

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**

**II B.Sc. – Statistics/Semester- III (2020-21)**

**Paper -III**

**Course: STATISTICAL METHODS & INFERENCE**

**Total Hrs. of Teaching: 60@ 4 h / Week**

**Total Credits: 03**

**Objective:** In statistics, **statistical inference** is the process of drawing conclusions from data that are subject to random variation, for example, observational errors or sampling variation. Initial requirements of such a system of procedures for inference and induction are that the system should produce reasonable answers when applied to well-defined situations and that it should be general enough to be applied across a range of situations. Inferential statistics are used to test hypotheses and make estimations using sample data.

**Module-1 (15h)**

- a. **Curve fitting:** Principle of least squares, straight line, parabola, power curve, exponential curves.
- b. **Attributes:** Analysis of categorical data-Independence, association & partial association of attributes-Coefficient of contingency, coefficient of colligation-Problems on attributes.

**Module -2 (15h)**

- a. **Correlation:** Bi-variate data, scatter diagram, correlation coefficient & it's properties. Spearman rank correlation coefficient. Correlation ratio, multiple & partial correlation. Problems on correlation
- b. **Regression:** regression coefficient & it's properties. Regression line of x on y & y on x , correlation vs regression, problems on regression & correlation.

**Module-3 (15h)**

- a. **Exact sample distributions:** Concepts of population, parameter, sample, statistic, sampling, sampling distribution, standard error- sample mean and proportion, degrees of freedom
- b. **Chi square distribution:** Applications & properties.
- c. **Student's t-distribution:** Applications & properties.
- d. **F-distribution:** applications & properties.
- e. Inter-relations between chi square, t & F distributions: t & F distributions, F and Chi-square distributions.

**Module-4 (15h)**

**Theory of Estimation**

- a. **Criteria of good estimator:** Concept of unbiasedness, consistency, efficiency, sufficiency with examples-Problems on binomial, Poisson, normal, exponential distributions. Statement & theory of MLE & it's properties, Method of moments, Method of variance. Concept of interval estimation- confidence intervals

**Additional Input:** Multiple Regression (not included in examination)

**List of Text Books:**

- 1. V.K. Kapoor & S.C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

**List of Reference Books:**

- 1. Goon AM, Gupta MK, Das Gupta B: Outlines of Statistics, Vol-1, the World Press Pvt, Ltd, Kolkata.
- 2. Hoel P.G.: Introduction to Mathematical Statistics, New Delhi.

**List of Practicals: (3 hrs/week credits:2)****Conduct any SIX (MS-Excel mandatory)**

1. Fitting of straight line and parabola by the method of least squares.
2. Fitting of power curves of the type  $y = a x^b$ ,  $y = a b^x$  and  $y = a e^{bx}$  by the method of least squares.
3. Computation of correlation coefficient, forming regression lines for ungrouped data.
4. Computation of correlation coefficient, forming regression lines for grouped data.
5. Computation of multiple and partial correlation coefficients.
6. Computation of correlation ratio.
7. Practicals 1, 2, 3, 5 using MS-Excel

**Model blue print for the Question Paper setter****Paper-III: STATISTICALMETHODS & INFERENCE****Max. Marks: 60****Time : 2 ½ Hrs.**

Unit / Chapter name	Short Answer Questions	Essay Questions	Marks allotted to the Unit/Chapter
<b>Unit – 1</b>			
<b>Curve fitting &amp; Attributes</b>	1	2	25
<b>Unit – 2</b>			
<b>Correlation &amp; Regression</b>	2	2	30
<b>Unit – 3</b>			
<b>Exact Sample Test</b>	2	2	30
<b>Unit – 4</b>			
<b>Theory of Estimation</b>	1	2	25
-			
<b>Total No. of Questions including choice (14)</b>	6	8	-
<b>Total marks allotted to all questions including choice =</b>			<b>110</b>

## Statistics Paper–III: Statistical Methods & Inference

### Question Bank

#### SHORT QUESTIONS:

1. Define principle of least squares and write the procedure to fit a straight line.
2. Define attribute and explain association of attributes.
3. Explain the criteria of independence of attributes
4. Explain partial association.
5. Define correlation and write types of correlation.
6. Explain multiple correlation.
7. Explain partial correlation.
8. Explain correlation ratio.
9. Write the difference between correlation and regression.
10. Write the properties of regression.
11. Define i) Population ii) Parameter iii) Sample iv) Statistic v) Sampling distribution vi) Standard error.
12. Write the applications of t-distribution.
13. Explain method of moments
14. Explain the concept of Interval estimation..

#### ESSAY QUESTIONS:

15. Explain fitting of exponential curve and power curve.
16. Fit a second degree parabola for the following data.  
X 5 4 6 2 7 9 4  
Y 6 7 4 8 4 1 8
17. Show that  $Q = \frac{2Y}{1+Y^2}$ ?
18. Show that the correlation coefficient is independent of change of origin and scale
19. Derive the two regression lines.
20. Obtain rank correlation for the following data.  
X 45 55 52 71 84 66 74 42 49 58  
Y 48 52 74 65 71 44 85 78 54 65
21. Define chi square test and write it's properties.
22. Define t-test and write it's properties.
23. Define F-test and write it's properties.
24. Explain criteria of good estimator.
25. Explain MLE and write it's properties.
26. Prove that the sample mean is consistent estimator of population mean for normal population
27. Find MLE for the parameter of a Poisson distribution on the basis of random sample of size n.
28. Find MLE for the parameters of a Normal distribution on the basis of random sample of size n.

**P.R. Government College (Autonomous), Kakinada**  
**II year B.Sc., Degree Examinations - III Semester**  
**Statistics Paper–III: Statistical Methods & Inference**  
**Model Paper**

Time: 2 ½ Hrs.

Max. Marks: 60

**Section – A**

Answer Any Four of the following questions.

4x5 = 20 M

1. Define Correlation and Regression?
2. What is meant by principle of least squares and write the normal equations of parabola.
3. Define 1) standard error 2) Parameter 3) Sampling distribution
4. Write the properties and applications of t-distribution
5. Explain the criteria for good estimation ?
6. Write the concept of Interval estimation

**Section – B**

2x10 = 20 M

Answer Any Two of the following questions.

7. Explain principles of least square and fit a straight line ?
8. Show that  $Q = \frac{2Y}{1+Y^2}$ ?
9. Show that correlation coefficient is independent of change of origin & scale.
10. Estimate regression lines from the following data .?

X	16	12	18	4	3	10	5	12
Y	87	88	89	68	78	80	75	83

**Section – C**

2x10 = 20 M

Answer Any Two of the following questions.

11. Define chi square distribution and write it's properties.
12. Define F-Statistic. Write its PDF and state its properties..
13. Explain the terms (i) unbiased Estimator (ii) Consistent
14. Find the maximum likelihood estimate for the parameter  $\lambda$  of a poison distribution on the bases of a sample of size n.

**P.R.GOVERNMENT COLLEGE (A), KAKINADA**

**II B.Sc. –Statistics / Semester- IV (2020-21)**

**Statistics paper- IV Course: TESTING OF HYPOTHESIS**

**Total Hrs. of Teaching: 60 @ 4 h / Week**

**Total Credits: 03**

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**Module -1**

**(16h)**

- a. **Concepts of statistical hypothesis:** Null & alternate hypothesis, procedure for testing of hypothesis, critical region, two types of errors, one & two tailed tests, level of significance, power of a test.
- b. **Large sample tests:** Test for single mean  
Test for difference of means  
Test for single proportion  
Test for difference of proportions  
Test for difference of standard deviations  
Problems on large sample tests.

**Module-2**

**(10h)**

- a. Randomized tests
- b. Non Randomized tests.
- c. Neman Pearson's Lemma theorem
- d. Examples in case of binomial, poisson, exponential, normal distributions.

**Module-3**

**(18h)**

**Small Sample Tests**

- a. **Chi square test:** chisquare test for variance, goodness of fit, independence of attributes & Problems based on chisquare test.
- b. **T-test:** test for single mean, test for difference of means, paired t -test ,test for standard deviation, test for sample correlation coefficient & problems.
- c. **F-test:** Test for equality of variance & problems.

**Module-4**

**(16h)**

**Non Parametric Tests**

- a. **Non Parametric tests:** comparison with parametric tests, advantages & dis advantages of NP tests, assumptions of NP tests.
- b. **Sign test:** one sample sign test, two sample sign test procedures & problems.
- c. Mann-Whitney wilcoxon U test: procedure & problem
- d. **Run test:** procedure & problem
- e. Wilcoxon Rank test for one & two simple tests: procedure & problem.

**Additional Input:** Fisher's Z-transformation (not included in examination)

**List of Text Books:**

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand&Sons, New Delhi

**List of Reference Books:**

2. Goon AM, Gupta MK, Das Gupta B : Outlines of Statistics , Vol-II, the World Press Pvt.Ltd., Kolakota.
3. Hoel P.G: Introduction to mathematical statistics, Asia Publishing hous.

**List of Practicals: (3 hrs/week credits:2)****Conduct any SIX (MS-Excel mandatory)**

1. Large sample tests for mean(s), proportion(s), Standard deviation (s)
2. Small sample tests for single mean and difference of means and correlation coefficient.
3. Paired t-test.
4. Small sample test for single and difference of variances.
5.  $\chi^2$  – test for goodness of fit and independence of attributes.
6. Nonparametric tests for single and related samples (sign test and Wilcoxon signed rank test) and one sample run test.
7. Nonparametric tests for two independent samples (Median test, Wilcoxon –Mann- Whitney - U test, Wald - Wolfowitz's run test)
8. Practicals 2, 3,4, 5 using MS-Excel

**Paper –IV: TESTING OF HYPOTHESIS****Model blue print for the Question Paper setter**

Max. Marks: 60

Time : 2 ½ Hrs.

Unit / Chapter name	Short Answer Questions	Essay Questions	Marks allotted to the Unit/Chapter
<b>Unit – 1</b>			
<b>Concepts of statistical hypothesis</b>	2	2	30
<b>Unit – 2</b>			
<b>Module-2</b>	1	2	25
<b>Unit – 3</b>			
<b>Small Sample tests</b>	1	2	25
<b>Unit – 4</b>			
<b>Non parametric tests</b>	2	2	30
-			
<b>Total No. of Questions including choice (14)</b>	<b>6</b>	<b>8</b>	-
<b>Total marks allotted to all questions including choice =</b>			<b>110</b>

**Statistics Paper –IV: Testing of Hypothesis  
Question Bank**

**SHORT QUESTIONS:**

1. Define null hypothesis and alternate hypothesis.
2. Explain one tailed tests and two tailed tests.
3. Explain two types of errors.
4. Define critical region, level of significance and power of test.
5. Write the procedure for testing of hypothesis.
6. Write the procedure for test for single mean.
7. Explain the procedure for single proportion.
8. Explain randomized tests and non randomized tests.
9. Write the procedure for t- test for sample correlation coefficient.
10. Explain the procedure for t-test for single mean.
11. Explain paired t-test for difference of means.
12. Write the advantages and disadvantages of NP tests over parametric tests.
13. Explain the test for randomness.
14. Write the procedure for one sample sign test.

**ESSAY QUESTIONS:**

15. State and prove Neyman Pearson's Lemma.
16. Obtain the most powerful critical region for testing  $H_0: \mu = \mu_0$  against  $H_1: \mu = \mu_1$ , in case of Normal population with known variance, using N-P lemma.
17. Explain large sample test for testing equality of two means and two standard deviation of two normal populations.
18. Random samples drawn from two countries gave the following data relating two heights of men.

Mean heights in inches	67.42	67.25
Standard deviation	2.58	2.5
Sizes of samples	1000	2000

  - i) Is the difference between means significant at 1% los.
  - ii) Is the difference between standard deviations significant at 1% los.
19. Explain t-test for difference of means.
20. Explain F-test for equality of variances of two populations.
21. Explain run test for equality of two populations.
22. Explain the chi-square test for i) goodness of fit ii) Independence of attributes.
23. Explain one and paired sample signed rank test.
24. Explain U test for equality of two populations.
25. Two sample are given below

X	15	12	18	22	25	24	30	10	35	32
Y	17	19	22	20	26	27	32	15	28	36

Find the significance difference between two samples by using U test at 10% los.
26. Two samples are given below

X	4	8	2	6	10	24	14	17	20	23	15			
Y	5	7	9	10	14	15	10	25	32	18	24	26	27	35

Find the significance difference between two samples by using run test at 5% los.
27. Explain the procedure for two sample sign test.

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**Statistics Paper –IV: Testing of Hypothesis**  
**Model Paper**

Time: 2 ½ Hrs.

Max. Marks: 60

**Section –A**

**4X5 = 20 M**

Answer **any four** questions

1. Define null hypotheses, alternative hypotheses, simple and composite hypotheses
2. Write about randomised and non randomised tests.
3. Write procedure of test for single mean for large sample.
4. Distinguish between parametric and non parametric tests.
5. Explain the types of errors.
6. Write run test procedure ?

**Section – B**

**2x10 = 20 M**

Answer **Any Two** of the following questions.?

7. Explain the large sample test for testing the difference of two means. Random samples drawn from two countries gave the following data relating to the heights of adult males.

	Country A	Country B
Mean Height (in inches)	67.42	67.25
S.D(in inches)	2.58	2.50
No.of samples	1000	1200

Is the difference between means significant at 1% los. [ $Z_{0.5\%} = 2.58$ ]

8. Explain procedure for testing of hypothesis and also explain large sample test for difference of standard deviation.
9. State and prove Neymann Pearsons Lemma
10. What are the advantages and disadvantages of Non Parametric methods.

**Section – C**

Answer **Any Two** questions

**2X10=20M**

11. Explain (i) Chisquare test for goodness of fit.

(ii) Chisquare test for independence of attributes.

12. Two random samples gave the following results:

Sample	size	Sample mean	Sum Squares of Deviations from the Mean
1	10	15	90
2	12	14	108

Test where the samples come from the same normal population at 5% level of significance. (Table Value:  $t(5\%, 20)=2.09$ ,  $t(5\%, 22)=2.07$ ,  $F(5\%, 9, 11)=2.91$ ,  $F(5\%, 11, 9)=3.11$ )

13. Explain Mann Whitney Wilcoxon U test.
14. Discuss about Wilcoxon Signed Rank test for one sample and two sample tests.

**Note: Provide Statistical table values wherever necessary.**