

THE UNIVERSITY OF CHICAGO
Graduate School of Business
Business 41202, Spring Quarter 2008, Mr. Ruey S. Tsay

Homework Assignment #3

Due Date: April 29 (Campus) & April 29 (Evening)

Note: Unless specifically assigned, all tests are based on the 5% significance level. All data are on the course web.

1. Consider the weekly conventional 30-year mortgage rate of U.S. from January 8, 2004 to April 3, 2008. The data are obtained from Federal Reserve Bank at St Louis. Build a time series model for the series. Perform model checking using $Q(12)$ for residuals. Write down the fitted model. Use the fitted model to produce 1-step to 4-step ahead forecasts at the forecast origin April 3, 2008. [The data format is (year, mm, dd, rate).] [The forecast horizon is about a month.]
2. The mortgage rate is highly related to the treasury interest rates. To study the dependence, consider the weekly 3-year treasury constant maturity interest rate from January 2, 2004 to March 28, 2008 as an independent variable. Note that the interest rate is a few days before the mortgage rate. Build a regression model with time series errors between the two time series with mortgage rate as the dependent variable. Perform model checking using $Q(12)$ of the residuals and write down the fitted model. Test the null hypothesis that the mortgage rate does depend on the interest rate.
3. Recall the monthly simple returns of the Decile 1 portfolio from January 1988 to December 2007. It is well-known that there was a January effect. To handle this January effect, we can use January dummy variable in a regression setup, resulting in a regression model with time series errors. To do this, use the following command to create January dummy in R for 20 years of data:

```
jan = rep(c(1,rep(0,11)),20)
```

where “rep” means “repeat”, i.e. $\text{rep}(0,11)$ means repeating 0 for 11 times.

Identify a regression model with time-series errors for the Decile 1 simple returns. Perform model checking using $Q(24)$ of the residuals, and write down the fitted model. Test the null hypothesis that the January effect is indeed significant.

To use the fitted model for forecasting, one needs to specify the “new” values for the independent variable. In this particular case, the “future” independent variable is just the indicator for January. If the forecast horizon is 12 (i.e., one year), then let

```
newjan=c(1,rep(0,11))
```

Use the model to obtain 1-step to 12-step ahead forecasts. [If the name of your fitted model is “m1”, then the command for forecasting is

```
predict(m1,newxreg=newjan,12)
```

4. Alternatively, you can use seasonal model to analyze the Decile 1 returns. This approach does not provide specifically the impact of January effect, but it can produce forecasts that automatically takes into consideration the January effect. The model is a multiplicative seasonal model as ARIMA(0,0,1)(1,0,1) with period 12. The command in R is

```
mm=arima(d1,order=c(0,0,1),seasonal=list(order=c(1,0,1),period=12))
```

where “d1” denotes the return series.

Perform model checking on the fitted model, e.g., compute $Q(24)$ of the residuals. Is the model adequate? Write down the fitted model. Use the model to produce 1-step to 12-step ahead forecasts for the simple returns of Decile 1 portfolio. Compare the forecasts with those of the previous problem that use January indicator. Comments on the forecasts of the two approaches.

5. Consider the quarterly earnings per share of the FedEx stock from the 4th quarter of 1991 to the fourth quarter of 2006. Note that one of earnings is negative. To take the log transformation, you may try $y = \log(\text{earn}+0.5)$. Build a model for the earning series. Perform model checking to ensure that the model is adequate using $Q(12)$ of the residuals. Use the model to produce 1-step to 4-step ahead forecasts. [You need to take anti-log transformation, then subtract 0.5.]