1M3N18228 (Pages : 2) Reg. No:......................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2018

MSTA3B11- Design and Analysis of Experiments

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Part A

(Answer **ALL** the questions. Weightage **1** for each question)

1. Distinguish between estimable and non-estimable parametric functions in linear models.
2. What is 'local control'? How does it help to increase the efficiency of a design?
3. State the basic assumptions for the Kruskal-Wallis Test for a completely randomized design.
4. Distinguish between complete and incomplete block designs and provide an example to each.
5. State a necessary and sufficient condition for a block design to be connected.
6. Define an Orthogonal Latin Square.
7. What are the objectives and rationale behind the technique of ANCOVA?
8. What is an incomplete block design? Give an example.
9. What is a PBIBD with two associate classes?
10. What are the advantages of factorial designs?
11. What is the role of 'confounding' in design of experiments?
12. Give an example situation where the split-plot design is appropriate.

(12 x 1 = 12 Weightage)

Part B

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

13. Explain the purpose of design of experiments and mention the characteristics of a good experimental design.
14. What are replication and local control? How do they increase the efficiency of an experiment?
15. Present a brief account of Kruskal-Wallis test, stating clearly the underlying problem.
16. Discuss the advantages of RBD over CRD.
17. Describe the linear model used in the analysis of data from Latin Square Design (LSD). Based on the model, present an outline of the ANOVA-table specifying the sources of variations, sum of squares, degrees of freedom and F-ratio.

18. Say true or false and justify your answer: 'Analysis of covariance improves the precision of the experiment'.
19. Explain a method for the construction of BIBD.
20. What are factorial experiments? Present the blocks of a 2^3 factorial design confounding the highest interaction effect.
21. Prove that in a PBIBD with two associate classes (in the usual notation),

$$\text{(i)}\ \sum_{i=1}^{2} n_i \lambda_i = r(k-1) \text{ and } \text{(ii)}\ n_i p_{jk}^{\ i} = n_j p_{ik}^{\ j}.$$

22. Discuss the salient features of fractional factorial designs.
23. Explain the concept of fractional factorial design with a suitable example.
24. Explain the situations in which you would recommend the use of split plot design. Write down the ANOVA table for a split plot design with m main plots treatments and n subplots treatments with a RBD layout for main plot treatments.

(8 x 2 = 16 Weightage)

Part C

(Answer any **TWO** questions. Weightage **4** for each question)

25. Describe the basic principles of experimentation and explain their need with examples. How are these principles implemented in LSD?
26. a) Define a Graeco-Latin square Design. Present a 5x5 Graeco-Latin square arrangement involving Graeco and Latin letters.

    b) Explain the ANCOVA in the case of a RBD with one concomitant variable.
27. What is a Youden Square Design? Carry out its analysis under the general row-column setting, bringing out the information matrix pertaining to the estimation of treatment effect and the AVOVA table.
28. Consider the set-up of a 2^5 factorial experiment in which we want to divide the total treatment effects into 2^3 groups by confounding three effects AD, BE and ABC. Identify the generalized interactions and obtain the arrangement of the treatments in blocks. Outline the analysis of variance in case of these confounded effects.

(2 x 4 = 8 Weightage)

1M3N18229 (Pages : 2) Reg. No:......................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2018

MSTA3B12- Testing of Statistical Hypothesis

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

PART A

Answer all questions Weightage 1 for each question

1. Define (a) type I and type II errors and (b) significance level.
2. Explain Monotone Likelihood Ratio property.
3. Define UMP test.
4. Define Locally Most Powerful Unbiased test.
5. Explain Bayesian test.
6. Explain similar tests and unbiased tests.
7. Describe sequential test procedure.
8. Define the OC function of SPRT.
9. Give advantages of SPRT over fixed sample tests.
10. Define Kolmogorov –Smirnov two sample test procedure.
11. Describe signed rank test.
12. Describe Likelihood ratio test.

(12 x 1 =12 Weightage)

PART- B

Answer any 8 questions. Weightage 2 for each question.

13. State and prove Neyman –Pearson fundamental lemma.
14. Find UMP size α test for testing $H_0 : p<p_0$ based on n observations from Bernoulli distribution with probability of success p.
15. Establish the relation between similar region tests and Neyman structure tests.
16. Describe how LMP tests are derived.
17. Define a consistent tests and show that Likelihood ratio tests are always consistent.
18. Explain invariance property in testing of hypothesis.
19. Explain Wilcoxon's test for randomness.
20. Explain Spearman's rank correlation coefficient.

21. Develop Mann-Whitney U test.
22. Show that SPRT terminates with probability one.
23. Derive the fundamental identity in SPRT.
24. Describe SPRT for testing $H_0 : \lambda=\lambda_0$ against $H_1 : \lambda =\lambda_1$ from Poisson distribution.

(8 x 2 =16 Weightage)

PART C

Answer any 2 questions. Weightage 4 for each question.

25. State and prove Karlin – Rudin theorem.
26. Derive the asymptotic distribution of Likely hood ratio tests by stating the assumptions, if any.
27. (a) Obtain mean and variance of Kolmogorov –Smirnov test statistic $D+$
    (b) Explain Median test for testing equality of location parameters of two population.
28. (a) Establish the economy of SPRT when compared to a fixed sample size test with the help of a suitable example.

    (b) Derive the SPRT for testing $H_0 : \mu =1$ against $H_1: \mu = 2$ when X follows $N(\mu, 1)$ at strength $\alpha =\beta = .01$.

(2 x 4 = 8 Weightage)

1M3N18230 (Pages : 2) Reg. No:........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2018

MSTA3B13- Multivariate Analysis

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section - A

Answer all *questions.*

Each question carries 1 weightage.

1. Let $X_1, X_2 \sim N(0,1)$, and $Y_1 = X_1 + X_2$, $Y_2 = X_1 - X_2$. If $\underline{Y} = \begin{pmatrix} Y_1 \\ Y_2 \end{pmatrix}$ find the covariance matrix of Y.
2. Distinguish between singular and non- singular multinormal distributions.
3. If $\underline{X} \sim N_p(0, \Sigma)$, identify the condition under which you can determine the distribution of the quadratic form $X'AX$.
4. Describe how do you test $H_0 : \mu = \mu_0$ based on a random sample of size N from $N_p(\mu, \Sigma)$, when Σ is known .
5. What is generalized variance ? Write down the distribution of sample generalized variance.
6. Find the mean vector of the bivariate normal whose probability density function is
$$f(x,y) = \frac{1}{2\pi} exp[-\frac{1}{2}(2x^2 + y^2 + 2xy - 22x - 14y + 65)], -\infty < x, y < \infty.$$
7. Define regression function? How do you get regression function from conditional distribution, explain?.
8. Write down the distribution of sample simple correlation coefficient in the null case.
9. What are canonical variables ? Explain.
10. Write down the two sample Hotelling's T^2- statistic describing each term you use.
11. Bring out the relationship between Hotelling's T^2 and Mahalnobis D^2- statistics.

12. Describe any two uses of Mahalnobis D^2- statistic.

(12×1= 12 weightage)

Section - B

Answer any 8 questions.

Each question carries 2 weightage.

13. Derive the characteristic function of non- singular multinormal distribution.

14. Let $X \sim N_4(\mu, \Sigma)$ where $\mu' = (1, b, c, d)$ and $\Sigma = \begin{pmatrix} 1 & \rho & \rho & \rho \\ \rho & 1 & \rho & \rho \\ \rho & \rho & 1 & \rho \\ \rho & \rho & \rho & 1 \end{pmatrix}$ and $X' = (X_1, X_2, X_3, X_4)$.

    Obtain the marginal distribution of $(X_1, X_2)'$ and the conditional distribution of $(X_1, X_2)'$ *given* $(X_3, X_4)' = (x_3, x_4)'$.

15. If $X \sim N_p(\mu, \Sigma)$ where μ and Σ are known parametres, derive the distribution of $(X-\mu)'\sum^{-1}(X-\mu)$.

16. Derive the MLE of the parameter Σ when a random sample of size N is given from $N_p(\mu, \Sigma)$ where μ is known.

17. What are the properties of Wishart's distribution?

18. Describe how do you test the hypothesis $H_0 : \mu_1 = \mu_2$ given samples of sizes N_1 and N_2 from $N_p(\mu_1, \Sigma)$ and $N_p(\mu_2, \Sigma)$ respectively when Σ is known.

19. Derive the null distribution of simple correlation coefficient.

20. What are canonical variables. Describe their importance in multivariate analysis.

21. Derive the distribution of sample partial correlation coefficient in the null case.

22. Derive the null distribution of Hotelling's T^2- statistic.

23. Describe how do you use Hotelling's T^2- statistic to test $H_0 : \mu_1 = \mu_2$ given two multinormal populations $N_p(\mu_1, \Sigma)$ and $N_p(\mu_2, \Sigma)$ when Σ is unknown.

24. Let $\underline{X} \sim N_p(\mu, \Sigma)$ where $\mu' = (\mu_1, \mu_2, ..., \mu_p)$ and Σ are unknown. Describe how do you test $H_0 : \mu_1 = \mu_2 = ... = \mu_p$.

(8×2= 16 weightage)

Section - C

Answer any 2 questions.

Each question carries 4 weightage.

25. a) Let $X_1, X_2, ..., X_n$ be a random sample of size n from the univariate normal distribution $N(\mu, \sigma^2)$. Using the result you studied in multivariate analysis, prove that $\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$ and $s^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$ are independent.

b) Find the mean vector and covariance matrix of a bivariate normal distribution whose pdf is

$$f(x, y) = \frac{1}{2\pi}\exp[-\frac{1}{2}(x^2 + y^2 + 4x - 6y + 13)], \ -\infty < x, y < \infty.$$

26. Derive the maximum likelihood estimators of the parameters of a non-singular multi-normal distribution. Check whether the estimators you derived are unbiased and consistent.

27. Define multiple correlation coefficient. Prove that it is the maximum correlation between a variable and a linear combination of a set of vectors when X is a multivariate random vector.

28. Define multivariate Fisher- Behren's problem. How do you solve this problem? Explain.

(2×4= 8 weightage)

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1M3N18231 (Pages : 2) Reg. No:……………………..

Name: ……………………….

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2018

MSTA3E(08) – Computer Oriented Statistical Methods

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

PART A

Answer all questions
Weightage 1 for each question

1. Why R is known as an open source software?.
2. If the vector x consists of first 5 prime numbers, then what is the output of the R command x[x > 4] ?
3. Explain how the R help commands can be utilized.
4. Illustrate the R control statement 'if ' .. *'else if...* ' with a suitable example .
5. The variable x represents the height of students and y represents their gender. Write an R command to draw a box plot for heights by gender.
6. Using any loop statement in R write a program that computes variance of first 100 natural numbers.
7. Discuss the concept of bootstrap sampling
8. Explain the concept of a jack-knife estimator.
9. Briefly describe the applications of jack-knifing in cross validation.
10. Explain why EM algorithm is very useful is solving likelihood equations.
11. Define a kernel and state its important properties.
12. What you mean by a non-parametric regression model?

(12 x 1 = 12 Weightage)

PART B

Answer any 8 questions
Weightage 2 for each question

13. Discuss various data inputting and data importing techniques in R?
14. With the help of an example, describe various steps involved in the construction of an R function.

15. Describe various aspects in the construction of a data frame in R. How vectors with missing observations or vectors with unequal size can be accommodated in data fame.

16. Distinguish between low level and high level plotting commands in R.

17. With the help of a suitable example describe how a user defined function can be created in R.

18. Write a program in R to generate a one dimensional random walk process.

19. With the help of an example, explain how bootstrapping can be used to estimate the sampling distribution of a statistic.

20. Discuss the use of bootstrap technique as a bias reduction tool.

21. Derive the Jackknife estimator for the sample variance.

22. Discuss the appealing properties of EM algorithm over other iterative algorithms.

23. Define kernel density estimator. Derive its bias and variance.

24. Explain how EM algorithm is useful in the computation of posterior density function.

(8 x 2 = 16 Weightage)

PART C

Answer any 2 questions
Weightage 4 for each question

25. With the help of suitable examples, describe the different operators used in R.

26. Explain the meaning and effect of each arguments of the following R function.
plot(x, y, type =, xlim =, ylim, main =, sub =, xlab =, ylab =, axes =, col =, bg =, pch =, cex =, lty =, lab =, lwd =)

27. Discuss the Bootstrap methods in the construction of confidence intervals and examine its asymptotic properties.

28. Derive the EM algorithm for a Gaussian mixture model.

(2 x 4 = 8 Weightage)

1M3N18231(A) (Pages : 2) Reg. No:.......................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester M.Sc Degree Examination, November 2018

MSTA3E2(09) – Life Time Data Analysis

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Part A

(Answer ALL the questions. Weightage 1 for each question)

1. What are the salient features of lifetime data?
2. Obtain the hazard rate when the lifetime has Gamma Distribution and comment on its ageing property.
3. Define a mixture model and point out its need in lifetime study.
4. Describe a method of estimating hazard function.
5. Explain the term 'censored observations'.
6. Offer your comments on the use of P-P plot in model diagnostics.
7. What are the approaches to regression modeling for lifetimes? Explain.
8. What is a model with threshold parameters? Give an example.
9. What is accelerated life model?
10. Suggest a graphical procedure to check for proportional hazard function.
11. Distinguish between fully parametric and semi-parametric regression for failure rate.
12. Narrate an example situation where lifetime study in the bivariate set up is required.

(12x 1=12 weightage)

Part B

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

13. Explain the notion of censoring in lifetime study. Distinguish between complete and censored samples, supported with illustrative examples.
14. When do you require discrete lifetime models? Explain the basic reliability concepts in this case.
15. Show that the hazard rate for the Poisson model with p.m.f.

    $P(x)=\dfrac{e^{-\lambda}\lambda^{x}}{x!}$, $x=0,1,2,\ldots$ $\lambda>0$ exhibits a monotonicity property.
16. Describe the progressive type 2 scheme of censoring used in lifetime data analysis.

17. State and prove the Greenwood formula for the variance of the KPML estimator.

18. What is a life table? Describe the standard life table methods.

19. Present a short note on 'reduced sample method' for life table.

20. Employing the maximum likelihood method, obtain the estimate of the parameter θ of the life distribution with pdf, $f(t)= (1/\theta) \exp\{-t/\theta\}$, $t>0$ $(\theta>0)$ under right censoring.

21. Give the physical interpretation of PH model and identify a model which belongs to this category.

22. Explain why Cox likelihood is called partial likelihood.

23. Bring out the relation between the PH model and accelerated life model.

24. Explain the linear rank test in accelerated life models.

(8 x 2 =16 weightage)

Part C

(Answer any TWO questions. Weightage 4 for each question)

25. Describe a continuous model for life time distribution, explaining the survival function, hazard rate and hazard function. Bring out the mutual relationship between these three elements.

26. Explain the Kaplan Meier Product Limit (KPML) estimator and mention itsimportant properties.

27. Discuss the inferential procedures for Weibull model with censored observations.

28. Derive the expression for the partial likelihood function and describe the test for significance of the regression coefficients in the Cox proportional hazard model, when there is a single covariate.

(2 x 4=8 weightage)