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1M3N19228 (Pages : 2) Reg. No:.........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3B11 – Design and Analysis of Experiments

(2018 Admission onwards)

Time: 3 hours Max. Weightage: 36

Part A

Answer *all* questions. Each question carries 1 weightage

1. Define linear model and Give the normal equation and Estimate sum of square of the linear model Y = Aβ +e.
2. Distinguish between fixed effects model and random effects model .
3. Briefly explain the determination of sample size using operating characteristic curve
4. Why local control measure is not used in CRD.
5. Explain Student Newman-Keuls range test
6. How you apply experimentation principles for RBD..
7 Explain a Lattice design.
8 What is a balanced design and connected design.
9. Explain the Incidence matrix of a design.
10. Explain the advantages of Factorial design.
11. Distinguish between Symmetrical and Asymmetrical factorial
12. What do you mean by fractional factorial.

(12x1=12 Weightage)

Part B

Answer any *EIGHT* questions. Each question carries 2 Weightage

13. For the model $(Y, A\beta, \sigma^2 I)$ and $A = \begin{matrix} 1 & 1 & 0 \\ 1 & 0 & 2 \\ 1 & 1 & 0 \end{matrix}$ find all estimable functions and their best estimates.
14. What is model adequacy checking? Explain how you verify the constant variance assumption of a model.
15 Define Graeco. –Latin square design with an example. Give the linear model and ANOVA table.

16. Explain the estimation of a missing value in RBD.

17. How you compare two designs. Compare the efficiency of RBD with CRD.

18. Explain a Nonparametric method for ANOVA.

19. Define BIBD. Establish Fishers inequality for a BIBD with b blocks of size k, v treatments each replicated r times and any two pairs of treatments occur together in λ blocks .

20. Define PBIBD with2 associate classes with an example. Establish any two parameter relations.

21. Define Youden square. Give an example and give the ANOVA table of the design

22. Define main effect and interaction of Factorial design and give the expression for the interaction ABC for a 2^3 factorial with treatments A,B,C..Also find the expression for sum of squares of the main effects.

23. Give the layout and outline the ANOVA for a 2^4factorial with factors A,B,C,D in two replications in which ACD, BD are confounded

24. Explain one-half fraction of a 2^k design with an example. What is design Resolution give an example of a Resolution III design.

(8x2=16 Weightage)

Part C

Answer any TWO questions

Each question carries 4 Weightage

25 State the assumptions of a linear model and explain how you check the validity of the assumptions that should be satisfied by the model

26. Define concomitant variable. Develop complete analysis of Covariance (ANCOVA) with one concomitant variable for two way classified data

27 (i) Develop intra block analysis of BIBD.

(ii)Write explanatory note on CBD and IBD

28. Give the layout of a 2^5 factorial with AE, BD and BCD confounded . Identify the confounded effects and interactions . Outline the analysis of variance.

(2x4=8 Weightage)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3B12 – Testing of Statistical Hypotheses

(2018 Admission onwards)

Time: 3 hours Max. Weightage: 36

Part A

Answer all questions. Weightage1 for each question

1. Distinguish between type I and type II error. What do you mean by power of a test?
2. Define a) UMP test b) UMPU test.
3. What do you mean by the family of distributions having a monotone likelihood ratio (MLR)?
4. Define the concept of invariance in hypothesis testing.
5. State Generalized Neyman Pearson lemma.
6. Explain locally most powerful tests.
7. Define OC function of SPRT. Point out its uses.
8. Explain Sign test.
9. Describe likelihood ratio test.
10. Explain chi-square test for homogeneity.
11. Define UMP α-similar tests
12. Explain sequential estimation

(12 x 1 = 12 weightage)

Part B

Answer any 8 questions. Weightage 2 for each question.

13. Let X be normally distributed with $\sigma = 10$ and it is desired to test $H_0: \mu = 100$ $against$ $H_1: \mu = 110$. How large a sample be taken so that P(accepting $H_0 | H_1$ $is\ true$) = 0.02 and P(X ∈ $W | H_0$) = 0.05.
14. Let $X_1 and$ X_2 be two observations independently drawn from a population with density $(x, \theta) = \theta e^{-\theta x}$, $\theta > 0$. We reject $H_0: \theta = 1$ vs $H_1: \theta = 2$ if $X_1 + X_2 \leq 1.5$. Obtain power and size of the test.

15. Let $x_1, x_2, \ldots, x_n$ be a random sample each having density $f(x,\theta) = e^{-(x-\theta)}, \theta \epsilon R, x > \theta$. Find the MP test for testing $H_0: \theta = \theta_0 \; vs \; H_1: \theta = \theta_1 (\theta_1 > \theta_0)$.

16. Obtain a UMP test for testing $H_0: M \leq M_0 \; vs \; H_1: M > M_0$ based on a single observation from hyper geometric distribution having p.m.f.

$$f(x;m) = \frac{(MC_x)(N-MC_{n-x})}{NC_n}; \text{ x = 0,1,...M.}$$

17. Explain Bayesian hypothesis testing.

18. State and prove Wald's fundamental identity.

19. Construct the SPRT for testing H0:$H_0: \mu = o \; against \; H_0: \mu = 1$, where μ is the mean of normal population with σ=1.

20. Obtain the OC function with respect to the SPRT for testing $H_0: \lambda = \lambda_0 \; vs \; H_1: \lambda = \lambda_1$ based on observations from Poisson distribution at strength (α, β).

21. Distinguish between Chi – square tests and Kolmogorov Smirnov tests.

22. Show that the Kolmogorov- Smirnov statistics are distribution free for any continuous distribution function F.

23. Discuss Wilcoxen Signed – Rank test, and examine its consistency.

24. Explain the advantages of non parametric tests over parametric tests.

(8 x 2 = 16 weightage)

Part C

Answer any 2 questions. Weightage 4 for each question.

25. Let X be an observation in (0, 1). Find an MP size α test of $H_0: X \sim f(x) = 4x, if \; 0 < x < \frac{1}{2}, and = 4 - 4x \; if \frac{1}{2} \leq x < 1$, against $H_1: X \sim f(x) = 1 \; if \; 0 < x < 1$. Find the power of the test.

26. Let a random sample $X_1, X_2, \ldots, X_n$ has been drawn from a normal population $N(\mu, \sigma^2)$. Obtain a likelihood ratio test of H_0: $\sigma^2 = \sigma_0^2$ against H_1: $\sigma^2 \neq \sigma_0^2$ when population mean μ is known.

27. Derive the asymptotic distribution of the likelihood ratio statistic under the null hypothesis for testing a composite hypothesis with *r* degrees of freedom against a composite alternative with *n* (>*r*) d.f.

28. Describe the Mann Whitney U – test for two independent samples. Derive the relationship between the Wilcoxen statistic W and U – statistic and the expression for the mean and variance of U under the null hypothesis.

(2 x 4 = 8 weightage)

M3N19230 (Pages : 2) Reg. No:..........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3B13 – Multivariate Analysis – I

(2018 Admission onwards)

me: 3 hours Max. Weightage: 36

Section - A

Answer all questions. Each question carries one Weightage.

1. Find the mean vector and dispersion matrix of a random vector whose pdf is

$$f(x,y) = \frac{1}{2\pi} e^{-\frac{1}{2}(2x^2+y^2+2xy-22x-14y+65)}, -\infty < x, y < \infty$$

2. Describe the condition for independence of two quadratic forms in X, where X has a multivariate normal distribution, $N_p(0, \Sigma)$.

3. Describe singular multivariate normal distribution.

4. Given random samples of sizes N_1 and N_2 from two multivariate normal populations $N_p(\mu_1, \Sigma)$ and $N_p(\mu_2, \Sigma)$, describe the confidence region for $\mu_1 - \mu_2$ when Σ is known.

5. Write down the density function of Wishart distribution. What are its parameters?

6. Write down the distribution of sample generalized variance based on a random sample from a multi normal distribution.

7. Distinguish between partial correlation and multiple correlation.

8. Write down the distribution of sample partial correlation coefficient.

9. Define canonical correlation.

10. Write down Hotellings T^2 - statistic for testing the equality of mean vectors of two multivariate normal population with equal covariance matrix.

11. Bring out the relationship between Hotellings T^2 and Mahalanobis D^2 - statistics.

12. Let $\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} \sim N_3(0, \Sigma)$, where $\Sigma = \begin{pmatrix} 1 & 0.80 & -0.40 \\ 0.80 & 1 & -0.56 \\ -0.40 & -0.56 & 1 \end{pmatrix}$. Find the distribution of $X_1 + 2X_2 - 3X_3$.

$(12 \times 1 = 12)$

Section - B

Answer any eight questions. Each question carries 2 weightage.

13 Show that a random vector X has multivariate normal distribution if and only if every linear combination $l'X$ is univariate normal.

14 Derive the characteristic function of multivariate normal distribution.

15 Let $X \sim N_p(0, \Sigma)$ and C be a nonsingular matrix of order p. Prove that Y = CX$\sim N_p(C\mu, C\Sigma C')$.

16 Show that the sample mean vector and sample dispersion matrix based on a random sample of size N from $N_p(\mu, \Sigma)$ are independent.

17 If X$\sim N_p(0, \Sigma)$, prove that the quadratic form $X'AX$ has chi-square distribution with r degrees of freedom if and only if A is an idempotent matrix of rank r.

18 Derive the characteristic function of Wishart distribution.

19 Let $A \sim W_p(n, \Sigma)$ and with usual notation A is partitioned as $\begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}$. Define $A_{11.2} = A_{11} - A_{12}A_{22}^{-1}A_{21}$. Show that $A_{11.2} \sim W_q(n, \Sigma_{11.2})$.

20 Derive the sampling distribution of simple correlation coefficient.

21 What you mean by canonical variables? Describe the importance of canonical variables in multivariate analysis.

22 Let $X \sim N_p(\mu, \Sigma)$ and X is partitioned into two sub vectors $X^{(1)}$ and $X^{(2)}$, where $X^{(1)}$ contains the first q components of X and $X^{(2)}$ the remaining. Describe how do you test the independence of the sub vectors $X^{(1)}$ and $X^{(2)}$.

23 Discuss the problem of symmetry of multivariate normal distribution. How do you test the hypothesis that multivariate normal distribution is symmetric.

24 Write a short note on multivariate analysis of variance. (8×2=16)

Section - C

Answer any two questions. Each question carries 4 weightage.

25 Starting with the density of univariate normal distribution derive the density function of multivariate normal distribution. Identify the parameters of the multivariate density you derived.

26 Derive the maximum likelihood estimators of the parameters of the multivariate normal distribution. Check whether the MLE's are consistent and sufficient.

27 What is Fisher-Behren's problem? How do you solve this problem? Explain.

28 Define Hotellings T^2 statistic. Derive any three properties of Hotellings T^2 statistic. (2×4=8)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3E1(08) – Computer Oriented Statistical Methods

(2018 Admission onwards)

Time: 3 hours Max. Weightage: 36

PART-A

Answer all Questions

Weightage 1 for each question.

1. Write down a useful R command for inputting small data sets with components 2,5,1, 6, 5, 5, 4 and 1.
2. Write down the command for editing an already defined dataframe.
3. Write down the syntax for plotting a histogram.
4. Explain the output of the command solve(A,B).
5. What is the use of the attach( ) function?
6. Explain the syntax of 'if loop' in R.
7. Describe bootstrap estimation of standard error.
8. Explain the estimation of bias using Jacknife method.
9. Briefly explain the construction of bootstrap confidence interval.
10. Explain the Basic Concepts of EM algorithm.
11. Define a Kernel and state its properties.
12. Write a short note on non-parametric regression method.

(12 × 1 = 12 Weightage)

Section - B

Answer any eight questions. Each question carries 2 weightage.

13 Show that a random vector X has multivariate normal distribution if and only if every linear combination $l'X$ is univariate normal.

14 Derive the characteristic function of multivariate normal distribution.

15 Let $X \sim N_p(0, \Sigma)$ and C be a nonsingular matrix of order p. Prove that $Y = CX \sim N_p(C\mu, C\Sigma C')$.

16 Show that the sample mean vector and sample dispersion matrix based on a random sample of size N from $N_p(\mu, \Sigma)$ are independent.

17 If $X \sim N_p(0, \Sigma)$, prove that the quadratic form $X'AX$ has chi-square distribution with r degrees of freedom if and only if A is an idempotent matrix of rank r.

18 Derive the characteristic function of Wishart distribution.

19 Let $A \sim W_p(n, \Sigma)$ and with usual notation A is partitioned as $\begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}$. Define $A_{11.2} = A_{11} - A_{12}A_{22}^{-1}A_{21}$. Show that $A_{11.2} \sim W_q(n, \Sigma_{11.2})$.

20 Derive the sampling distribution of simple correlation coefficient.

21 What you mean by canonical variables? Describe the importance of canonical variables in multivariate analysis.

22 Let $X \sim N_p(\mu, \Sigma)$ and X is partitioned into two sub vectors $X^{(1)}$ and $X^{(2)}$, where $X^{(1)}$ contains the first q components of X and $X^{(2)}$ the remaining. Describe how do you test the independence of the sub vectors $X^{(1)}$ and $X^{(2)}$.

23 Discuss the problem of symmetry of multivariate normal distribution. How do you test the hypothesis that multivariate normal distribution is symmetric.

24 Write a short note on multivariate analysis of variance. (8×2=16)

Section - C

Answer any two questions. Each question carries 4 weightage.

25 Starting with the density of univariate normal distribution derive the density function of multivariate normal distribution. Identify the parameters of the multivariate density you derived.

26 Derive the maximum likelihood estimators of the parameters of the multivariate normal distribution. Check whether the MLE's are consistent and sufficient.

27 What is Fisher-Behren's problem? How do you solve this problem? Explain.

28 Define Hotellings T^2 statistic. Derive any three properties of Hotellings T^2 statistic. (2×4=8)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3E1(08) – Computer Oriented Statistical Methods

(2018 Admission onwards)

Time: 3 hours Max. Weightage: 36

PART-A

Answer all Questions

Weightage 1 for each question.

1. Write down a useful R command for inputting small data sets with components 2,5,1, 6, 5, 5, 4 and 1.
2. Write down the command for editing an already defined dataframe.
3. Write down the syntax for plotting a histogram.
4. Explain the output of the command solve(A,B).
5. What is the use of the attach( ) function?
6. Explain the syntax of 'if loop' in R.
7. Describe bootstrap estimation of standard error.
8. Explain the estimation of bias using Jacknife method.
9. Briefly explain the construction of bootstrap confidence interval.
10. Explain the Basic Concepts of EM algorithm.
11. Define a Kernel and state its properties.
12. Write a short note on non-parametric regression method.

(12 × 1 = 12 Weightage)

PART B

Answer eight Questions

Weightage 2 for each question.

13. Explain R programming as a statistical software and language.
14. What is a data frame in R ?
15. Explain the uses of rbind( ) and cbind( ) functions.
16. Explain the construction of an R function with an example.
17. Explain the use of histogram. Give the R command to draw the histogram.
18. Write a program in R to generate a one dimensional random walk process.
19. Describe the application of jackknife method in cross validation.
20. Explain the concept of bootstrap t-interval.
21. Explain bootstrap estimation of the bias and standard error of the correlation statistics.
22. Explain the solutions of likelihood equation using EM algorithm.
23. Explain the application of EM algorithm in incomplete data problems.
24. State the properties of Kernels.

(8 × 2 = 16 Weightage)

PART-C

Answer two Questions

Weightage 4 for each question.

25. Describe the use of plot function. Explain the meaning and effect of each of the arguments of the following R function plot( ).
26. Write down the syntax of the R function to draw a boxplot, explaining all its arguments. What are the informations that one can get from a boxplot?
27. Derive the EM algorithm for a finite normal mixture model.
28. Describe the various kernel density estimation methods.

(2 × 4 = 8 Weightage)

12

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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Statistics Degree Examination, November 2019

MSTA3E2(09) – Life Time Data Analysis

(2018 Admission onwards)

Time: 3 hours Max. Weightage: 36

Part A

(Answer ALL questions. Weightage 1 for each question)

1. Define discrete time hazard function and give the expression of survival function in terms of hazard function in discrete case.
2. Distinguish between censoring and truncation.
3. Explain mixture models in the context of survival analysis.
4. Define Nelson-Aalen estimate.
5. Describe the utility of probability plots in the analysis of lifetime data.
6. Describe a method of estimating hazard function.
7. Obtain an exact confidence interval for the parameter when the lifetimes follow exponential distribution.
8. What are threshold parameters? Mention the role of it in three parameter Weibull distribution.
9. What is accelerated lifetime model? Explain.
10. Describe a graphical procedure to check for proportional hazard function.
11. Define Lehman family of life distributions. Show that Cox proportional regression model belongs to this family.
12. Explain generalized Wilcoxon test.

(12 × 1 = 12 weightage)

Part B

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

13. Examine the monotone behaviors of Weibull distribution with survival function $\overline{F}(t)=\exp\{-(\lambda t)^{\alpha}\},\alpha,\lambda>0$.
14. Obtain the survival function and hazard function of log-logistic distribution and examine its monotone behaviours.
15. Distinguish between type II and progressive type II censoring. Obtain the likelihood function in each case, based on a random sample of size n.
16. Describe the inference procedures for right truncated data.

17. State and prove Greenwood formula.

18. List the different diagnostic plots that involve survival or cumulative hazard functions. Explain any one in detail.

19. Explain likelihood ratio tests procedure for comparing two exponential distributions.

20. Obtain the methods of construction of confidence intervals for the parameters of location-scale distributions.

21. Obtain the exact methods for Type 2 censored test plans based on exponential distribution.

22. What do you mean by partial likelihood? Describe the method of estimation of parameter vector β using partial likelihood.

23. Define accelerated failure time regression models and describe the inference procedures of it.

24. What are log-rank tests? Explain.

($8 \times 2 = 16$ weightage)

Part C

(Answer any two questions. Weighage 4 for each question)

25. (a) Discuss the role of lognormal distribution in survival studies.

(b) Consider a gamma distribution with pdf $f(t) = \dfrac{\lambda(\lambda t)^{k-1} e^{-\lambda t}}{\Gamma(k)}; \lambda, t > 0$. Show that the hazard function for this distribution is strictly monotone increasing if $k > 1$ and strictly monotone decreasing if $k < 1$. In both the cases, show that $\lim_{t \to \infty} h(t) = \lambda$, where $h(t)$ denote the hazard function.

26. Derive the Kaplan-Meier product limit estimator and discuss its properties.

27. Explain the likelihood-based inference procedures when random sample of lifetimes follow Weibull distribution.

28. Describe the procedure for comparing two or more life distributions using proportional hazard model.

($2 \times 4 = 8$ weightage)