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

STAT460: Time Series
Dr. Mohammad H. Omar
Major 1 Exam Term 172 FORM A
Wednesday Feb 28 2018
6.00pm-8.00pm

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

The test consists of 2 parts. Each part is 60 minutes. GOOD LUCK, and you may begin now!

Part	Question	Total Marks	Marks Obtained	Comments
A	1	3+3=6		
	2	5		
	3	5+4+2=11		
B	4	2*3+2*3+4+2=18		
	5	6+4=10		
	6	4+2+2+2=10		
	Total	60		

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Part A. Concepts

1. (3+3=6 points) Suppose $Cov(W_t, W_{t-k}) = \gamma_k$ is free of t but that $E(W_t) = 5t + t^2$.

(a) Is $\{W_t\}$ stationary?
(b) Let $Y_t = 4 - 5t - t^2 + W_t$. Is $\{Y_t\}$ stationary?

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2. (5 points) The following partial data from tempdub file provides the monthly temperature for 24 months from Jan 1975 to December 1977 in Dubuque, Iowa.

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1975	22.4	25.7	42.3	45.2	55.5	68.9	72.3	72.3	62.5	55.6	38.0	20.4
1976	17.6	20.5	34.2	49.2	54.8	63.8	74.0	67.1	57.7	50.8	36.8	25.5
1977	20.4	19.6	24.6	41.3	61.8	68.5	72.0	71.1	57.3	52.5	40.6	26.2

$\sum_{t=1}^{36} Y_t = 1689$, $\sum_{t=1+1}^{36} Y_t Y_{t-1} = 89123.58$, and $\sum_{t=1}^{36} Y_t^2 = 91657.2$

With these information, **Calculate** and **interpret** the **lag 1 sample autocorrelations** for the data.

3. (5+4+2=11 points) Let $\{W_t\}$ be a **zero-mean**, **unit variance** stationary process with **autocorrelation function** ρ_k. Suppose that μ_t is a **nonconstant** function and that σ_t is a positive valued **nonconstant** function. The observed series is formed as $Y_t = \mu_t + 2\sigma_t W_t$.

(a) Find the **mean** and **covariance** function for the $\{Y_t\}$ process.

(b) Show that the **autocorrelation function** for the $\{Y_t\}$ process depends only on the time lag. Is the process $\{Y_t\}$ **stationary**?

(c) Is it possible to have a time series with a constant mean and with $Corr(Y_t, Y_{t-k})$ free of t but with $\{Y_t\}$ **not stationary**? Why or why not?

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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*3+4+2=18 points) The data file "oil.price" in *R* package TSA contains **monthly** spot **price for crude oil** in Cushing, Oklahoma in the USA (in US dollars per barrel) from January 1986 to January 2006.

   Using this data to conduct some appropriate *R* analyses to answer the following questions

   a)Describe the data in regards to the following:

   i) Trends: _____

   ii) Seasonality: _____

   iii) Independence: _____

   b) Conduct a simple linear regression analysis of oil.price on time. Report the following:

   i) R^2 = _____

   ii) The estimated regression model is_____

   ii) Normality of the residuals: _____

   c) Do the residuals of the regression model support the other model assumptions?

   d) Are the residuals of the regression model white noise?

5. (6+4=10 points).The data file "oilfilters" contain monthly wholesale specialty oil filter sales of Deere & Co from July 1983 to June 1987. Do the appropriate R analysis to answer the following questions.

a) Complete the **missing information** in the R analysis **output below**

Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
January		355.6	15.481	< 2e-16 ***
February	5361	355.6	15.074	< 2e-16 ***
March	2978	355.6	8.374	5.68e-10 ***
April	4591.5	355.6	12.911	4.48e-15 ***
May	3705.5	355.6	10.419	2.05e-12 ***
June	3404.2	355.6	9.572	1.97e-11 ***
July		355.6	8.722	2.10e-10 ***
August	2676.8	355.6	7.527	6.77e-09 ***
September	2271.8	355.6	6.388	2.11e-07 ***
October	2470.2	355.6	6.946	3.87e-08 ***
November		355.6	6.125	4.73e-07 ***
December	2409	355.6	6.774	6.51e-08 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: [ ] on 36 degrees of freedom

Multiple R-squared: [ ] , Adjusted R-squared: 0.9614

F-statistic: [ ] on 12 and 36 DF, p-value: < 2.2e-16

b) Describe the **residuals** in regards to the following:

i) Trends: _____

ii) Seasonality: _____

iii) Independence: _____

iv) Normality: _____

6. (4+2+2+2=10 points) The data file "oilfilters" contain monthly wholesale specialty oil filter sales of Deere & Co from July 1983 to June 1987. Do the appropriate R analysis to answer the following questions.

a) Complete the **missing information** in the R analysis **output below**

Coefficient	**Estimate**	**Std. Error**	t-**value**	$Pr(>\|t\|)$
Intercept	3387.8	148.8	22.761	< 2e-16 ***
$\cos(2\pi t)$		210.5	2.736	0.00886 **
$\sin(2\pi t)$		210.5	4.668	2.76e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: [ ] on 45 degrees of freedom

Multiple R-squared: [ ], Adjusted R-squared: 0.3672

F-statistic: 14.64 on 2 and 45 DF, p-value: 1.268e-05

b) Explain why R^2_{adj} is smaller for this model compared with the model in question 5 above.

c) Compute the estimate for Φ and interpret this quantity

d) Compute the estimated **amplitude** for this model.

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