2M2M21442 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Degree Examination, March/April 2020

MST2C06 – Design & Analysis of Experiments

(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. Explain classification with equal and unequal number of observations per cell
2. Describe fixed effects and Random effects models.
3. Explain Complete block design, Incomplete block design, Balanced design and partially balanced design
4. Under What situation a BIBD reduces to RBD. With usual notations for a BIBD prove that $r(k-1) = \lambda(v-1)$.
5. What is the role of confounding in design of experiments. Write down the advantages of a factorial design.
6. Define split plot and give an advantage and a situation where this design is appropriate.
7. What is a response surface design. Define Rotatability?

(4 x 2= 8 weightage)

Part B
Short Essay Type/ problem solving type questions
(Answer any four questions. Weightage 3 for each question)

8. What is local control How does it help to increase the efficiency of a design. Explain the ANCOVA for completely randomized design.
9. What are the assumptions of a linear design model. Explain how you check(1) the constant variance assumption (2) Independence of error components.
10. Define BIBD and give an example. Establish the relation that for a BIBD the number of treatments is always greater than the block size. Explain any method for the construction of a BIBD.
11. Define PBIBD and derive the analysis of PBIBD with only two associate classes.
12. What is a 2^n factorial experiment? Define main effect and interaction. Develop the layout of a 2^4 factorial with 4 factors A,B,C,D in which ABCD and BCD are confounded.
13. Describe Yates procedure for Factorial experiments. Differentiate total and partial confounding.
14. Describe fractional factorial design. Explain the advantage of fractional factorial

(4 x 3= 12 weightage)

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

15. (a) Explain the randamisation procedure for LSD?

    (b)) Develop ANCOVA for one way classified data with one concomitant variable

    (c) Explain the estimation of a missing observation in RBD.

16. Describe the inter block analysis of BIBD. Establish Fishers inequality. Discuss the efficiency of BIBD relative to RBD

17. (a) Outline the analysis of a split plot design with r blocks, α main plot treatments a β subplot treatments.

    (b) Explain the confounding technique for 3^3 Design. Give the layout of a factorial in which AB^2 is confounded. For the following layout identify confound effects and explain the ANOVA table.

Block 1	000	110	220	201	121	102	212	022	0
Block 2	100	210	020	001	221	202	012	122	1
Block 3	200	010	120	101	021	002	112	222	2

18. Define orthogonality. Describe the method of steepest accent. Explain resolution of design.

(2 x 5= 10 weightag

2M2M21443 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester MSc Degree Examination, March/April 2021

MST2C07 – Estimation Theory

(2020 Admission onwards)

Time : 3 hours Max. Weightage : 30

PART A(Short Answer type)

(Answer any 4 questions. Weightage 2 for each question)

1. (a) Define ancillary statistic. Give an example of it
   (b) State Basu's theorem
2. Define (i) Loss function (ii) Risk function (iii) Bayes estimator
3. What is MLE. Give an example to show that MLE is not always unique
4. Give an example of a sufficient statistic which is not minimal sufficient
5. Explain interval estimation. What is meant by shortest confidence interval
6. Find a complete sufficient statistic of θ where $f(x,\theta) = \frac{1}{\theta}; \quad 0 < x < \theta$
7. What do you mean by Fisher information? Find the Fisher information of θ contained in the random sample $X_1, X_2, \ldots, X_n$ from $N(\theta, 1)$

(4 x 2 = 8 weightage)

PART B(Short Essay type questions)

(Answer any 4questions. Weightage3for each question)

8. Explain the method of moments. Find the estimators of n and p of a binomial distribution by the method of moments
9. Let $X_1, X_2, \ldots, X_n$ be random sample from$N(\mu, \sigma^2)$. Obtain the MLE of σ (i) when μ is known (ii) when μ is unknown
10. Examine whether there exist a minimum variance bound estimator for θ for the pdf

$$f(x,\theta) = \begin{cases} = \frac{1}{\theta} e^{\frac{-x}{\theta}}; \ x > 0, \ \theta > 0 \\ = 0; otherwise \end{cases}$$

11. Define one-parameter exponential family of distribution. Identify a distribution which is not a member of this family
12. If T is an unbiased and consistent estimator of θ, then show that
    (i) T^2 is a biased estimator of θ^2
    (ii) T^2 is a consistent estimator of θ^2

13. Describe the pivotal quantity method of constructing shortest confidence interval

14. Let $X_1, X_2, \ldots, X_n$ be random sample from $U(0, \theta)$, then compare the efficiency of tl estimators $\left(\frac{n+1}{n}\right) X_{(n)}$ and $2\bar{X}$, where $X_{(n)} = Max(X_1, X_2, \ldots, X_n)$ and $\bar{X} = \sum_{i=1}^{n} X_i$

(4 x 3 = 12 weightag

PART C (Long Essay type questions)

(Answer any 2 questions. Weightage 5 for each question)

15. (a) Define CAN estimator. Let $X \sim P(\lambda)$, find the CAN estimator of $e^{-\lambda}$.

    (b) Under regularity conditions to be stated, prove that MLE's are CAN estimators

16. (a) State and prove Lehmann-Scheffe theorem

    (b) Let $X_1, X_2, \ldots, X_n$ be random sample from $U(\theta - \frac{1}{2}, \theta + \frac{1}{2})$. Show that $T = (X_{(1)}, X_{(n)})$ is sufficient for θ but not complete.

17. Explain how Bayesian approach is different from the classical methodology in t theory of estimation. Let a random variable with pdf $f(x, \theta) = \frac{1}{\theta^n \lceil n} e^{-\left(\frac{x}{\theta}\right)}; x > 0, \theta > 0$ and the corresponding prior distribution of $\pi(\theta) = \frac{e^{-\left(\frac{1}{\theta}\right)}}{6\theta^5}; \theta > 0$. Find the posterior estimator of θ, Bayes estimator of θ usin squared error loss function

18. (a) Find a $100(1-\alpha)\%$ shortest length confidence for θ when $X \sim N(\theta, 1)$

    (b) Prove the invariance property of MLE

(2 x 5 = 10 weighta

2M2M21444 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Degree Examination, March/April 2021

MST2C08 – Sampling Theory

(2020 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 Sampling frame and Sampling unit.(b) Define SRSWR and SRSWOR, explain it with the help of an example.
2. Write down the conditions under which ratio estimator become BLUE.(b) Explain bias of Ratio estimator.
3. Estimate an unbiased estimator for population proportion in SRS.(b) Define regression estimator of population mean.
4. Show that regression estimator of population mean is not unbiased but consistent(b)What you mean by Sen-Medzano scheme of sampling.
5. Explain Durbin's πps sampling scheme(b) Derive the sampling variance of Horvitz-Thompson estimator for population total.
6. Define multistage sampling. (b) What are the different types of non-sampling errors.
7. Give an unbiased estimator of population variance based upon SRSWOR and prove your claim.

(4x2=8 weightage)

PART B
Short Essay Type / Problem solving type questions
(Answer **any four** questions. Weightage 3 for each question)

8 (a) Show that Sample mean is the BLUE of population mean in SRSWOR(b)Differentiate between Cumulative Total Method and Lahiri's method.

9. (a) What is deep stratification?(b)Explain linear systematic sampling and circular systematic sampling with the help of an example.

10. (a) What are the advantages of sampling over census?(b)What is Lottery method of sampling? (c)What are the basic principles of Sampling?

11. Show that $B(\hat{R})=((N-n)/(Nn\bar{x}^2)\{RSx^2-\rho SxSy\}$ in ratio estimation.(b) Explain Systematic sampling. What are the advantages of systematic sampling?

12. (a) Explain Regression estimators in stratified sampling.

    (b) Show that Var $(\overline{y_{sys}}) = \frac{N-1}{Nn}(1+(n-1)\rho)S^2$, where ρ is the interclass correlation between the units of the same systematic sample.

13. (a) Obtain an unbiased estimator of variance of sample mean in two-stage sampling with equal first stage units.(b) Show that the efficiency of cluster sampling increases as the size of the cluster decreases.

14. Explain the methods of allocation in stratified sampling and find efficiency of variances.

(4x3=12 weightage)

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

15. What are the principle steps in sampling?(b)Explain any two methods of determining the sample size in SRSWOR.

16. Give any three estimators of population mean in cluster sampling where clusters are of unequal size and discuss their properties.(b)What is the advantage of cluster sampling over simple random sampling.

17. Compute the gain due to PPS sampling with replacement compared to simple random sampling.(b)Prove that in PPS sampling without replacement, Desraj ordered estimator is unbiased for population total. Derive its sampling variance.

18. Show that $V(\overline{yRd}) = (\frac{1}{n'}-\frac{1}{N})S_y^2+(\frac{1}{n}-\frac{1}{n'})(S_y^2+R^2S_x^2-2RS_{yx})$ in double sampling ratio estimator.(b)Describe the situation in which two stage sampling is better than simple random sampling.

(2x5=10 weightage)

2M2M21445 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Degree Examination, March/April 2021

MST2C09 – Testing of Statistical Hypothesis

(2020 Admission onwards)

Time : 3 hours Max. Weightage : 30

PART A (Short Answer type)

(Answer any 4 questions. Weightage 2 for each question)

1. Define monotone likelihood ratio test.
2. Define UMP α similar test.
3. Explain invariance property in testing of hypothesis.
4. Discuss the general approach of likelihood ratio test.
5. Explain the advantages of non – parametric tests over parametric tests.
6. Define SPRT and OC function.
7. How do you determine the stopping bounds for SPRT?

(4 x 2 = 8 weightage)

PART B (Short Essay type questions)

(Answer any 4 questions. Weightage 3 for each question)

8. A sample of size 1 is taken from an exponential pdf with parameter θ, that is $G(1,\theta)$. To test $H_0: \theta = 1$ against $H_1: \theta > 1$, the test to be used is the nonrandomized test

$$\varphi(x) = \begin{cases} 1, if\ x > 2 \\ 0, if\ x \leq 2 \end{cases}$$

Find the size of the test. What is the power function?

9. For the pdf $f_\theta(x) = e^{-(x-\theta)}, x \geq \theta$, find the MP test of size α test of $\theta = \theta_0$against $\theta = \theta_1(\theta_1 > \theta_0)$, based on a sample of size n .
10. Explain most powerful (MP), uniformly most powerful (UMP) and uniformly most powerful unbiased (UMPU) tests with examples. Prove that MP tests are unbiased.
11. (a) Describe briefly Kolmogorov Smirnov test of goodness of fit in case of one sample.

    (b) Explain median test.
12. (a) Explain Spearman's rank correlation coefficient.

    (b) Explain χ^2 test for homogeneity.
13. State and prove Wald's fundamental identity.
14. Define ASN function. Let $X \sim P(\lambda)$, Consider $H_0: \lambda = \lambda_0$against$H_1: \lambda = \lambda_1(\lambda > 0)$. Derive SPRT and find ASN of the test.

(4 x 3 = 12 weightage)

PART C (Long Essay type questions)

(Answer any 2 questions. Weightage 5 for each question)

15. (a) Obtain the UMP test of level α for testing $H_0: \mu \leq \mu_1 \text{ or } \mu \geq \mu_2 \text{ vs } H_1: \mu_1 < \mu < \mu_2$ based on a random sample of size n from $N(\mu, \sigma^2)$ where σ is known.

(b) Let the distribution of a random variable X under H_0 and H_1 be given as

x	1	2	3	4	5	6
$f_0(x)$	0.01	0.01	0.01	0.01	0.01	0.95
$f_1(x)$	0.05	0.04	0.03	0.02	0.01	0.85

Find the best test of size 0.03 and also its power for testing $H_0: f = f_0 \text{ against } H_1: f = f_1$.

16. (a) Show that likelihood ratio tests are consistent under regularity conditions. State these conditions clearly.

(b)Obtain the likelihood ratio test for testing $H_0: \mu = \mu_0 \text{ vs } H_1: \mu \neq \mu_0$ based on a sample of size n from $N(\mu, \sigma^2)$, both $\mu \text{ and } \sigma^2$ are unknown.

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

18. (a) Derive the expression for O.C. function.

(b) Obtain the O.C. function for SPRT for testing $H_0: \sigma = \sigma_0 \text{ vs } H_1: \sigma = \sigma_1$ based on observations from $N(\mu, \sigma^2)$ at strength (α, β) where μ is known. Give the standard points of the O.C. curve.

(2 x 5 = 10 weightage)