Time Series Student Project 2010

The US Female Unemployment Rate

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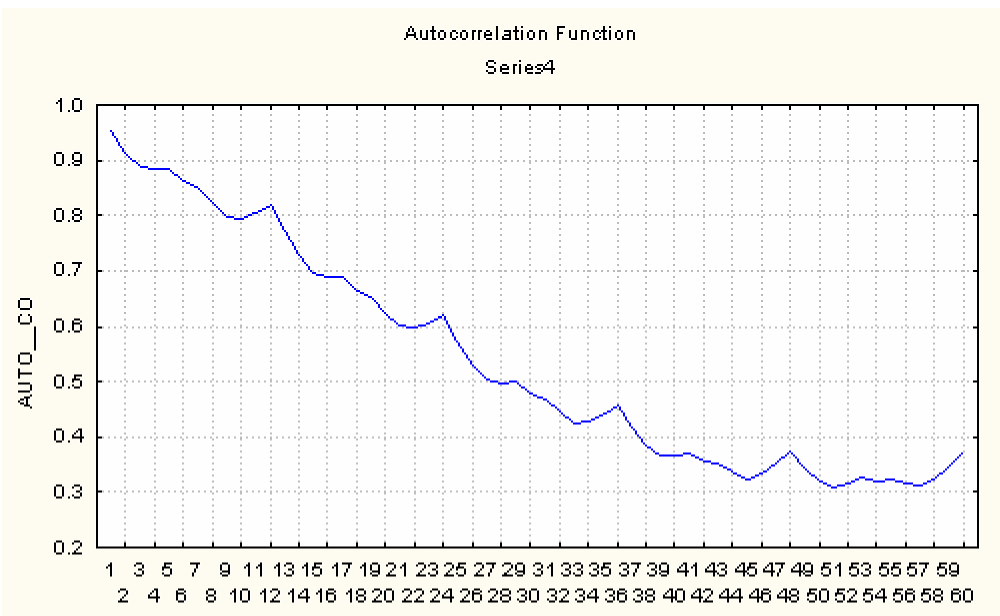
1. Introduction

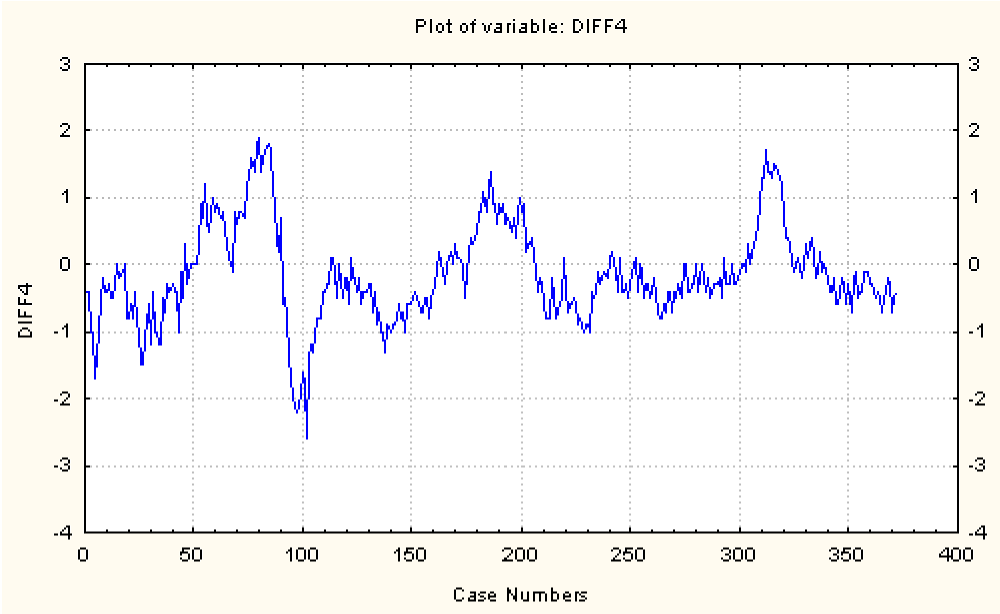
The unemployment rate is a good economic indicator. For example the high unemployment rate has raised many social and economic problems. So it can help to determine impacts to both the insurance and financial market. In this project, we will focus of the analysis of the US female monthly unemployment rate from 1995 to 2008. In this project, we used data from 1995 to 2006 to develop of a time series model and to forecast 2007 to 2008 unemployment rate to evaluate the model. The data is from NEAS of SERIES 4.

2. Model Specification

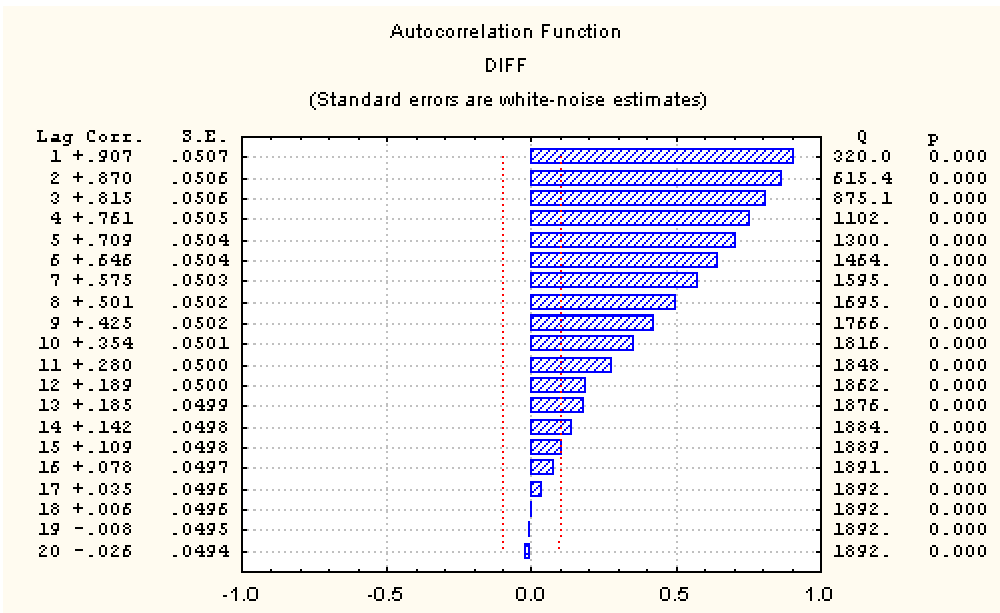
We can determine the stationarity of the series by looking at the data itself or looking at the sample autocorrelation function of the series. If the sample autocorrelations dampen to zero as lag k increases, the series is stationary. Although this series does dampen to zero, there are significant spikes every lag of twelve.



This is an indication that we should take twelve-month differences to remove these spikes. Below is the new twelve month differenced series:



Below is the first autocorrelations of the new twelve month differenced series:



It appears that these points are declining in a geometrical pattern. This is an indication that an autoregressive model should be used. There is no evidence that any moving average terms are present. We will therefore proceed with developing several autoregressive models.

3. Estimation Method

If there are no moving average terms, we can use a simple linear regression to determine our parameters. Since we are using twelve-month differences, we lost 12 data points. We will also leave the last 14 points out of the model in order to use those points as a check of our model accuracy. We will begin with the AR(1) model. Below is our estimated model:

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.371E-02	.016		-.858	.391
	YT_1	.908	.022	.908	41.729	.000

a. Dependent Variable: YT

The AR(1) model is : $\boldsymbol{y_t = -.0.01371 + .0.908y_{t-1}}$
The adjusted R^2 is 0.825. It show $\boldsymbol{y_t}$ and $\boldsymbol{y_{t-1}}$ have highly relationship.

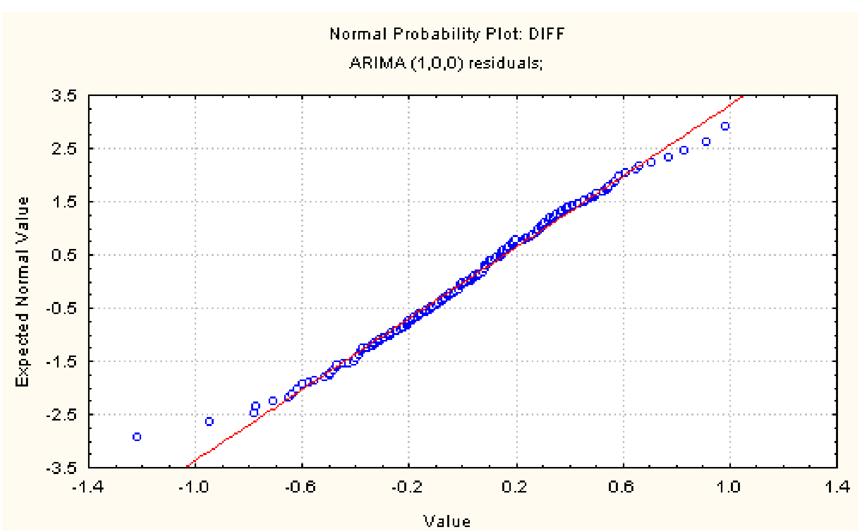
Model Summary

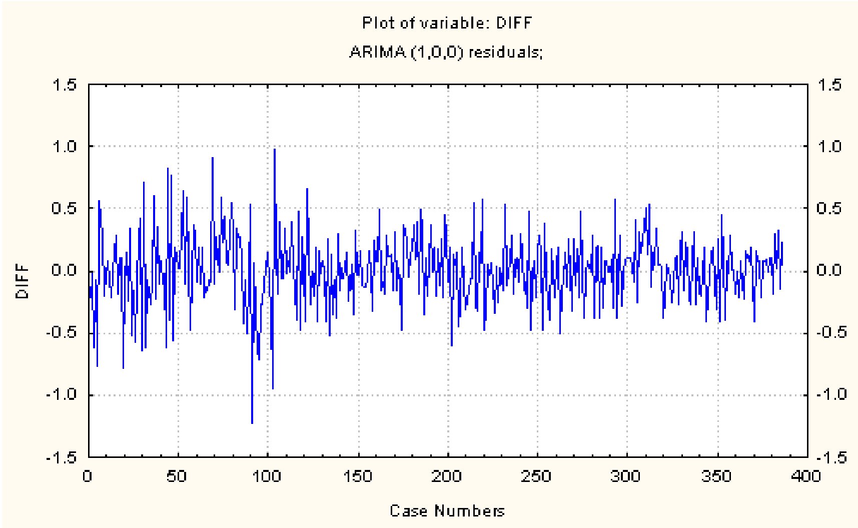
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.908[a]	.825	.825	.30118

a. Predictors: (Constant), YT_1

At Normal Probablity Plot :the AR(1) model residuals' distribution is approximating Normal distribution.

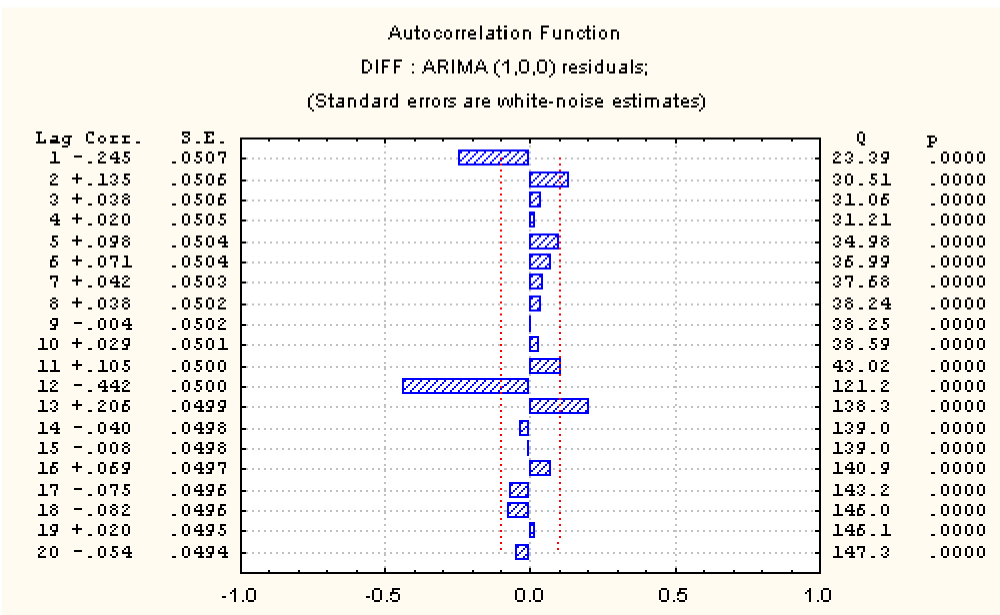
The AR(1) model residuals are scattered alone with the zero axis and the deviation almost fall into the interval (-0.5, 0.5). The AR(1) model residuals are accepted.





This AR(1) model residuals would produce the following autocorrelation points:

This follows along very closely with our sample autocorrelation function, one sign that this may be a good model.



Let's now turn to an AR(2) model. Below is our estimated model:

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.006E-02	.015		-.650	.516
	YT_1	.665	.050	.665	13.220	.000
	YT_2	.268	.050	.268	5.330	.000

a. Dependent Variable: YT

The AR(2) model is : $\boldsymbol{y_t = -.001006 + .665y_{t-1} + .268y_{t-2}}$

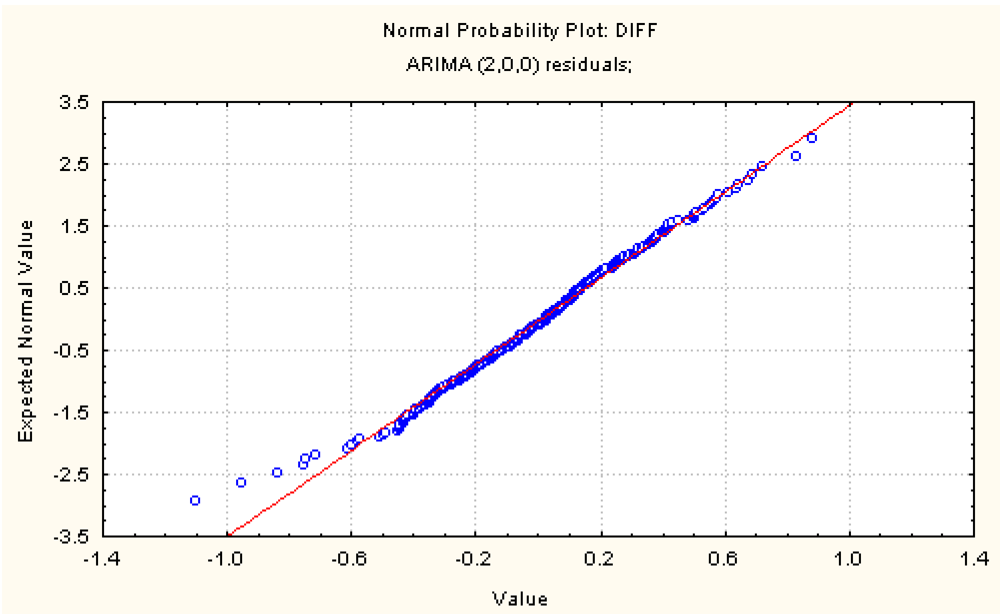
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.915[a]	.838	.837	.29095

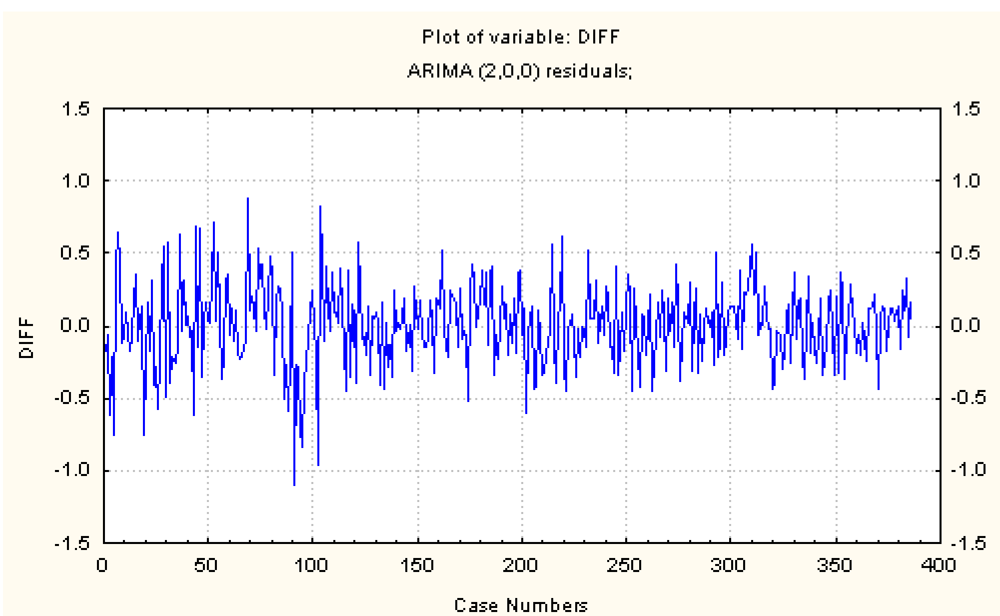
a. Predictors: (Constant), YT_2, YT_1

Both of two variables y_{t-1} and y_{t-2} are signinificent and the adjusted R^2 increases from 0.825 to 0.837,so the AR(2) model is better then the AR(1) model.

At Normal Probablity Plot :AR(2) model residuals' distribution is approximating Normal distribution.

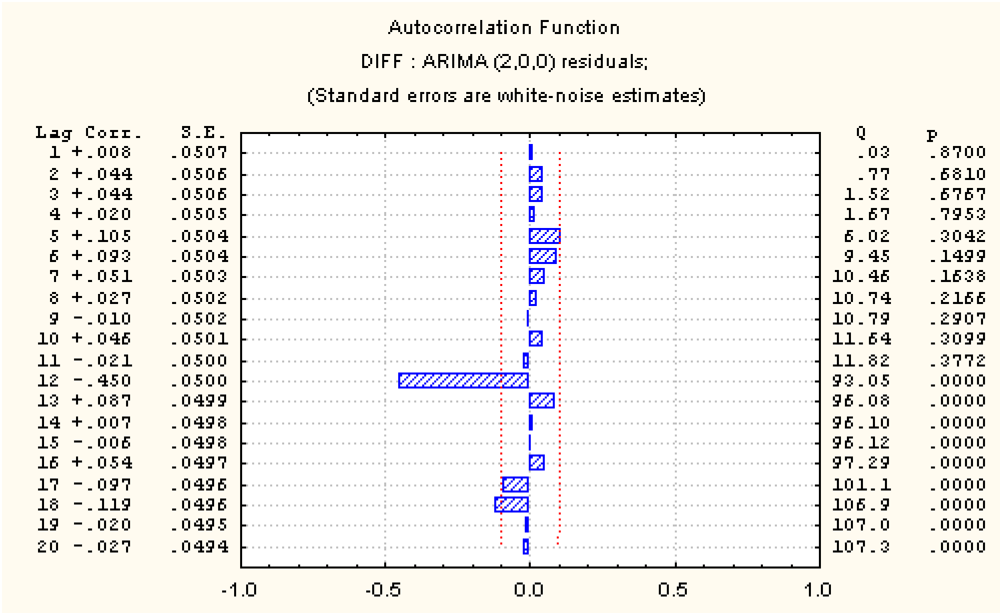


The AR(2) model residuals are scattered alone with the zero axis and the deviation almost fall into the interval (-0.5, 0.5). The AR(2) model residuals are accepted.



This AR(2) model residuals would produce the following autocorrelation points:

This follows along very closely with our sample autocorrelation function, one sign that this may be a good model.



Let's now turn to an AR(3) model. Below is our estimated model:

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-8.757E-03	.015		-.568	.571
	YT_1	.672	.052	.673	12.912	.000
	YT_2	.285	.061	.286	4.689	.000
	YT_3	-2.681E-02	.052	-.027	-.515	.607

a. Dependent Variable: YT

The AR(3) model is : $\boldsymbol{y_t = -.008757 + .672_{t-1} + .285y_{t-2} - .002681y_{t-3}}$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.916[a]	.839	.838	.28984

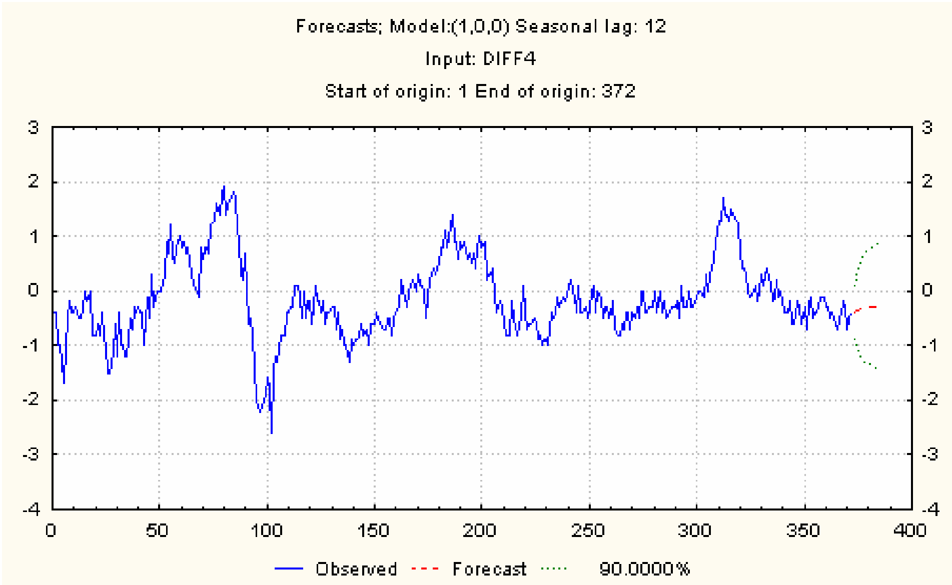
a. Predictors: (Constant), YT_3, YT_1, YT_2

The addition of the next term adds almost nothing to the model. The adjusted R^2 barely increases, and the coefficient for the new term is nearly zero. The P-value for the new term is also very high. So we stop to explore more models and accept the AR(1) model and the AR(2) model.

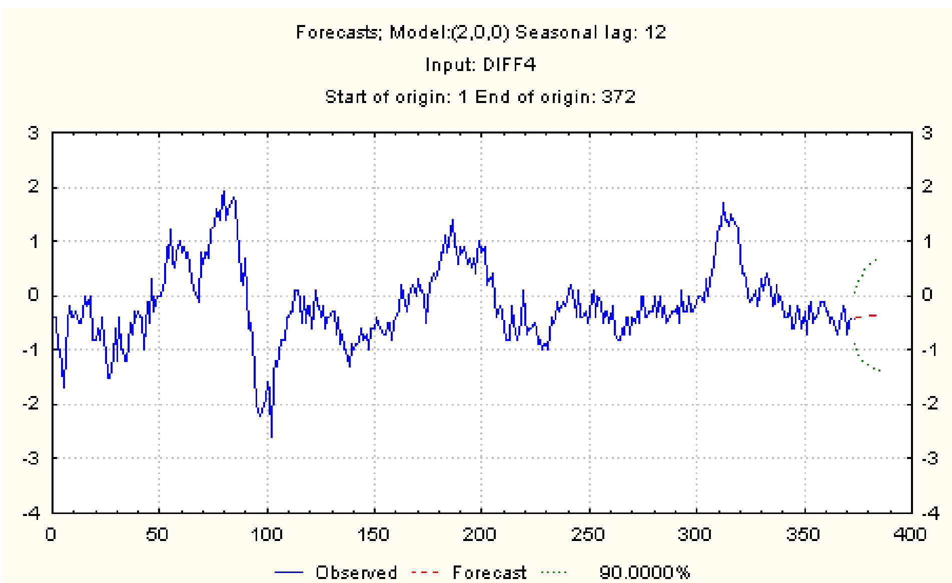
4. Evaluation

We will now evaluate the accuracy of the model by forecasting 2007 to 2008 unemployment rate and compare it to the data that we intentionally left out of the model estimation.

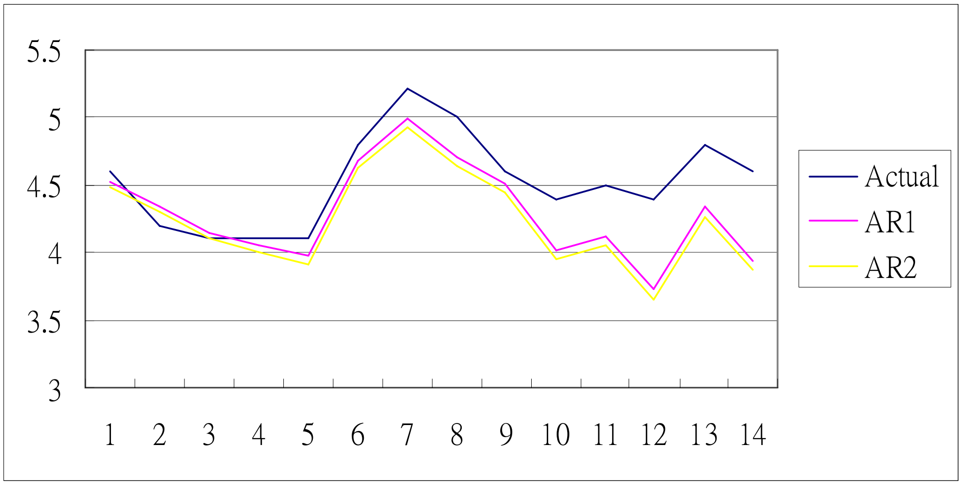
The AR(1) model forecasts is red line and 90% confident interval is green line in below Figure.



The AR(1) model forecasts is red line and 90% confident interval is green line in below Figure.



The AR(1) model forecast line is vary similar to the AR(2) model forecast line, so we merge two forecast lines and focus on the last 14 point(2007-Jan to 2008-Feb).The graph below showcases both the actual data points and the forecasted points. There are three Series : actual data , the AR(1) model forecasted data and the AR(2) model forecasted data.



The AR(1) model and the AR(2) model are closely to actual series for only a short time. Both of two model are only useful for a few months, and thus may not be reliable for longer-term predictions. The AR(2) model adjusted R^2 is higher then the AR(1) model. But the AR(1) model's forecasted data is more closely to actual series then the AR(2) model's.

5. Conclusion

The US Female unemployment rates may be forecast by applying the AR(2) model $\boldsymbol{y_t = -.001006 + .665y_{t-1} + .268y_{t-2}}$ or the AR(1) model $\boldsymbol{y_t = -.0.01371 + .0.908y_{t-1}}$ .The AR(2) model's adjusted R^2 is better then the AR(1) model, because the adjusted R^2 increases from 0.825 to 0.837.But after comparing actual data, the AR(1) model's forecasted data is more closely to actual series then the AR(2) model's and the AR(1) model has fewer variable. In addition, structural economic models may be a better predictor of the unemployment rate. Example: Economists presume that unemployment rates are correlated with other macroeconomic indices, such as GDP and inflation. Female adult unemployment rates may reflect school-age children with vacation in the summer. We can do more research on those variables to get better model.