QP CODE: 25022332

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Reg No : ....

Name : ....

M.Sc DEGREE (CSS) SPECIAL REAPPEARANCE EXAMINATION, APRIL 2025

Third Semester

M.Sc BIOSTATISTICS

CORE - ST020302 - STOCHASTIC MODELS AND TIME SERIES ANALYSIS

2019 ADMISSION ONWARDS

E252E9ED

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Suppose that climate can be sunny(1) or rainy(2) or cloudy(3) with the following transition matrix,

$$P = \begin{bmatrix} 0.5 & 0.3 & 0.2 \\ 0.3 & 0.5 & 0.2 \\ 0.2 & 0.3 & 0.5 \end{bmatrix}$$

Write down the two step transition matrix and find the probability that $X_0=1$, $X_1=3$, $X_2=2$, where X_n is the climate on the n^{th} day.

2. What is a (i) periodic state (ii) absorbing state.

3. Distinguish between reducible and irreducible Markov chain.

4. Define a stochastic process with stationary independent increments.

5. Derive Kolmogrov differential equations.

6. Define a Poisson Process, stating the axioms.

7. Define subcritical and supercritical branching process.

8. Explain Box-Jenkins models

9. Define a moving average process.

10. Describe any two applications of Time series modelling in biostatistics.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Explain state space and parameter space giving examples.

12. A box contains two black balls and three red balls. A second box contains three blackballs and two red balls. At each stage one ball each is taken from both boxes and they are interchanged. Let X_n denote the number of red balls in the first box. Write down the state space and transition probability Matrix of the Markov chain $\{X_n ; n \geq 0\}$. Also find (i) $P(X_2 = 2 | X_0 = 3)$ (ii) $P(X_2 = 3 | X_0 = 3)$

13. Consider the process $\{Y_n\}$ where $Y_n = a_0X_n + a_1X_{n-1}$ where a_0 and a_1 are constants and $\{X_n\}$ for n=0,1,2,3…are i.i.d random variables with zero mean and finite common variance. Examine whether $\{Y_n\}$ is stationary.

14. Explain how birth and death process can be applied in queuing theory. Derive the stationary solution of an M|M|1 queue.

15. State and prove Elementary renewal theorem. What is its use?

16. What is an MA(q) model. Derive the autocorrelation function of MA(2) model.

17. Explain non-Gaussian time series modelling and its applications.

18. Explain non-Gaussian time series models and their needs.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Describe an example of a countable state Markov chain. Write down its state space and transition matrix.

20. a) Explain a pure birth process and obtain its distribution.
b) Explain a Yule –Furry process and obtain its distribution.

21. a) Define age, residual life time and total life. Derive the residual life time distribution of a Poisson process.
b) Derive the distribution of current life time in the case of a Poisson process.

22. Distinguish between AR and MA models. Also distinguish between ARMA and ARIMA models. How they are applied to a given time series data.

(2×5=10 weightage)