

THE UNIVERSITY OF CHICAGO
Graduate School of Business
Business 41202, Spring Quarter 2007, Mr. Ruey S. Tsay

Homework Assignment #3

Due Date: April 20 (Campus) & April 21 (Weekend)

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

1. Consider the conventional 30-year mortgage rate of U.S. from June 1976 to March 2007. The data are obtained from Federal Reserve Bank at St Louis. Take the natural log transformation of the mortgage rate to 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 March, 2007. [The data format is (year, mm, dd, rate).]
2. The mortgage rate is highly related to the treasury interest rates. To study the dependence, consider the monthly 2-year treasury constant maturity interest rate of the same time period as the independent variable. Take the log transformation of the two series and build a regression model with time series errors between the two log 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 1980 to December 2006. 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 27 years of data:

```
jan = rep(c(1,rep(0,11)),27)
```

where “rep” is a command for “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.

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 $\text{ARIMA}(0,0,1)(1,0,1)$ 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.

5. Consider the quarterly earnings per share of the Alcoa stock from the 4th quarter of 1991 to the most recent quarter. Note that some earnings are negative. 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.