2M3N21342 (Pages : 2) Reg. No:……………………..

Name: ………………………

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MST3C12 – Stochastic Process

(2019 Admission onwards)

Time: 3 hours Max. weightage : 30

PART A

Answer any four (2weightage each)

1. Define a Markov chain and its transition probability matrix. Show that the n-step t.p.m. is the n^{th} power of the one-step t.p.m.
2. Distinguish between transient and persistent states in a Markov chain.
3. Define a Poisson process and check whether it is stationary.
4. Explain a continuous time branching process with general variable lifetime.
5. Can a process with independent increments be stationary? justify your answer with an example.
6. Customers arrive at a service station according to a homogeneous Poisson process at the rate of 2 per minute. What is the probability that no customer arrives betwben 8.00 a.m. and 8.05 a.m. ? What is the mean number of customers arrived during 8.00 am and 12.00 noon
7. What is a queue ? Explain the basic elements of queues.

(4 x 2 =8weightage)

Part B

Answer any four (3 weightage each)

8. Distinguish between weak and strict stationary stochastic processes. Give an example for each case.

9. Let $\{X_n, n \geq 0\}$ be a Markov chain with the state-space {0, 1,2,3} and t.p.m.

$$\begin{bmatrix} 1/2 & 1/2 & 0 & 0 \\ 0 & 1/3 & 2/3 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 2/3 & 1/3 \end{bmatrix}$$

Classify all the states. Find the period of state 2 and of state 3.

10. Find the probability of ultlmate ruin of the Gambler, Gambler's ruin problem.

11. Show that $\{N(t), t \geq 0\}$ is a Poisson process if, and only if, the successive inter-arrival times form a sequence of i.i.d. exponential random variables.

12. Explain Birth and Death process. Obtain the limiting probabilities of the process, stating the condition for its existence.

13. If π is the probability of ultimate extinction of a Branching Process $\{X_n, n \geq 0\}$, with $X(0) = 1$ and m is the mean of the offspring distribution then show that $\pi = 1$ if and only if $m \leq 1$.

14. Show that in a queueing system, if interarrival times are exponentially distributed, the number of arrivals in a period of time is a Poisson process.

(4x3=12weightage)

PART C

Answer any two (5 weightage each)

15. Establish the chapman-Kolmogorov equation for a Markov chain with stationary transition probabilities, when the time domain is discrete. Also state the analogous version of identity in the continuous domain.

16. If $\{X_n, n \geq 0\}$ is a Galton-Watson Branching Process , P(s) is the probability generating function of the offspring distribution and $P_n(s)$ is that of X_n, show that $P_n(s) = P_{n-1}(P(s)) = P(P_{n-1}(s))$, and hence find the mean and variance of X_n.

17. What is a renewal process ? State and prove the elementary renewal theorem.

18. Describe M/M/l queueing system. Obtain the steady state distribution. Also obtain the expected number of customers in the system.

(2x5=10 weightage)

2M3N21341 (Pages : 2) Reg. No:............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MST3C11 – Applied Regression Analysis

(2019 Admission onwards)

Time: 3 hours Max. weightage : 30

PART A

Answer any four (2 weightage each)

1. Prove that least squares estimate of β in multiple linear regression model is an unbiased estimate of β .
2. What are Bonferroni t intervals?
3. Explain the generalized least squares procedure
4. Explain the role of hat matrix in the detection of influential observations.
5. Explain the test procedure for testing overall significance of a regression model.
6. Explain the term odds ratio.
7. Explain multicollinearity. How do we detect it?

(4×2 = 8 weightage)

PART B

Answer any four (3 weightage each)

8. State and prove Gauss Markov Theorem.
9. Describe the weighted least squares with known and unknown weights for a straight line model.
10 Explain the concept of orthogonal polynomials. Discuss the advantages of orthogonal polynomials in curve fitting.
11. What is autocorrelation? How do we detect it?
12. Let $Y_i = \beta_0 + \beta_1 X_{i1} + \epsilon_i$, i= 1,2,…,n, where $\epsilon_i \sim N(0, \sigma^2)$. Obtain the confidence intervals of β_0, β_1.
13. Explain the bias due to under fitting and its effect in the estimates of regression coefficients.
14. Describe Poisson regression model.

(4×3 = 12 weightage)

PART C

Answer any two (5 weightage each)

15. a) Explain the various probability plots to examine the normality assumption in regression analysis.

    b) State the assumptions in the multiple linear regression models. How are the departures from underlying assumptions identified using residual analysis.

16. a)Describe the situation where you come across estimation with linear restriction. Obtain the least squares estimate of β in the multiple linear model, when there is a linear restriction $A\beta = C$ where A is a known qxq matrix of rank q and C is a known qx1 vector.

    b) Explain the likelihood ratio test procedure in multiple linear regression model. Find out the likelihood ratio test statistic.

17. a)Explain the problem of ill conditioning in polynomial regression. Describe how orthogonal polynomials can be used to overcome the ill conditioning.

    b) Describe Non linear Regression model. Explain the parameter estimation procedure.

18. a)Describe the consequences of presence of autocorrelation in ordinary least square estimation? What are the remedial procedures to overcome these problems.

    b) Discuss about the outliers present in regression analysis. How to detect and dealing with outliers.

(2×5 = 10 weightage)

2M3N21344 (Pages : 2) Reg. No:............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MST3E05 – Lifetime Data Analysis

(2019 Admission onwards)

Time: 3 hours Max. weightage : 30

Part A

Short Answer Type questions

(Answer any four questions. Weightage 2 for each question)

1. Define type II censoring.
2. Define cumulative hazard function. Express survivor function in terms of cumulative hazard function
3. Briefly describe discrete mixture models
4. What is the Nelson- Aalen estimate of cumulative hazard function?
5. What do you mean by truncation? Explain.
6. Give the density function, hazard rate and survivor function of Weibull distribution.
7. What do you mean by log-location scale models?

(4 x 2= 8 weightage)

Part B

Short Essay Type/ problem solving type questions

(Answer any four questions. Weightage 3 for each question)

8. Discuss Kaplan Meier method for obtaining estimate of the survival function.
9. Explain the role of log-normal distribution in survival analysis. Obtain survivor function, hazard rate and discuss about monotone behaviors of log-normal distribution.
10. Explain the inference procedures for right censored data where the underlying model is exponential.
11. Discuss estimation of μ and σ^2 of lognormal distribution for samples without censored observation.
12. What is meant by residual function? Obtain its relationship with hazard rate. Also show that the mean residual life function uniquely determines the distribution.
13. Distinguish between accelerated failure time models and proportional hazards regression models.
14. Explain log-rank test.

(4 x 3= 12 weightage)

Part C
Long Essay Type questions
(Answer any two questions. Weightage 5 for each question)

15. Describe the general formulation of right censoring and also derive the likelihood function.
16. Discuss likelihood ratio test for comparing two survival distributions which follow exponential model with parameters λ_1 and λ_2 respectively.
17. Explain the inference procedure for censored data when the underlying distribution is gamma.
18. Explain inference procedures for accelerated failure time models.

(2 x 5= 10 weightage)

2M3N21343 (Pages : 2) Reg. No:.............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2021

MST3E02 – Time Series Analysis

(2019 Admission onwards)

Time: 3 hours Max. weightage : 30

Part A

(Answer any Four the questions. Weightage 2 for each question)

1. Define time series as a special case of stochastic process with example.
2. Define auto covariance function and derive auto covariance function of AR(1) process.
3. Obtain the autocorrelation function of moving average model of order 1.
4. Discuss the invertibility conditions of AR(1) and MA(1) models.
5. Describe any of the diagnostic checking methods in time series modelling.
6. Define the terms homoscedasticity and heteroscedasticity in the context of time series analysis.
7. Define the spectral density function.

(4 x 2=8 weightage)

Part B

(Answer any Four questions. Weightage 3 for each question)

8. Distinguish between moving average smoothing and exponential smoothing.
9. Explain the steps involved in Box-Jenkins methodology of time series modelling.
10. Explain the duality between AR and MA time series models.
11. Show that the AR(1) model with deterministic linear trend becomes equal to random walk with drift model in case autocorrelation coefficient $\varphi_1 = 1$.
12. Describe a method of parameter estimation of an AR(1) model.
13. For the MA(1) model $Z_t = a_t - 0.6a_{t-1}$, explain how its forecast for lead time $l = 1$ will be determined.
14. Find the spectral density function of an AR(1) process.

(4 x 3=12 weightage)

Part C

(Answer any TWO questions. Weightage 5 for each question)

15. Explain how will you test for trend and seasonality in a time series data.

16. Define ACF and PACF. How to identify time series models and its order using ACF and PACF?

17. A time series model is specified by $Z_t = 2aZ_{t-1} - a^2 Z_{t-2} + \varepsilon_t$, where ε_t is a white noise process with variance σ^2.

    i) Determine the value of 'a' for which the process is stationary.

    ii) Derive the autocovariances ν_k for $k \geq 2$.

18. Define an ARCH(p) model and obtain the ACF of squared ARCH(1) process.

(2 x 5=10 weightage)