FE5209/FE5209D

NATIONAL UNIVERSITY OF SINGAPORE

FE5209/FE5209D FINANCIAL ECONOMETRICS

Semester: AY2014/15

Time Allowed : Two and A Half Hours

INSTRUCTIONS TO STUDENTS

1. Please write only your student number below. **Do not write your name.**
2. This booklet contains **two (2) Sections** and comprises **EIGHT (8)** printed pages.
3. Answer **ALL** questions. This is an OPEN Book examination.
4. Write legibly. A dark pencil may be used.
5. Graphic calculators or other calculators may be used.
6. Write your answers in the spaces provided after each part of a question, except that answers to Section A must be circled.
7. Plan your answers to ensure they fit within the spaces provided. Other than this cover page and the spaces designated for providing your answers, you may do your “rough work” anywhere. Whatever you write outside of the answer spaces will be ignored.

Write your SEAT NUMBER and MATRICULATION NUMBER below.

Seat No:

Matriculation No :

Question	Max	Marks
Section A	60	
Section B		
Question 1	20	
Question 2	20	
Total	100	

Section A (60 marks). Each question carries 6 marks. Circle the most appropriate answer.

1. Consider the variance of the slope coefficient in regression analysis. Which of the following statement(s) is (are) true?
   (i) The variance of slope is positively related to the variance of residuals.
   (ii) The variance of slope is negatively related to the variance of the explanatory variable.
   (iii) The variance of slope is negatively related to the sample size.
   (iv) The variance of slope gives a measure of the precision of the coefficient estimate.

   A. (ii) and (iv) only
   B. (i) and (iii) only
   C. (i), (ii), and (iii) only
   D. (i), (ii), (iii), and (iv)

2. Consider two regression models:
   Model 1: $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \epsilon_t$
   Model 2: $Y_t = \alpha_0 + \alpha_1 X_{1t} + \alpha_2 X_{2t} + \alpha_3 X_{3t} + w_t$
   Which of the following statements are true?
   (i) Model 2 has a larger R^2 than Model 1.
   (ii) Model 2 has a larger adjusted R^2 than Model 1.
   (iii) Models 1 and 2 have an identical value of R^2, if the estimated coefficient on α_3 is zero.
   (iv) Models 1 and 2 have an identical value of adjusted R^2 , if the estimated coefficient on α_3 is zero.

   A. (ii) and (iv) only
   B. (i) and (iii) only
   C. (i), (ii), and (iii) only
   D. (i), (ii), (iii), and (iv)

3. We conduct an analysis of weekly interest-rate data. The change of AAA Bond rate (aaa_dif) is the dependent variable. The change of the 30-year Treasury rate (cm30_dif) and the change of the Federal funds rate (ff_dif) are the predictors. We consider two models, with either one or two predictors respectively. The ANOVA output is displayed as follows, where some numbers are missing.

Analysis of Variance Table
Model 1 : aaa_dif ~ cm10_dif
Model 2: aaa_dif ~ cm10_dif + cm30_dif + ff_dif

	Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
1	297	2.0772				
2	295	1.9136	?	?	12.614	5.542e-06 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Which of the following statement is true?

A. The mean sum of square $MS(II|I)$ is 0.16. We choose Model 1 as the F test statistic is significant.
B. The mean sum of square $MS(II|I)$ is 0.16. We choose Model 2 as the F test statistic is significant.
C. The mean sum of square $MS(II|I)$ is 0.08. We choose Model 1 as the P value is less than 5%.
D. The mean sum of square $MS(II|I)$ is 0.08. We choose Model 2 as the P value is less than 5%.

4. Consider the following AR(1) model:

$$x_t = 0.2 + 0.8x_{t-1} + \epsilon_t, \qquad \epsilon_t \sim IID\ N(0, \sigma_\epsilon^2)$$

Which of the following statements are correct?
(i) $E[x_t|x_{t-1}] = 0.2 + 0.8x_{t-1.}$
(ii) $E[x_t] = 1.$
(iii) $Var[x_t|x_{t-1}] = \sigma_\epsilon^2.$
(iv) $Var[x_t] = 5\sigma_\epsilon^2.$
(v) $Var[x_t|x_{t-2}] = 1.64\sigma_\epsilon^2.$

A. (i), (ii) and (iii)
B. (i), (ii), (iii) and (v)
C. (ii), (iii), (iv) and (v)
D. None of the above.

5. A model of asset returns:

$$R_{t+1} = \sigma_{t+1}z_{t+1}, \quad z_{t+1} \sim IID\ N(0,1)$$
$$\sigma_{t+1}^2 = \omega + \alpha R_t^2 + \beta\sigma_t^2$$

After performing the maximum likelihood estimation, we obtain the estimators $\widehat{\omega} = 0.005$ with a standard error of 0.002, $\hat{\alpha} = 0.046$ with a standard error of 0.011 and $\hat{\beta} = 0.954$ with a standard error of 0.077. Moreover, the estimated covariance between $\hat{\alpha}$ and $\hat{\beta}$ is zero.
Which of the following statement is correct?
A. The volatility model is a stationary GARCH model, because the hypothesis that $\alpha + \beta = 1$ is rejected.
B. The volatility model can be reformulated as a classical RiskMetrics specification without intercept ω, in which $\sigma_{t+1}^2 = 0.041R_t^2 + 0.959\sigma_t^2$.
C. The parameter estimates imply that the conditional variance of the stock returns process may turn negative, which is clearly impossible.
D. None of the above.

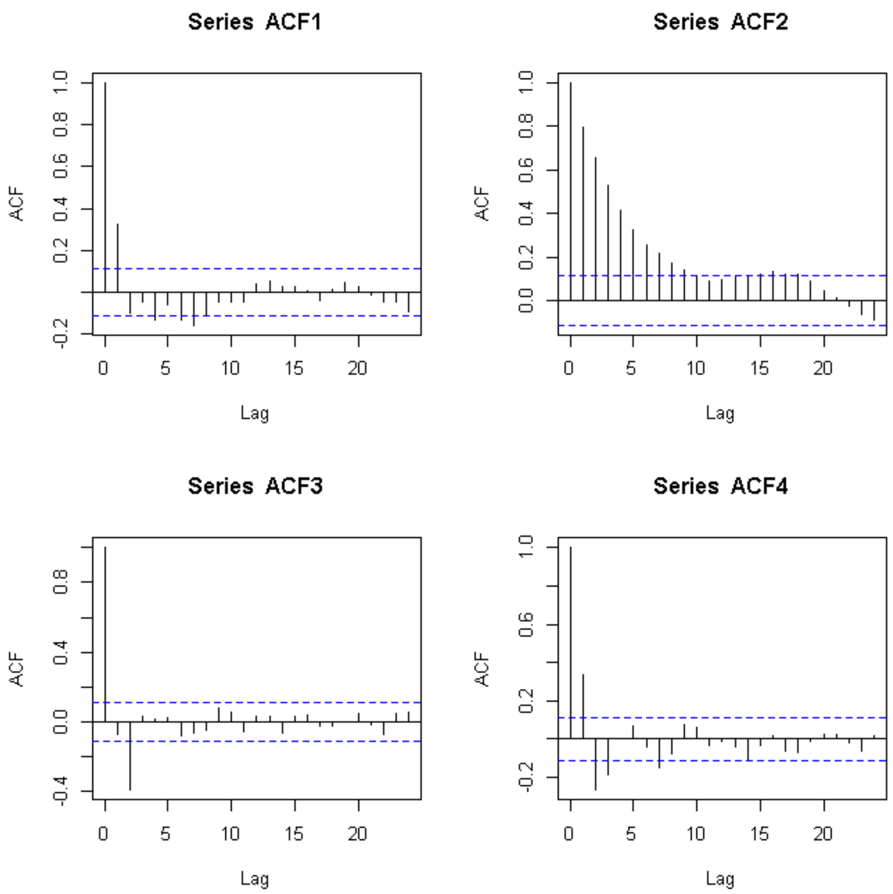
6. Suppose that the monthly log-earning of a company, denoted as x_t, follows the model

$$(1 - 0.7B - 0.1B^2)x_t = (1 - 0.3B - 0.7B^2)\epsilon_t, \quad \epsilon_t \sim IID\ N(0, \sigma_\epsilon^2)$$

Which of the following statement is correct?

A. The process is stationary, because its two roots are larger than 1 in magnitude. Its sample autocorrelations are similar to graph ACF1.

B. The process is non-stationary, because one root equals 1. Its sample autocorrelations follow graph ACF2.
C. The process is non-stationary, because its two roots are larger than 1 in magnitude. Its sample autocorrelations follow graph ACF3.
D. The process is stationary, because one root equals 1. Its sample autocorrelations follow graph ACF4.



7. A researcher is computing the sample autocorrelations of the daily log returns of a stock. The results are $\hat{\rho}_1 = 0.336$, $\hat{\rho}_2 = -0.267$, $\hat{\rho}_3 = -0.187$. Which statement is correct?

A. The Yule-Walker estimate of the sample PACF at lag order 1 is 0.66.
B. The Yule-Walker estimate of the sample PACF at lag order 2 is -0.27.
C. The Yule-Walker estimate of the sample PACF at lag order 2 is -0.43.
D. The Yule-Walker estimate of the sample PACF at lag order 3 is 0.75.

8. Which of the following statements are true concerning the Box-Jenkins approach to diagnostic testing for ARMA models?
(i) The Ljung-Box test tells whether the identified model is either too large or too small.
(ii) The Ljung-Box test checks the model's residuals for autocorrelation.
(iii) If the model is appropriate, the residuals are autocorrelated.
(iv) If the model is appropriate, an over-fitted model with additional variables will have statistically insignificant coefficients.

A. (ii) and (iv) only
B. (i) and (iii) only
C. (i), (ii), and (iii) only
D. (i), (ii), (iii), and (iv)

9. Suppose that $X_t = \left(X_{1,t}, X_{2,t}\right)^T$ follows a bivariate VAR(1) process:
$$\Delta X_{1,t} = -0.5X_{1,t-1} - X_{2,t-1} + \epsilon_{1,t}$$
$$\Delta X_{2,t} = -0.25X_{1,t-1} - 0.5X_{2,t-1} + \epsilon_{2,t}$$
Where $\epsilon_{1,t} \sim IID(0{,}0.25)$ and $\epsilon_{2,t} \sim IID(0{,}0.81)$.

A. X_t is stationary. $X_{1,t} + X_{2,t}$ is stationary.
B. X_t is not stationary. $X_{1,t} + 2X_{2,t}$ is stationary.
C. X_t is stationary. $X_{1,t} + 2X_{2,t}$ is not stationary.
D. X_t is not stationary. $X_{1,t} + X_{2,t}$ is not stationary.

10. Assume that portfolio daily returns are independently and identically normally distributed. Sam Neil, a new quantitative analyst, has been asked by the portfolio manager to calculate the portfolio Value-at-Risk (VaR) measure for 10, 15, 20 and 25 day periods. The portfolio manager notices something amiss with Sam's calculations displayed below. Which one of following VARs on this portfolio is inconsistent with the others?

A. VAR(10-day) = USD 316M
B. VAR(15-day) = USD 465M
C. VAR(20-day) = USD 537M
D. VAR(25-day) = USD 600M

Section B (40 marks). There are 2 questions.

Question 1. (20 marks)

Suppose that the quarterly log earning of company DeBIZ, denoted as x_t , follows the model

$$(1-L)(1-L^4)x_t = (1-0.57L)(1-0.18L^4)\epsilon_t$$
$$\epsilon_t = \sigma_t z_t \quad z_t \sim N(0,1)$$
$$\sigma_t^2 = 8.09\times 10^{-5} + 0.244\epsilon_{t-1}^2 + 0.711\sigma_{t-1}^2,$$

where L is the lag-operator and σ_t^2 are the conditional variance of ϵ_t.
Suppose that the last 5 log earnings, residuals, and volatilities are:

time	**96**	**97**	**98**	**99**	**100**
x_t	1.05	1.30	0.91	1.12	1.18
ϵ_t	0.0221	-0.0318	0.0010	-0.0108	0.0113
σ_t	0.03608	0.03416	0.03323	0.02951	0.02669

A. [10p]At the forecast origin $T = 100$, calculate the 1-step and 2-step ahead predictions of the log earnings and the 1-step and 2-step ahead volatility forecasts (not the variances).

\sigma=0.02487

B. [5p]Compute the unconditional variance of ϵ_t.

C. [5p]Also, let $y_t = (1-L)(1-L^4)x_t$. What is the mean equation for y_t conditional on the information available at time $t-1$?

Question 2. (20 marks)

Consider the daily log returns of IBM stock and the Bank of America Merrill Lynch AAA bond index. Let $\boldsymbol{r}_t = \begin{bmatrix} IBM_t \\ AAA_t \end{bmatrix}$ denote the 2-dimensional log returns, in percentages. The lag-1 sample cross-correlation matrix of $\boldsymbol{r}_t$ is

$$\boldsymbol{\rho}_1 = \begin{bmatrix} -0.0125 & 0.0263 \\ 0.0376 & 0.0546 \end{bmatrix}$$

A. [5p]Explain the meaning of each element of $\boldsymbol{\rho}_1$.

B. [10p] Based on AIC, a VAR(2) model is selected. The R output is displayed below. Write down the fitted model and justify the adequacy of the fitted model using multivariate Portmanteau test.

```
> mm1=VAR(rt,2)
Constant term:
Estimates:  0.02355837 0.01995118
Std.Error:  0.03377135 0.007399749
AR coefficient matrix
AR( 1 )-matrix
         [,1]   [,2]
[1,] -0.00679 0.0935
[2,]  0.01173 0.0680
standard error
        [,1]   [,2]
[1,] 0.02031 0.0933
[2,] 0.00445 0.0204
AR( 2 )-matrix
         [,1]    [,2]
[1,] -0.00037 -0.1438
[2,]  0.01039 -0.0208
standard error
        [,1]   [,2]
[1,] 0.02032 0.0931
[2,] 0.00445 0.0204
```

```
> resi=mm1$residuals
> mq(resi,lag=10)
Ljung-Box Statistics:
             m       Q(m)       df    p-value
 [1,]    1.0000     0.0220   4.0000      1.00
 [2,]    2.0000     0.0577   8.0000      1.00
 [3,]    3.0000     3.0115  12.0000      1.00
 [4,]    4.0000     6.0285  16.0000      0.99
 [5,]    5.0000    13.7578  20.0000      0.84
 [6,]    6.0000    15.3481  24.0000      0.91
 [7,]    7.0000    22.5133  28.0000      0.76
 [8,]    8.0000    32.9126  32.0000      0.42
 [9,]    9.0000    38.2431  36.0000      0.37
[10,]   10.0000    42.3941  40.0000      0.37
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C. [5p] Give two reasons for analyzing jointly multiple financial time series.

END OF PAPER