



FACULTY OF SCIENCE AND ENGINEERING
DEPARTMENT OF MATHEMATICS AND
STATISTICS

OPEN- BOOK LABORATORY EXAM

MODULE CODE: MS4218

MODULE TITLE: Time Series Analysis DURATION OF EXAM: 50 minutes

LECTURER: Dr. Joseph Lynch

GRADING SCHEME: 30 marks
15% of module

INSTRUCTIONS TO CANDIDATE

Answer all three questions

Save output in Word file which contains your name and number as a header.

Include all R code input and output in the Word file.

Email file to: joseph.lynch@ul.ie

Load library(TSA)

Q1.

The data file named *gold* contains the daily price of gold in dollars per troy ounce for the 252 trading days of year 2005.

Load the file with the following command:

```
data(gold)
```

- (a) Display the time series plot of these data and interpret the plot.
- (b) Display the time series plot of the differences of the logarithms of these data and interpret the plot.
- (c) Calculate and display the sample auto-correlation function (acf) for the differences of the logarithms of these data and interpret the plot.
- (d) Display the differences of the logarithms of these data in a histogram and interpret the plot.
- (e) Display the differences of the logarithms of these data in a quantile-quantile (QQ) and interpret the plot.
- (f) Perform a Shapiro-Wilk test and comment on the result.

Q2.

The data file named *days* contains accounting data from the Winegard Co. of Burlington, Iowa. the days are the number of days until Winegard receives payment for 130 consecutive orders from a particular distributor of Winegard products.

Load the file with the following command:

```
data(days)
```

- (a) Display the time series plot of these data and interpret the plot.
- (b) Calculate and display the sample acf and partial acf (pacf) for this series and comment on the plots.
- (c) Replace the unusual values with a more typical value of 35 days. Repeat the acf and pacf on the modified data and comment on the plots.
- (d) Calculate the extended auto-correlation function (eacf) and comment on the output.

Q3.

- (a) Using the seed 54321, simulate an ARMA(1,1) model with $\phi = 0.7$, $\theta = -0.6$ and $n = 200$.
- (b) Display the eacf of the series. Is an ARMA(1,1) model suggested?
- (c) Calculate the Ljung-Box statistic summing to $K = 6$. Does this support an ARMA(1,1) specification?
- (c) Using maximum likelihood, estimate ϕ and θ from the series and comment on the results.
- (d) Using method-of-moments, estimate ϕ . Why is it difficult to estimate θ with this method?