Dept of Mathematics and Statistics
King Fahd University of Petroleum & Minerals
STAT460: Time Series
Dr. Mohammad H. Omar
Major 2 Exam Term 172 FORM A
Thursday Mar 29 2018
4.00pm-6.00pm

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 financial calculators only. Write important steps to arrive at the solution of the following problems.

The test is 120 minutes, GOOD LUCK, and you may begin now!

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

Part A. Concepts

1. (4+2+5=11 points) Let $\{Y_t\}$ be a special ARIMA process of the form $Y_t = \phi Y_{t-3} + e_t$.

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

b) Write the **correct order** (p and q) of this stationary ARMA process

c) Express this model in the **general linear process** form to find ψ_3 and ψ_5.

2. (4 points) A stationary time series of length 144 produced sample partial autocorrelations of $\hat{\phi}_{11} = 0.8$, $\hat{\phi}_{22} = -0.6$, $\hat{\phi}_{33} = 0.08$, and $\hat{\phi}_{44} = 0.00$. Based on this information alone, what model should be tentatively specified for this series?

3. (3+3+4=10 points). Let $W_t = \phi Y_{t-1} + e_t$. Also

$$Y_t = e_t + \beta\phi e_{t-2}$$

is a process that satisfies the zero-mean "stationary" MA(1) equation with $-1 < \beta < 1$ and $-1 < \phi < 1$.

a) Find $E(W_t)$

b) What is the correct model for $\{W_t\}$?

c) Given $\beta = 1/6$, argue and justify whether or not $\{W_t\}$ is invertible and find π_2.

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Part B. Analysis.

Direction: Use *R* software to conduct appropriate analysis to answer the following questions. Be sure to save your important outputs and graph into MSWORD file under your name and email this file to the instructor at the end of the exam.

4. (2+3+2+4=10 points) The file named "gold" contains the daily price of gold (in dollars per troy ounce) for 252 trading days of year 2005.
   a) Describe noteworthy patterns in the time series plot of this gold price data.
   b) Describe noteworthy patterns in the time series plot of the *differences* in the *logarithms* of this gold price data.
   c) Use the *acf* plot of the *differences* in the *logarithms* of this gold price data to determine if a "random walk" model is appropriate.
   d) Does the *differences* in the *logarithms* of this gold price data appear to support Normality? Justify your answer by providing appropriate graphical (histogram and qq plot) and statistical evidence (at 0.05 alpha significance level).

5. (2+3+3=8) The data file named “robot” contains a time series obtained from an industrial robot. The robot was put through a sequence of maneuvers, and the distance from a desired ending point was recorded in inches. This was repeated 324 times to form the time series.
   a) Based on the time series plot of the data, do these data appear to come from a stationary or nonstationary process?
   b) Compute and plot the sample ACF and PACF for these data. Based on this additional information, do these data appear to come from a stationary or nonstationary process?
   c) Complete and interpret the sample EACF below.

AR\MA	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0			x	x	x	x	x	x	x	o	x	x	x	x
1	x			o	o	o	o	o	o	o	o	o	o	o
2			o	o	o	o	o	o	o	o	o	o	o	o
3	x	x	o	o	o	o	o	o	o	o	o	o	o	o
4	x	x	x	x	o	o	o	o	o	o	o	o	x	o
5	x	x	x	o	o	o	o	o	o	o	o	o	x	o
6	x	o	o	o	o	x	o	o	o	o	o	o	o	o
7	x	o	o	x	o	x	x	o	o	o	o	o	o	o

6. (4+3=7) Monthly US milk production from 01/1994 to 12/2005 is found in the file "milk".
   a) Estimate the appropriate λ from a Box-Cox transformation of the data. Is the suggested transformation distinguishable from no transformation?
   b) With a time series plot of the data, can you describe a potentially more useful transformation of the data.