# QP CODE: 25022332

Reg No 2 ..... Name 1 .....

## **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,

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

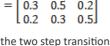
Write down the two step transition matrix and find the probability that  $X_0=1$ ,  $X_1=3$ ,  $X_2=2$ , where  $X_n$  is the climate on the n<sup>th</sup> day.

2.	What is a (i) periodic state (ii) absorbing stat
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- Distinguish between reducible and irreducible Markov chain. 3.
- Define a stochastic process with stationary independent increments. 4.
- Derive Kolmogrov differential equations. 5.
- Define a Poisson Process, stating the axioms. 6.
- 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  $\{X_n ; n \ge 0\}$ . 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  $Y_n = a_0 X_n + a_1 X_{n-1}$  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.
- 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)