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# FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Fourth Semester B.Sc Psychology Degree Examination, April 2022**

**BST4C08 - Statistical Techniques for Psychology**

(2019 Admission onwards)

Time: 2 hours

Max. Marks : 60

## SECTION-A

**Each question carries 2 Marks.**

**Maximum Marks that can be scored in this section is 20.**

1. Give the mathematical model for two-way ANOVA. Explain its terms.
2. What are the assumptions of ANOVA?
3. What is meant by post hoc test?
4. What does a goodness of fit test assess?
5. When is Yate's correction applied? Give the expression.
6. What is meant by a run?
7. How does Wilcoxon Rank Sum test differ from Sign test?
8. Which is the non-parametric alternative for ANOVA? Give its null hypothesis.
9. What are factorial experiments?
10. What is meant by interaction effect? Give the expression for interaction effect in a $2^2$ factorial design.?
11. What is meant by validity of a test score?
12. Define T score.

## SECTION-B

**Each question carries 5 Marks.**

**Maximum Marks that can be scored in this section is 30.**

13. How do you split total variations in one-way and two-way ANOVA?
14. Each toddler is told that he/she can select the toy of their choice. All toys are identical except for colour. The observed frequencies are as given below.

| | Red | Blue | Yellow | Green |
|---|---|---|---|---|
| Frequency | 13 | 9 | 15 | 3 |

Test if the population of toddlers are equally divided with respect to the colour preference.

15. While collecting data to test the effectiveness of vaccination against chicken pox, the following table was obtained, test whether the attack of virus is controlled by the vaccine or not.

| | Vaccinated | Not vaccinated |
|---|---|---|
| Attacked | 30 | 140 |
| Not attacked | 180 | 430 |

16. Explain one sample sign test.
17. The gender of arrival of applicants at a passport office is as follows:
MM FFF MMMM FF MMMMM FF MMMM FFF M. Test whether the gender of arriving customers is random at 5% level.
18. What are the characteristics of a good questionnaire?
19. Write a short note on scores of measurements.

**SECTION-C**

**(Answer *any one question and* carries 10 marks)**

20. The following table gives the yields of paddy in 30 plots. Test 1% level, whether the fertilizers are equal in their effect.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fertilizer 1 | 50 | 60 | 65 | 70 | 80 | 75 | 80 | 85 | 75 | 75 |
| Fertilizer 2 | 60 | 60 | 65 | 70 | 75 | 80 | 70 | 75 | 85 | 80 |
| Fertilizer 3 | 40 | 50 | 50 | 60 | 60 | 60 | 65 | 75 | 70 | 70 |

21. Explain the analysis of a $2^3$ factorial design.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Fourth Semester B.Sc Degree Examination, April 2022**

**BST4B04 – Testing of Hypothesis**

(2019 Admission onwards)

Time: 2.5 hours

Max. Marks : 80

## PART A
**Each question carries 2 marks**

1. Define significance level and power.
2. Distinguish between simple and composite hypothesis.
3. Define most powerful test.
4. What is a statistical hypothesis?
5. State clearly the theorem which is used to determine the best critical region for simple hypothesis at a given significance level.
6. Distinguish between standard deviation and standard error.
7. State the application of F distribution in tests of statistical hypothesis.
8. What are the conditions for using Chi square for testing agreement between theoretical frequencies and observed frequencies?
9. State two assumptions of ANOVA technique.
10. If the binomial frequencies 35 and 9 are expected to occur in the ratio 3:1, find the value of the Chi square statistic.
11. What is large sample test?.
12. Explain sequential analysis.
13. The production of lignite in India from 1975 to 1985 in Mn. Tonnes was

    3.03, 4.02, 3.58, 3.30, 2.90, 5.11, 6.31, 6.93, 7.30, 7.80, 8.03

    It is expected that the median production of lignite in India is 5 Mn. Tonnes/ year. To test $H_0: M = 5.0$, find the value of $T^-$ in Wilcoxen's signed rank test.
14. What are the advantages of non parametric test over parametric test?
15. How to resolve the problem of zero difference in sign test?

**Maximum Marks = 25**

## PART B
**Each question carries 5 marks**

16. If $X \geq 1$, is the critical region for testing $H_0 : \theta = 2$ against the alternative $H_1 : \theta = 1$, on the basis of a single observation from the population $f(x; \theta) = \theta e^{-\theta x}, x > 0$. Obtain the probabilities of type 1 and type 2 errors.

17. It is desired to test the hypothesis that 25 % of the articles produced by a machine are defective against the alternative that 50 % are defective. The test suggested was to take a sample of size 5 and reject the hypothesis if the number of defectives is greater than 1. What is (1) critical region (2) level of significance and (3) power of the test.
18. The average height of a sample of 400 college students is found to be 4.75 ft. The standard deviation of the population is believed to be 1.5. Does the data contradict the hypothesis that the mean height of students is 4.48 ft at 1% level of significance?
19. Develop the large sample test for testing the equality of proportions.
20. A random sample of 27 pairs of observations from a normal population gave a correlation coefficient of 0.6. Is this significant of correlation in the population?
21. Describe a procedure for testing the equality of variances of two normal populations.
22. Following is a sequence of heads (H) and tails (T) in tossing of a coin 14 times.

HTTHHHTHTTHHTH

Test whether the heads and tails occur in random order.

[Given : for $\alpha = 0.05$, $r_L = 2, r_U = 12$ ]
23. Explain median test.

**Maximum Marks = 35**

## PART C

**Each question carries 10 marks** (Answer any **TWO** Questions)

24. A sample of size N is taken from a binomial population with parameters $n$ and $p$ of which $n$ is known. Find the most powerful critical region for testing $p = p_0$ against $p = p_1$ $(p_1 > p_0)$.
25. 12 rats were given a high protein diet and another set of 7 rats given a low protein diet. The gain in weight in gms observed in the two sets are given below.

High protein diet: 13, 14, 10, 11,12, 16, 10, 8, 11, 12, 9, 12

Low protein diet: 7, 11, 10, 8, 10, 13, 9

Examine whether the high protein diet is superior to the low protein diet at 5 % level of significance.
26. A die was thrown 180 times. The following results were obtained.

| No. turning up | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Frequency | 25 | 35 | 40 | 22 | 32 | 26 |

Test whether the die is unbiased.
27. Explain Kruskal Wallis method of analysis for one way classification of data stating clearly the assumptions.

**2 × 10 = 20 Marks**

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# FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Fourth Semester B.Sc Mathematics Degree Examination, April 2022**

**BST4C04 – Statistical Inference and Quality Control**

(2019 Admission onwards)

Time: 2 hours

Max. Marks : 60

## SECTION-A

**Each question carries 2 Marks.**

**Maximum Marks that can be scored in this section is 20.**

1. How sufficiency is related to conditional distribution?
2. State any three assumptions of ANOVA.
3. Mention the test and the test statistic employed for testing whether population mean has a specified value in case of large samples.
4. Let $X_1, X_2, ..., X_n$ be a random sample of size $n$ taken from a population having mean $\mu$ and variance $\sigma^2$. Check the unbiasdeness of $T = \frac{X_1 + X_2 + ... + X_n}{n+1}$.
5. What makes a '$t$' test differed from Mann Whitney U test.
6. Distinguish between control chart for variables and attributes.
7. What is Median test?
8. Give an instance where test for proportion is suitable.
9. Define consistency of an estimator.
10. What is minimum variance bound estimator ?
11. Write down the model for two way ANOVA.
12. What is critical region?

## SECTION-B

**Each question carries 5 Marks.**

**Maximum Marks that can be scored in this section is 30.**

13. Explain how the sign test is used to compare two populations.
14. Derive the 95% confidence interval of the variance of a normal distribution.

15. A sample of 23 items was taken from a population with SD 9 and the sample mean is found to be 63. Can it be regarded as a sample from a normal population with mean $\mu = 60$ (use $\alpha = 0.05$)

16. What is analysis of variance and where is it used? Give two suitable examples

17. Hemoglobin levels of children under age 6 are distributed as normal population $N(\mu, 0.85)$. To test $H_0 : \mu = 12.3g/100ml$ against $H_A : \mu = 11.5g/100ml$, it is decided to reject null hypothesis, if $\bar{x} \leq 11.8$, where $\bar{x}$ is the sample mean of 25 samples. Find the significance level and power of the test.

18. In a sample of size n from a population with $N(\mu, 1)$ distribution, show that the sample mean is a sufficient estimator of $\mu$.

19. Explain the method of chi-square test for independence of attributes

## SECTION-C

**(Answer *any one* Question and carries 10 marks)**

20. The following data pertains to 6 samples of bolts tested for hardness

| Sample Number | Hardness rating | | | |
|---|---|---|---|---|
| 1 | 47.1 | 47.2 | 47.2 | 48.1 |
| 2 | 46.1 | 47.1 | 47.8 | 45.4 |
| 3 | 45.0 | 44.1 | 44.1 | 44.3 |
| 4 | 44.7 | 44.6 | 43.1 | 43.3 |
| 5 | 45.9 | 45.7 | 46.5 | 44.4 |
| 6 | 47.1 | 46.7 | 46.1 | 45.5 |

Calculate the control limits for averages and ranges and draw the control chart for $\bar{X}$ and $R$ charts.

(for $n = 4, A_2 = 0.73,\ D_4 = 2.28,\ D_3 = 0$)

21. (a) Distinguish between point estimation and interval estimation with examples

(b) Estimate a 95% confidence interval for $\mu$ based on 10 random samples 22, 25, 30, 21, 24, 26, 24, 28, 25, 26 taken from $N(\mu, 5)$.

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# FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Fourth Semester B.Sc Degree Examination, April 2022**

**BAS4C04 – Probability Models and Risk Theory**

(2019 Admission onwards)

Time: 2 hours Max. Marks : 60

## PART A (Short answers)

**Each question carries two marks. Maximum 20 marks**

1. Define zero-sum two player game.
2. Define risk function.
3. Obtain minimax strategy for player A and determine value of game.

**PLAYER A**

| PLAYER B | I | II | |
|---|---|---|---|
| 1 | -3 | 4 | |
| 2 | 3 | 2 | |

4. Obtain the mean and variance of claim random variable X where q=0.05 and claim amount fixed at 10.
5. Define two forms of proportional reinsurance.
6. The probability of a claim arising on any given policy in a portfolio of 1000 one- year term assurance policies is 0.004. Claim amounts have a Gamma (5,0.002) distribution. Find mean and variance of the aggregate claim.
7. Define compound Poisson distribution.
8. State two conditions that must hold for risk to be insurable
9. What is adjustment coefficient ?
10. Explain concept of ruin for risk model.
11. Define compound binomial distribution.
12. Define Convolution.

## PART B

**Each question carries Five marks. Maximum 30 marks**

13. The table below shows the payoff to player b in a 3 by 2 zero sum two person game.

| | Player A | | | |
|---|---|---|---|---|
| | I | II | III | |
| Player B | -2 | 3 | 9 | 1 |
| | 6 | 5 | 7 | 2 |

(i) Find the optimum strategies and the value of game if both players adopt pure strategy based on the minimax criterion

(ii) Explain what is meant by saying that strategies in(i) are equilibrium strategies

14. Derive distribution of reinsurance claim amounts on claims in which it is involved.

15. Show that sums of independent compound Poisson random variable is itself a Compound Poisson random variable.

16. A compound distribution S has claim number distribution

$$P(N=n) = 9\,(n+1)4^{(-n-2)},\ n=0,1,2\ \ldots$$

If the individual claim size distribution X is exponential with mean of 2, what are the values of E(S) and Var(S).

17. A compound distribution S is such that P(N=0) = 0.6 , P(N=1)=0.3 and P(N=2)=0.1 . Claim amounts are either for 1units or 2 units, each with probability 0.5. Derive the distribution function of S.

18. The number of claims from a portfolio of policies has a Poisson distribution with parameter 30 per year. The individual claim amount distribution is lognormal with parameters $\mu=3$ and $\sigma^2 = 1.1$.

The rate of premium income from portfolio is 1200 per year. If the insurer has initial surplus of 1000, estimate the probability that the insurers surplus at time 2 will be negative by assuming that the aggregate claims distribution is approximately normal.

19. Describe concept of probability of ruin in discrete time.

PART C

**Each question carries 10 Marks. Maximum 10 Marks**

0. An insurer has an excess of loss reinsurance arrangement in place with retention limit of 50. Claim amounts have a pareto distribution with parameter $\alpha$=2.5 and $\lambda$ =350.

   (i) Find the mean claim amount paid by the insurer.

   (ii) Find the mean claim amount paid by reinsurer on claims in which reinsurer is involved.

:1.

   (i) Explain concept of surplus process.

   (ii) Claims occur according to a compound Poisson process at a rate of ¼ claims per year. Individual claim amounts X have probability function

   P(X=50) =0.8

   P(X=100) =0.2

   The insurer charges a premium at the beginning of each year using 20% loading factor. The insurers surplus at time t is U(t). Find P[U(2)<0] if insurer starts at time 0 with surplus of 100.

**(1 x 10 =10 Marks)**