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UNIVERSITY EXAMINATIONS 2022/2023

FOURTH YEAR, FIRST SEMESTER SPECIAL SUPPLEMENTARY EXAMINATION
FOR DEGREE OF BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE

SMS 3463: FINANCIAL TIME SERIES

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

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Define the following terms
   i. One-period simple return (2 Marks)
   ii. Multi-period simple return (2 Marks)
   iii. Continuously compounded return (2 Marks)
   iv. Time varying volatility (3 Marks)
   v. Volatility clustering (3 Marks)
   vi. Portmanteau test statistic (3 Marks)
   vii. Lying and Box teact statistic (3 Marks)

b) State four characteristics of volatility that are commonly seen in asset returns. (4 Marks)

c) Give four weaknesses of ARCH models. (4 Marks)

d) Differentiate between extreme value theory and peak over threshold methods in estimation of quantiles. (4 Marks)

QUESTION TWO (20 MARKS)

a) The following data represents the number of people vaccinated in a certain town during a today programme.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
No. of people	404	600	502	408	308	400	400	306	402	404

i. Sketch a time plot (3 Marks)

ii. Using a smoothing coefficient of $W = 0.25$ and $W = 0.4$ exponentially smooth the series. (6 Marks)

iii. Plot the exponentially smoothed values of $W = 0.25$ and $W = 0.4$ using the same axis. (5 Marks)

iv. Find the exponentially smoothed forecast for Thursday (11^{th} days) when $W = 0.25$ and $W = 0.4$. (2 Marks)

b) i. Distinguish between exponentially weighted moving average ($EWMA$) and equally weighted average (EWA) approaches. (2 Marks)

ii. State two weaknesses of $EWMA$ and EWA. (2 Marks)

QUESTION THREE (20 MARKS)

a) given an $AR(1)$, $r_t = \phi_0 + \phi_1 r_{t-1} + e_t$ where $\{e_t\}$ is white noise $(0, \sigma_e^2)$ and given that r_t is weakly stationary find

i. $E(r_t)$ (2 Marks)

ii. $Var(r_t)$ (3 Marks)

iii. $Cov\ (r_t r_{t+h})$ (3 Marks)

iv. *ACF of* r_t (4 Marks)

b) Given an $AR(2) as r_t = -0.4r_{t-1} + 0.25r_{t-2} + e_t$ where $\{e_t\}$ is white noise find its $PACF$. (8 Marks)

QUESTION FOUR (20 MARKS)

a) Given an ARMA(1,1) model as $r_t - \phi_1 r_{t-1} = \phi_0 + e_t - \theta_1 e_{t-1}$ where $\phi_1 + \theta\{e_t\}$ is a white noise series $(0_1 \sigma_e^2)$. Find assuming that the process is stationary

i. $E(r_t)$ (3 Marks)

ii. $Var(r_t)$ given that $\phi_0 = 0$ (4 Marks)

iii. $ACF\ of\ ARMA(1,1)$ (4 Marks)

b) Given an $MA\ (I)$ model as

$r_t = c_0 + e_t - \theta_1 e_{t-1}$ where $\{e_t\}$ is a white noise $(0, \sigma_e^2)$ find

i. ACF at $lag\ 1$ (3 Marks)

ii. ACF at $lag\ 2$ (3 Marks)

iii. $Var(r_t)$ (3 Marks)

QUESTION FIVE (20 MARKS)

a) Suppose an $AR\ (2)$ process is given by $r_t = \mu + \phi_1 r_{t-1} + \phi_2 r_{t-2} + e_t$ where $\{e_t\}$ is a white noise. Find

i. One step ahead forecast (3 Marks)

ii. Two step ahead forecast (3 Marks)

iii. Three step ahead forecast (3 Marks)

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

i. $ARCH\ (M)$ (3 Marks)

ii. $GARCH\ (M,S)$ (4 Marks)

iii. $GARCH - M$ (4 Marks)