Dept of Mathematics and Statistics
King Fahd University of Petroleum & Minerals

STAT460: Time Series

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Major 2 Exam Term 162 FORM A

Tuesday Apr 18 2017

7.00pm-8.20pm

Name________________________ ID#:__________ Serial #:___

Instructions.

1. Please turn off your cell phones and place them under your chair. Any student caught with mobile phones on during the exam will be considered under the **cheating rules** of the University.
2. If you need to leave the room, please do so quietly so not to disturb others taking the test. No two person can leave the room at the same time. No extra time will be provided for the time missed outside the classroom.
3. Only materials provided by the instructor can be present on the table during the exam.
4. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
5. Use the blank portions of each page for your work. Extra blank pages can be provided if necessary. If you use an extra page, indicate clearly what problem you are working on.
6. Only answers supported by work will be considered. Unsupported guesses will not be graded.
7. While every attempt is made to avoid defective questions, sometimes they do occur. In the rare event that you believe a question is defective, the instructor cannot give you any guidance beyond these instructions.
8. Mobile calculators, I-pad, or communicable devices are disallowed. Use regular scientific calculators or financail calculators only. Write important steps to arrive at the solution of the following problems.

The test is 80 minutes, GOOD LUCK, and you may begin now!

Question	Total Marks	Marks Obtained	Comments
1	4+2+5=11		
2	3+3+3=9		
3	2+3+2+4=10		
4	3+2+3=8		
5	5		
6	4+3=7		
Total	50		

Extra blank page

1. (4+2+5=11 points) Let $\{Y_t\}$ be a special ARIMA process of the form $Y_t = \phi_2 Y_{t-2} + e_t$.

   a) Find the range of values of ϕ_2 for which the process is stationary.

   b) Write the correct order (p, d, and q) of this stationary ARIMA process

   c) Express this model in the **general linear process** form to find ψ_3 and ψ_4.

2. (3+3+3=9 points). Consider a process that satisfies the zero-mean "stationary" MA(1) equation

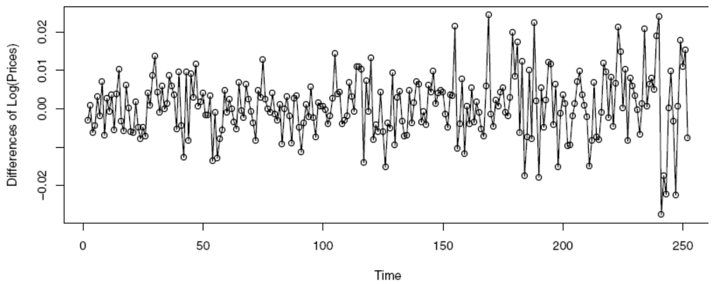
$$Y_t = e_t + \phi\theta e_{t-1}$$

with $-1 < \theta < 1$ and $-1 < \phi < 1$. Let c be any nonzero constant, and define $W_t = \phi Y_{t-1} + e_t$.

a) Find $E(W_t)$.
b) What is the correct model for $\{W_t\}$?
c) Given $\theta = 1/4$, argue whether or not $\{W_t\}$ is invertible and find π_2.

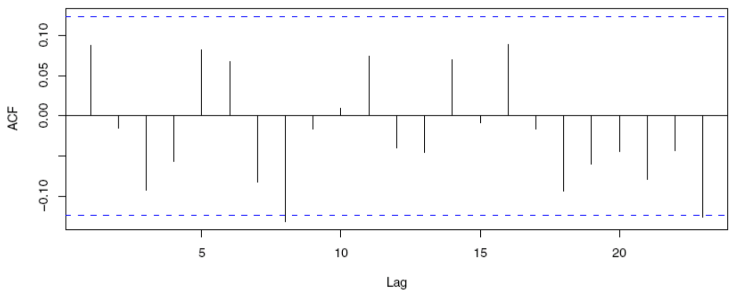
3. (2+3+2+4=10 points) The file named "**gold**" contains the daily price of gold (in dollars per troy ounce) for the 252 trading days of year 2005.

(a) The graph below displays the time series plot of the differences of the logarithms of these data.Interpret this plot.



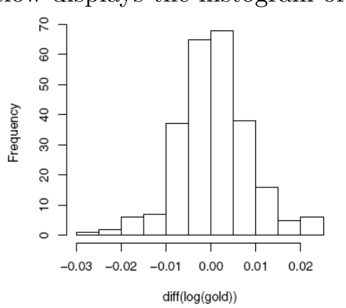

```
> plot(diff(log(gold)),type='o',ylab='Differences of Log(Prices)')
```

(b) The graph below displays the sample ACF for the differences of the logarithms of these data. Can or can you not argue that the logarithms appear to follow a random walk model.



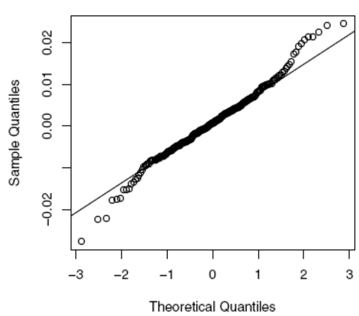

```
> acf(diff(log(gold)),main='')
```

(c) The graph below displays the histogram of the differences of logs. **Interpret** the results.




```
> win.graph(width=3,height=3,pointsize=8)
> hist(diff(log(gold)))
```

(d) Below are a quantile-quantile normal plot and Shapiro test results on the differences of logs. **Interpret** the results.




```
> qqnorm(diff(log(gold))); qqline(diff(log(gold)))
> shapiro.test(diff(log(gold)))

        Shapiro-Wilk normality test
        data:  diff(log(gold))
        W = 0.9861, p-value = 0.01519
```

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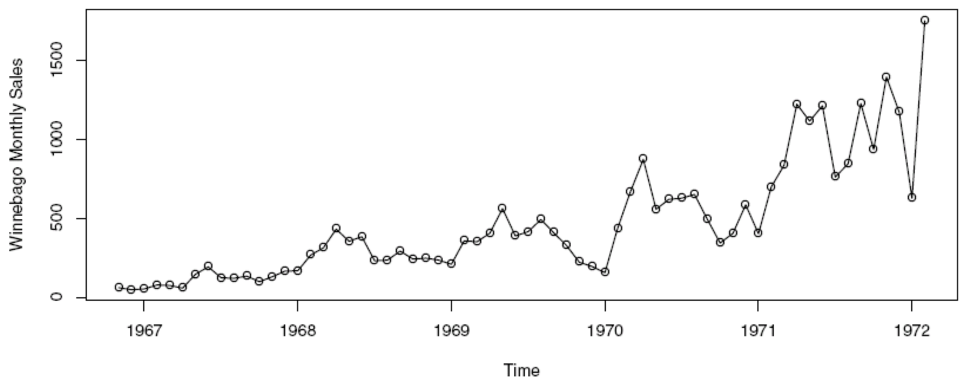
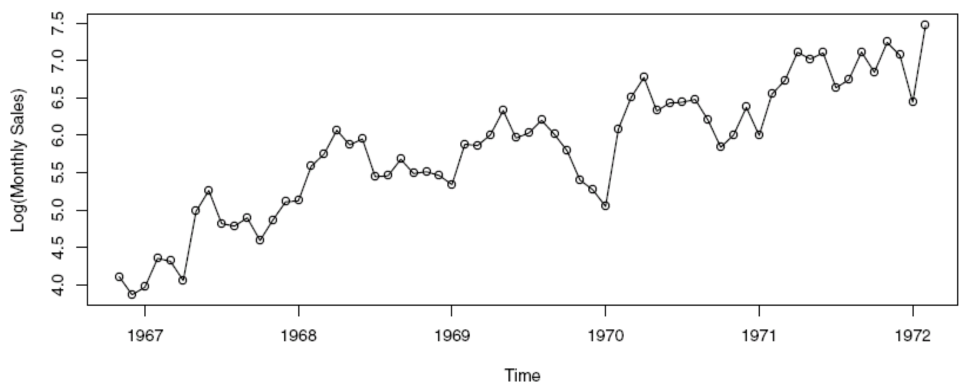
4. (3+2+3=8 points) The data file "**winnebago**" contains monthly unit sales of recreational vehicles (RVs) from Winnebago, Inc., from November 1966 through February 1972.

(a) The graph below display the time series plot for these data. **Interpret** this plot.



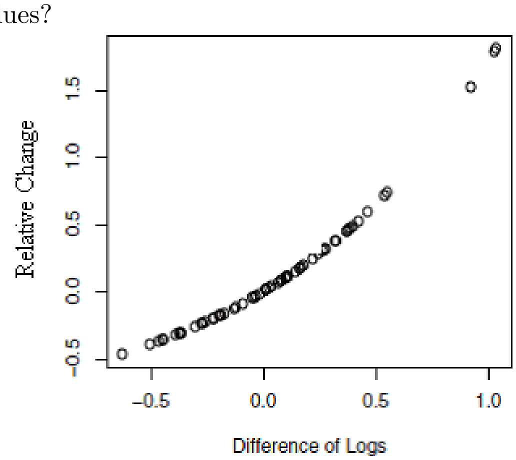

```
> data(winnebago); win.graph(width=6.5,height=3,pointsize=8)
> plot(winnebago,type='o',ylab='Winnebago Monthly Sales')
```

(b) The graph below shows the natural logarithms of the monthly sales figures. **Describe the effect** of the logarithms on the behavior of the series.




```
> plot(log(winnebago),type='o',ylab='Log(Monthly Sales)')
```

(c) The fractional relative changes, $(Y_t - Y_{t-1})/Y_{t-1}$, is computed and compared with the differences of (natural) logarithms, $\nabla log(Y_t) = log(Y_t) - log(Y_{t-1})$ in the plot below. The correlation of relative change to difference of natural log is 0.96. How do the two transformations **compare** for smaller values and for larger values?



> percentage=na.omit((winnebago-zlag(winnebago))/zlag(winnebago))

> win.graph(width=3,height=3,pointsize=8); plot(x=diff(log(winnebago))[-1],y=percentage[-1], ylab='Relative Change', xlab='Difference of Logs')

> cor(diff(log(winnebago))[-1],percentage[-1])

5. (5 points) For a series of length 64, the sample **partial autocorrelations** are given as:

Lag	1	2	3	4	5
PACF	0.47	-0.34	0.20	0.02	-0.06

Which **models** should we consider in this case?

6. (4+3=7 points) Consider an **AR**(1) series of length 100 with $\phi = 0.7$.

(a) Would you be surprised if $r_1 = 0.6$?
(b)Would $r_{10} = -0.15$ be unusual?

END OF TEST PAPER