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UNIVERSITY EXAMINATIONS 2022/2023

FOURTH YEAR, SECOND SEMESTER SPECIAL SUPPLEMENTARY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN STATISTICS

SMS 3460: FINANCIAL TIME SERIES AND RISK MANAGEMENT

DATE: JANUARY 2023 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Describe the approaches to compute the daily pricing volatilities of stock using the intraday transaction data. (4 Marks)

b) Describe two advantages of using the Perks over threshold (POT) method of extreme value theory over the tradition block maximum method. (4 Marks)

c) Show that the yearly arithmetic returns R is a product of daily arithmetic returns. r_t. (4 Marks)

d) State four weaknesses of an ARCH model. (4 Marks)

e) Define a simple GARCH (1,1) Model. (4 Marks)

f) Explain two assumptions made when using risk metrics methodology of calculating VaR. (4 Marks)

g) The most recent estimate of the daily volatility of an asset is 1.5% and the price of the asset at the close of trading yesterday was \$30.0. The parameter λ in the EWMA model is 0.94. Suppose that the price of the asset at the close of trading today is \$30.50. How will this cause the volatility to be updated by the EWMA model. (6 Marks)

QUESTION TWO (20 MARKS)

a) Describe the difference between strictly stationary processes and weakly stationary processes. (3 Marks)

b) Explain why weakly stationary multivariate normal processes are also strictly stationary. (2 Marks)

c) Show that the following bivariate time series process, $(X_n, Y_n)^t$, is weakly stationary:

$$X_n = 0.5X_{n-1} + 0.3Y_{n-1} + e_n^x$$

$$Y_n = 0.1X_{n-1} + 0.8Y_{n-1} + e_n^y$$

Where e_n^x and e_n^y are two independent white noise processes. (7 Marks)

d) Determine the positive values of c for which the process

$$X_n = (0.5 + c)X_{n-1} + 0.3Y_{n-1} + e_n^x$$

$$Y_n = 0.1X_{n-1} + (0.8 + c)Y_{n-1} + e_n^y$$

Is stationary. (8 Marks)

QUESTION THREE (20 MARKS)

a) Define and state the regularity conditions which must be satisfied for;

i. ARCH (M) (3 Marks)

ii. GARCH (M.S) (3 Marks)

b) State the risk metrics in its simplest from giving the assumptions made. (4 Marks)

c) The sample standard deviation of the continuously compounded daily return of the Ksh/US dollar exchange rate was about 0.53% in June 2007. Suppose that an investor was long in $1 million worth of Ksh/US dollar exchange rate contract. Find at 1% level of significance.

i. 1-day horizon of the investor (3 Marks)

ii. 1-month horizon of the investor (3 Marks)

iii. 1-year horizon of the investor (4 Marks)

QUESTION FOUR (20 MARKS)

Suppose that the quarterly log earnings of a company A follows the model

$(1-\beta)(1-\beta^4)x_t = (1-0.57\beta)(1-0.81\beta^4)a_t$

$a_t = \delta_t e_t \quad e_t \sim N(0,1)$

$\delta_t^2 = 8.09 + 10^{-5} + 0.244a_{t-1}^2 + 0.711\delta_{t-1}^2$

Suppose that the last 5 log earnings, residuals and volatilities are;

Time	**96**	**97**	**98**	**99**	**100**
x_t	1.05	1.30	0.90	1.12	1.18
a_t	0.0221	-0.0318	0.0010	-0.0108	0.0113
δ_t	0.03608	0.03416	0.3323	0.02951	0.02669

Consider the forecast origin T=100.

a) Calculate the 1-step and 2-step;

   i. Ahead predictions of the log earnings (6 Marks)

   ii. Ahead volatility forecasts (5 Marks)

b) i. Compute the unconditional standard error of a_t. (6 Marks)

   ii. Let $w_t = (1-B)(1-B^4)x_t$. What is the mean equation for conditional on information w_t available at time $t-1$. (1 Mark)

c) Determine two applications of VaR (Value at Risk) in making financial decision. (2 Marks)

QUESTION FIVE (20 MARKS)

a) State and explain Balkama-de-Haan and Pick and theorem. (4 Marks)

b) Consider the case of holding a long position of IBM stock valued at 10 million. Using the values given in the table below;

Threshold	Exceedance	Shape parameter K	By (Scale) In α	Location B
3.0%	184	-030516(0.088)	0.30807(0.12395)	4.73800(0.19151)
2.5%	334	-0.28179(0.06737)	0.31968(0.12065)	4.76808(0.18533)
2.0%	590	-0.19260(0.0436)	0.27917(0.09913)	4.84859(0.17255)

NB:

1. Numbers in parenthesis are standard errors.
2. Baseline time interval is 252 (1 year)
   i. Calculate 1 day horizon VaR for the tail probabilities of 0.05 and 0.01. (12 Marks)
   ii. Briefly explain the VaR results in relation to tail Behaviour. (4 Marks)