W1-2-60-1-6

JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

EXAMINATIONS 2017/2018

FOURTH YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN STATISTICS , BACHELOR OF SCIENCE IN ACTUARIAL SCIENCES

STA 2410/ STA 2420: FINANCIAL TIME SERIES AND RISK MEASUREMENT/ FINANCIAL TIME SERIES

DATE: AUGUST 2018 TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. *Answer questions ONE (section A) and any two questions in section B*
2. *Be neat and show all your workings*
3. *All questions except question one carry equal marks*

This paper consists of 5 printed pages

STACS Examination board 2017/2018

QUESTION ONE (30 MARKS)

(a) Discuss how volatility clustering is detected in a financial time series data [2 marks]

(b) Describe main features of financial time series [3 marks]

(c) The following output was obtained after fitting a GARCH (1,1)

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Call:
garch(x = hy, order = c(1, 1))

Model:
GARCH(1,1)

Residuals:
Min       1Q  Median      3Q     Max
-7.9714 -0.4211  0.1070  0.5783  3.8675

Coefficient(s):
Estimate   Std. Error   t value  Pr(>|t|)
a0 1.167e-05   1.227e-06    9.509   <2e-16 ***
a1 1.423e-01   5.712e-03   24.911   <2e-16 ***
b1 7.301e-01   1.908e-02   38.258   <2e-16 ***
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Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1  1


Diagnostic Tests:
Jarque Bera Test

data:  Residuals
X-squared = 5021.7, df = 2, p-value < 2.2e-16


Box-Ljung test

data:  Squared.Residuals
X-squared = 0.37276, df = 1, p-value = 0.5415
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(i) Write the model [1 mark]

(ii) Explain all the parameters involved [2 marks]

(iii) Calculate the unconditional variance of the innovations [2 marks]

(iv) Discuss the goodness of fit of the model

(g) Discuss the advantages of RiskMetrics in calculating VaR [2 marks]

(h) The sample standard deviation of the continuously compounded daily return of the KSH/U.S. dollar exchange rate was about 0.67% in january 2015. Suppose that an investor was long in in \$5 million worth of KSH/U.S. dollar exchange rate contract.

(i) Find the 5% VaR for a 1− day horizon of the investor. [3 marks]

(ii) Find the corresponding VaR for a 1− day horizon(30 days) [3 marks]

QUESTION TWO (20 MARKS)

(a) Discuss what is meant by ARCH effects and how they can be determined. [3 marks]

(b) Outline the steps involved in building a volatility model for an asset return series. [6 marks]

(c) Discuss the application of the extreme value approach to the calculation of VaR. [11 marks]

QUESTION THREE (20 MARKS)

(a) Given both geometric and arithmetic returns, which one would be your first choice to work with? Give reasons. [2 marks]

(b) Discuss the formulation of the following models:

(i) IGARCH [2 marks]

(ii) GARCH-M [2 marks]

(c) Consider a stationary GARCH(1,1) process $\{X_t\}$, given as

$$X_t = \sigma_t e_t$$

where $e_t \sim iidN(0,1)$ and independent of X_{t-1}

(i) Find the stationary variance of X_t [5 marks]

(ii) Comment on the values of $\alpha_1 + \beta_1$ [1 mark]

(iii) Find the $k-$period volatility forecast $\sigma^2_{t+k}(t)$ [4 marks]

(iv) Find the excess kurtosis of the process [4 marks]

QUESTION FOUR (20 MARKS)

(a) Let P_t and P_{t-1} be prices of an asset at days t and $t-1$ respectively. Suppose P_0 and P_T are prices of the asset at the first and last trading days of the year respectively, show that the yearly geometric returns are equal to the sum of daily geometric returns. [5 marks]

(b) With reference to the variable X_t, define mathematically a GARCH(2,2) model, stating the necessary conditions for the process to be covariance stationary. [2 marks]

(c) Write an R function that can be used to simulate a GARCH(2,2) process. Choose the parameters appropriately. [3 marks]

(d) Consider an ARCH(1) process $\{X_t\}$ given as

$$X_t = \sqrt{\beta_0 + \beta_1 X_{t-1}^2}\ e_t$$

where $e_t \sim iidN(0,1)$ and independent of X_{t-1}.

(i) Find the stationary variance of X_t, giving necessary conditions on β_0 and β_1 [5 marks]

(ii) Describe the estimation of ARCH(p) [5 marks]