
Economic growth is defined as the increasing capacity of the economy to satisfy the wants of the members of society. Economic growth rate is usually measured as a percentage change in the GDP. Inflation can make it difficult to measure economic growth rate. To express real growth rather than changes in prices for the same goods, statistics on economic growth rate are often adjusted for inflation.

Data

The official GDP and Economic growth rate statistics for Taiwan are calculated by the Directorate General of Budget, Accounting and Statistics of Executive Yuan and are released (http://www.dgbas.gov.tw/) every year since 1951. In particular, economic growth rate is defined as the annual GDP increase based on the price level in 2006.

This report takes data from the first quarter of 1962 to the fourth quarter of 2009 and retains the last four sections of data (Q1 to Q4 2010) to be used in forecasting. It can be seen in the trend of economic growth rate (Figure.1) that the overall variance of the data is dramatic.

Figure.1 Economic Growth Rates Y_t



Model Specification

From Figure.1, The Y_t series is obviously non-stationary. The transformations or differences should be performed to achieve stationary. It can be seen in the trend of economic growth rate in Figure.2, the first difference of Y_t series looks much more stationary when compared with the original time series shown in Figure.1.

Figure.2 Economic Growth Rates Diff(Y_t)

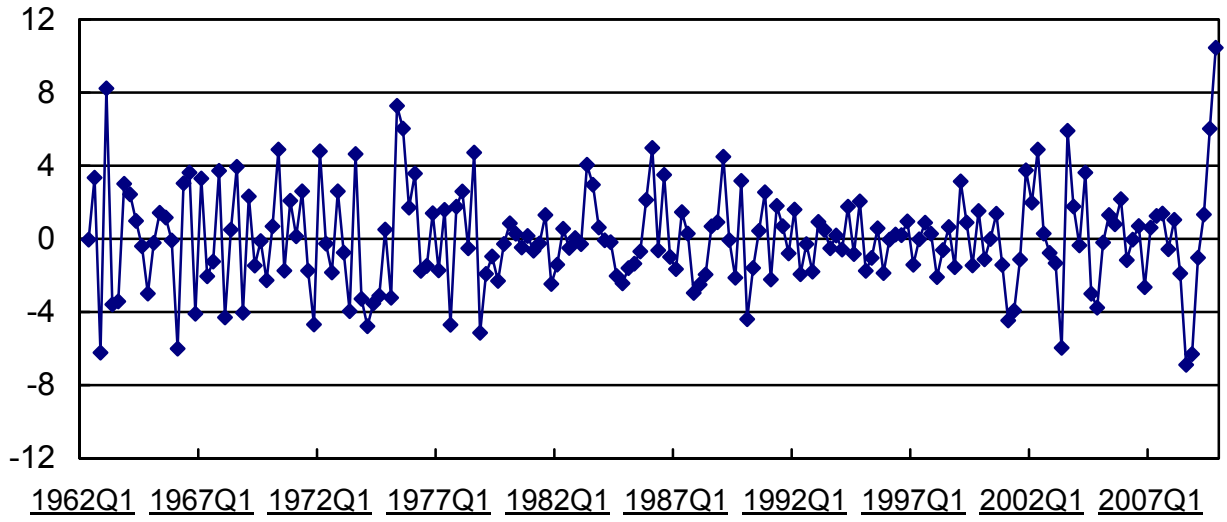


Figure.3 shows the ACF plots of Diff(Y_t) and Figure.4 shows the PACF plots of Diff(Y_t)

Figure.3 Sample ACF of Diff(Y_t)

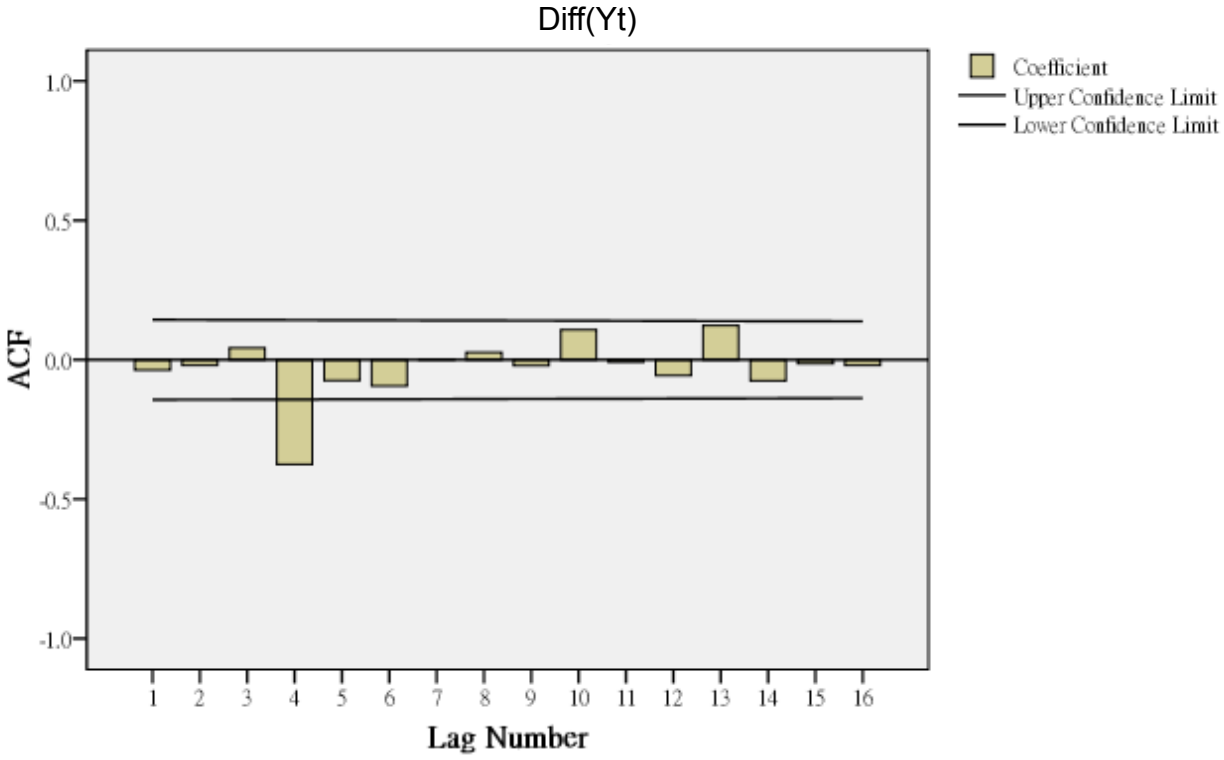
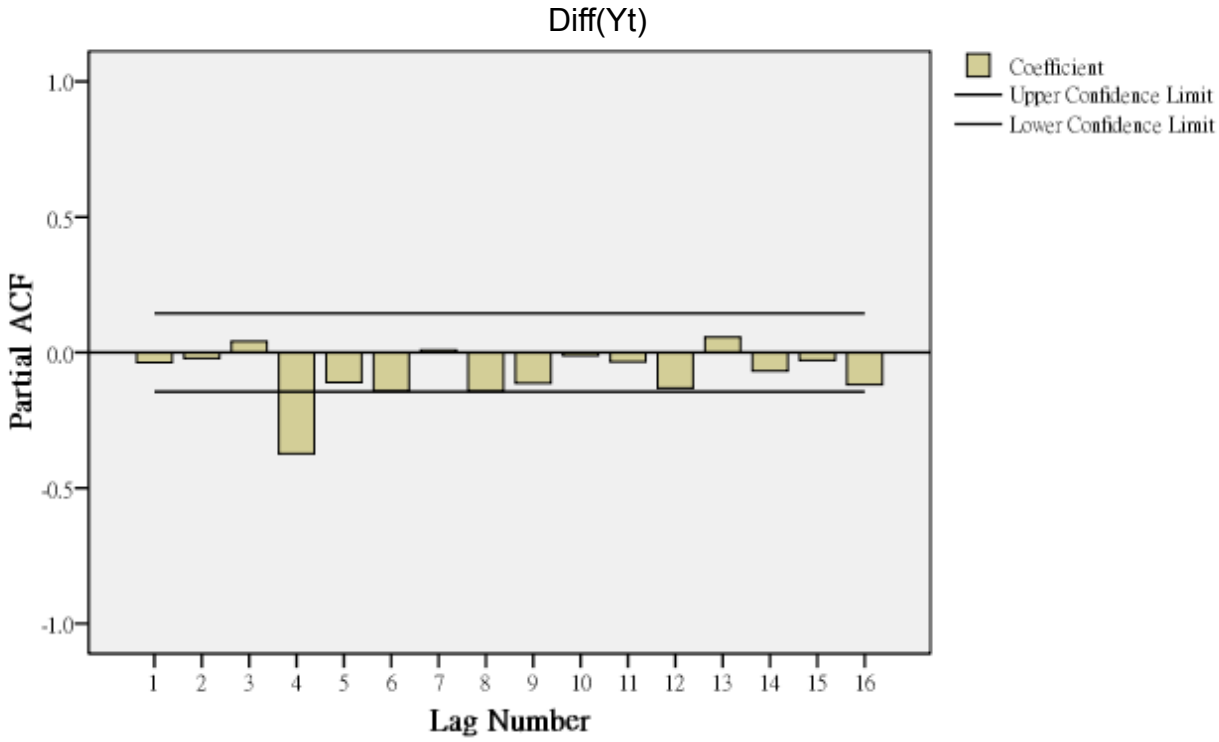


Figure.4 Sample PACF of Diff(Y_t)



From ACF plots and PACF plots, there is a cut-off of the correlation at lag 4. Based on the ACF and PACF plots, it is not immediately clear what model is most appropriate for this data. The possibilities include an ARIMA model with a differencing of 1 and a MA(4), or an ARIMA model with differencing of 1 and an AR(4).

Model Fitting and Model Diagnostics

ARIMA Model Parameters

		Estimate	SE	t	Sig.
Difference		1			
Seasonal Difference					
MA, Seasonal	Lag 1	.541	.063	8.591	.000

The data are fitted to a ARIMA(0,1,0)(0,0,1)$_4$ model. Based on the following parameters, the model may be represented as $Y_t - Y_{t-1} = \varepsilon_t - 0.541\varepsilon_{t-4}$ and the absolute value of the T-ratio indicates the parametric estimate is significant. In addition, by observing Sample ACF and Sample PACF of Residual (Figure.5), it can be discovered that the residuals fall within confidence interval, which proves the goodness of fit of the model.

In summary, it can be concluded that the residuals are independent white noise series. That is, the ARIMA(0,1,0)(0,0,1)$_4$ model provides a good fit to the Economic Growth Rate in Taiwan.

Figure.5 Sample ACF and Sample PACF of Residual

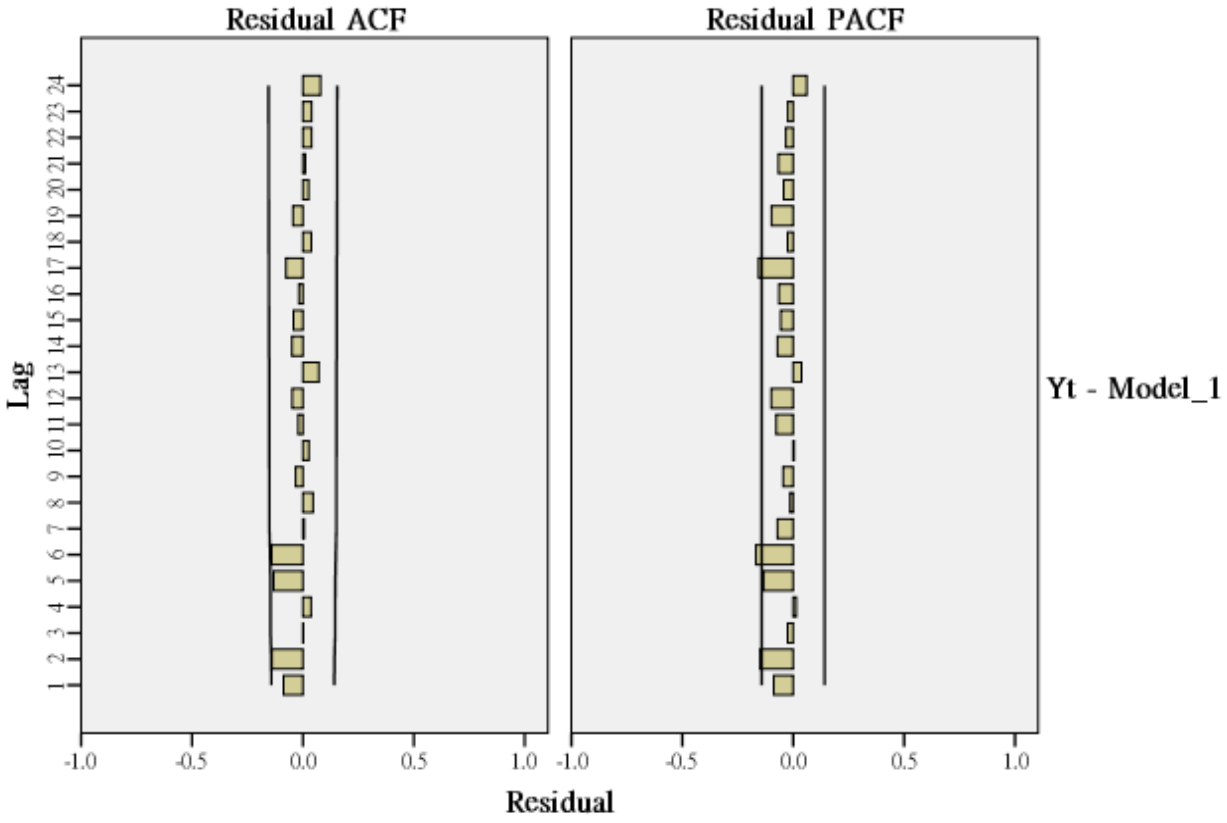
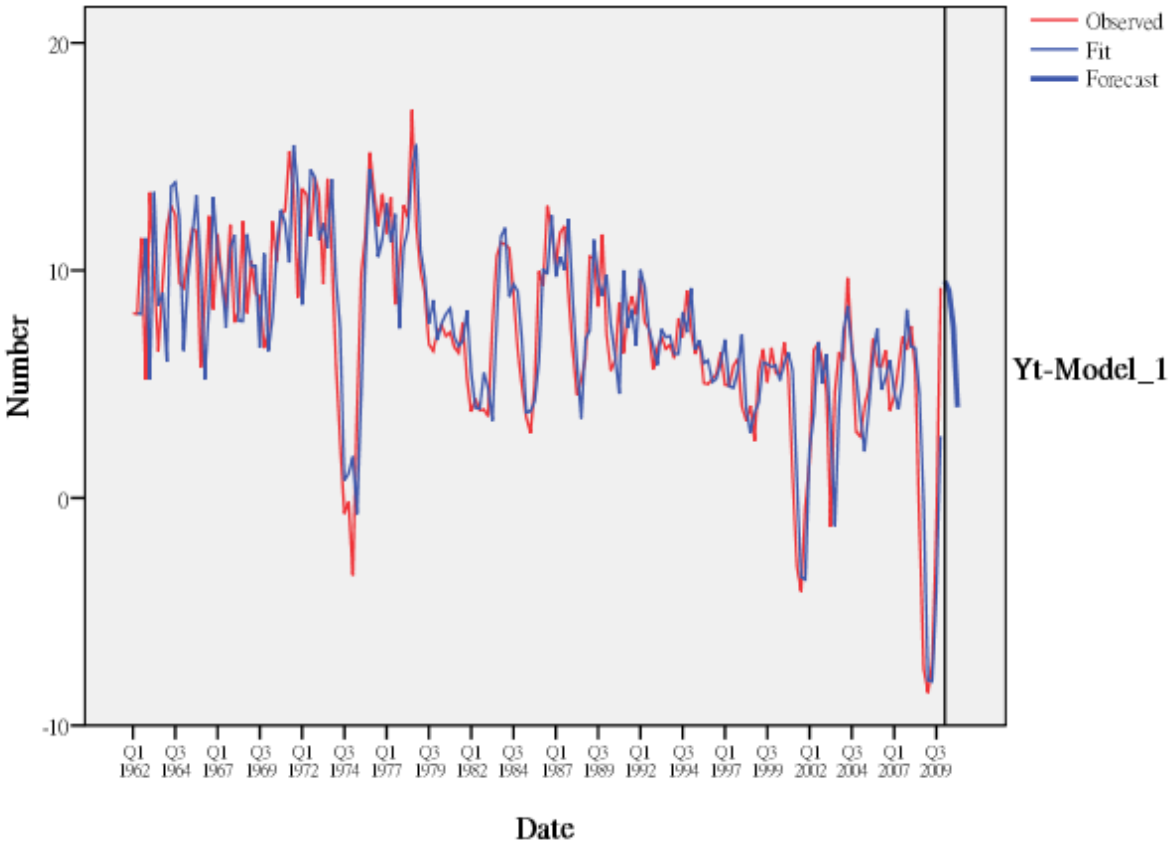


Figure.6 The Time Series Y_t of Observed and Fit and Forecast



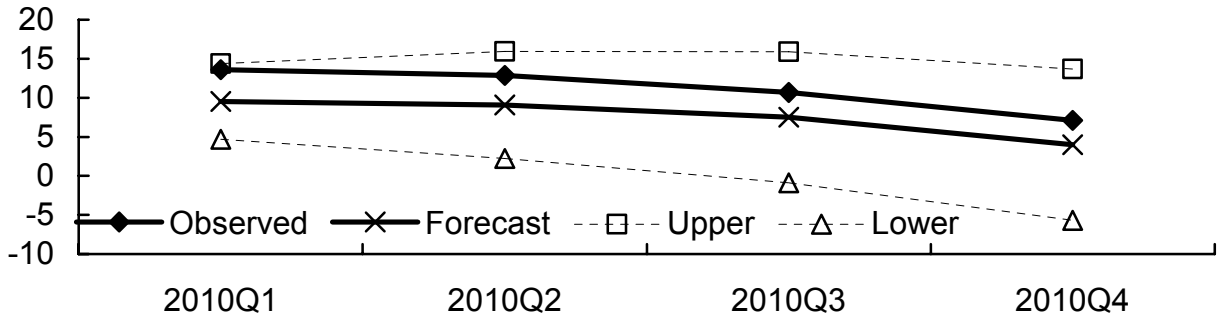
In Figure 6, the fitted series are compared to the actual one. The model looks good to fit the

actual series. We may also see the model configuration in Figure 6 and the forecast for Q1 to Q4 2010. The forecasting processing is described separately in the next section.

Forecast

Figure 7 shows predictions of the Economic Growth Rate in Taiwan for Q1 to Q4 2010. It is clear the forecast values are quite different from the actual values. However, the overall growth trend is demonstrated in the forecast values, which all fall within the 95% confidence interval.

Figure.7 The Time Series Y_t (Q1 to Q4 2010) of Observed and Forecast



Conclusions

This project utilizes time series analysis to forecast the Taiwan economic growth rate. It uses the historical data from Q1 1962 to Q4 2009 to create the optimal estimation model and diagnoses the estimate residuals to be white noises. The data from Q1 to Q4 2010 are used to verify the effectiveness of the model. Although it is clear the forecast power of the model is limited, the model proves to be able to show the trend and the actual values remain within the 95% confidence interval. The results are sufficient to prove ARIMA$(0,1,0)(0,0,1)_4$ to be the best fit to the Economic Growth Rate in Taiwan.