

- N.B. (1) Attempt any five questions; each question is of 20 marks.
 (2) Question No. 1 is compulsory.
 (3) Scientific calculator can be used.
 (4) Appropriate Statistical Tables can be used.

1. (a) There are three main brands of certain powder. A set of its 120 sales is examined and found to be allocated among four groups A, B, C, D and brands I, II, III as shown have under :—

| Brand | GROUPS | | | |
|-------|--------|----|----|----|
| | A | B | C | D |
| I | 0 | 4 | 8 | 15 |
| II | 5 | 8 | 13 | 6 |
| III | 18 | 19 | 11 | 13 |

Is there any significant difference in brands preference? Answer at 5% LOS using one way ANOVA Table. (Take 10 as the code value to subtract from all given values in your working) :

(Given : $F(2,9)_{0.05} = F_{tab} = 4.26$)

- (b) Fit a curve of the type $y = ax^2 + \frac{b}{x}$ to the following data :—

$a = .509$
 $b = -2.037$

| X | 1 | 2 | 3 | 4 |
|---|-------|------|------|------|
| Y | -1.51 | 0.99 | 3.88 | 7.66 |

$159.93 = 354a + 10b$
 $2.1933 = 10a + 1.423b$

$\sum x^2 y = a \sum x^4 + b \sum x$

$\frac{\sum y}{x} = a \sum x + b \sum \frac{1}{x}$

- (c) A sample of 900 members has a mean 3.4 inches and SD 2.61 inches. Can we conclude that the sample is drawn from a large population of mean 3.25 inches and SD 2.61 inches by 5% LOS? If the population is normal and its mean is unknown find 95, 99 percent limits for true population mean.

- (d) The general appearance score of 10 mentally retarded girls are given as follows :—

| Girl | Score | Girl | Score |
|------|-------|------|-------|
| 1 | 4.5 | 6 | 6+ |
| 2 | 5.0 | 7 | 10+ |
| 3 | 8+ | 8 | 7+ |
| 4 | 8+ | 9 | 6+ |
| 5 | 9+ | 10 | 6+ |

H_0 Median = 5

H_A : $\neq 5$ or $P(G) \neq F(G)$

We wish to know if we may conclude that the median score of the population from which we assume this sample to have been drawn is different from 5 by LOS 5%, use Sign Test?

2. (a) An ambulatory status at Discharge of Group I and II patients is given in following table :—

| Group | Ambulatory Status | | |
|-------|-------------------|------------|------------|
| | Non Ambulatory | Ambulatory | Total |
| I | 16 = a | 2 = A - a | 18 |
| II | 1 = b | 8 = B - b | 9 |
| Total | 17 = a + b | 10 = | 27 = A + B |

We wish to know if we may conclude that patients classified as G-II have a higher probability of ambulation at discharge than of G-I by using Fisher Exact Test :—
 (Given : b = 3 For A = 18, B = 9, a = 16, LOS 1%).

- (b) In a study of nutrition care in nursing homes it was found that among 55 patients with hypertension, 24 were on sodium restricted diets. Of 149 patients without hypertension, 36 were on sodium restricted diets. May we conclude that in the sampled populations the proportion of patients on sodium restricted diets is higher among patient with hypertension than among patients without hypertension?

the following results :—

| Plot No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------|---|---|---|---|---|---|---|---|---|----|
| Treatment | A | B | C | A | C | C | A | B | A | B |
| Yield | 5 | 4 | 3 | 7 | 5 | 1 | 3 | 4 | 1 | 7 |

Analyze the results for treatment effect using one way ANOVA Table.
(Given : $F_{0.05}(2,9) = 19.38$).

3. (a) A medical research team wished to evaluate a proposed screening test for a disease. The test was given to a random sample of 450 patients with that disease and an independent sample of 500 patients without the symptoms of that disease. The two samples were drawn from populations of subjects who were 65 years of age or older. The results were as follows :—

| Test Results | Alzheimer's Diagnosis | | |
|------------------------|-----------------------|------------------|-------|
| | Yes (D) | No (\bar{D}) | Total |
| Positive (T) | 436 | 5 | 441 |
| Negative (\bar{T}) | 14 | 495 | 509 |
| Total | 450 | 500 | 950 |

Find the following probabilities using the above table :—

$P(T)$, $P(\bar{T})$, $P(T | D)$, $P(\bar{T} | D)$, $P(T | \bar{D})$.

- (b) The following table shows the weights X_1 to the nearest pound (lb), the height X_2 to the nearest inch (in) and the ages X_3 to the nearest years of 12 boys :—

| Weight X_1 | 64 | 71 | 53 | 67 | 55 | 58 | 77 | 57 | 56 | 51 | 76 | 68 |
|--------------|----|----|----|----|----|----|----|----|----|----|----|----|
| Height X_2 | 57 | 59 | 49 | 62 | 51 | 50 | 55 | 48 | 52 | 42 | 61 | 57 |
| Age X_3 | 8 | 10 | 6 | 11 | 8 | 7 | 10 | 9 | 10 | 6 | 12 | 9 |

- (i) Find the least square regression equation of X_1 on X_2 and X_3 .
(ii) Estimate the weight of a boy who is 9 years old and 54 inch tall.
(iii) Find : r_{12} , r_{13} , r_{23}
(iv) Find : $R_{1.23}$, $R_{2.13}$, $R_{3.12}$
- (c) For 14 subjects under study the Body Mass Index (BMI) is given as follows :
23, 25, 21, 37, 39, 21, 23, 24, 32, 57, 23, 26, 31, 45
Can we conclude that mean BMI is 35 by using 5% LOS ?

4. (a) The purpose of a study Ingle and Eastell was to examine the Bone Mineral Density (BMD) and ultrasound properties of women with ankle fractures. The investigators recruited 31 post-menopausal women with ankle fractures and 31 healthy post-menopausal women to serve as controls. One of the baseline measurements was the stiffness index of the lunar Achilles. The mean stiffness index for the ankle fracture group was 76.9 with a SD of 12.6. In the control group the mean was 90.0 with a SD of 12.5; do these data provide sufficient evidence to allow you to conclude that, in general, the mean stiffness index is higher in healthy post-menopausal women than in post-menopausal women with ankle stiffness ? Choose LOS as 5%.

- (b) Twelve persons submitted to an experiment where a drug was to be tested to know if it tends to increase the blood pressure. The data give B. P. before the drug was given and also after it was given :—

| Before | 120 | 144 | 100 | 130 | 125 | 140 | 118 | 121 | 125 | 127 | 115 | 125 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| After | 125 | 116 | 108 | 129 | 129 | 140 | 116 | 122 | 130 | 127 | 119 | 131 |

- (i) Null and Alternate Hypothesis
(ii) Level of Significance

- (iii) One and Two Tailed Test
(iv) Type I and Type II Errors.

5. (a) Two batches of 12 animals are taken for the test of inoculation, one batch was inoculated and the other batch was not. The numbers of dead and surviving animals are given in the following table for both cases. Can the inoculation be regarded as effective against the disease? Make Yates correction for continuity :—

| | Dead | Survived | Total |
|----------------|------|----------|-------|
| Inoculated | 2 | 10 | 12 |
| Not inoculated | 8 | 4 | 12 |
| Total | 10 | 14 | 24 |

- (b) Motivated by an unawareness of the existence of a body of controversial literature suggesting that stress, anxiety and depression are harmful to the immune system, Gorman et-al. conducted a study in which the subjects were homo-sexual men, some of them were HIV positive and some of whom was HIV negative. Data are collected on a wide variety of medical, immunological, psychiatric and neurological measures, one of which was the number of CD4+ cells in the blood. The mean number of CD4+ cells for the 112 men with HIV infection was 401.8 with a SD of 226.4. For the 75 men without HIV infection the mean and SD were 828.2 and 274.0 respectively. Construct a 95%, 98%, 99% confidence interval for the difference between population means.

- (c) Sixteen laboratory animals were fed a special diet from birth through age 12 weeks. Their weight gains (in grams) were as follows :—

63 68 79 65 64 63 65 64 76 74 66 66 67 73 69 76

Can we conclude from these data that the diet results in a mean weight gain of less than 70 grams by using 5% LOS, use Wilcoxon Signed Rank Test for Location.

(Given : $T_{\text{tab}} = T_{16} (0.05) = 35$).

6. (a) A physical therapist wished to compare three methods of teaching patients to use a certain prosthetic device. He felt that the rate of learning would be different for patients of different ages and wished to design an experiment in which the influence of age could be taken into account.

| TIME IN DAYS REQUIRED TO LEARN THE USE OF PROSTHETIC DEVICE TEACHING METHOD | | | | |
|---|----|----|----|-------|
| AGE GROUP | A | B | C | TOTAL |
| Under 20 | 7 | 9 | 10 | 26 |
| 20 to 29 | 8 | 9 | 10 | 27 |
| 30 to 39 | 9 | 9 | 12 | 30 |
| 40 to 49 | 10 | 9 | 12 | 31 |
| 50 and Over | 11 | 12 | 14 | 37 |
| TOTAL | 45 | 48 | 58 | 151 |

Use to way ANOVA to determine whether treatment effects are equal or not ?

[Given : $F(2,8)_{\text{tab}(0.05)} = 4.46$, $F(4,8)_{\text{tab}(0.05)} = 3.84$] 08M.

- (b) Find mean, median and mode of the following data :—

| Class interval | Frequency |
|----------------|-----------|
| 93-97 | 3 |
| 98-102 | 5 |
| 103-107 | 12 |
| 108-112 | 17 |
| 113-117 | 14 |
| 118-122 | 16 |
| 123-127 | 3 |

- (c) Suppose that the ages at time of onset of a certain disease are approximately normally distributed with a mean of 11.5 years and a SD of 3 years. A child has just come down with the disease. Find the probability that the child is :

- Between the ages of 8.5 to 14.5 years
- Over 10 years of age
- Under 12.

7. (a) In a simple random sample of 250 industrial workers with cancer researchers found that 102 had worked at jobs classified as "high exposure" w.r.t suspected cancer causing agents. Of the remainder, 84 had worked at "moderate exposure" jobs, and 64 had experienced ~~on~~ known exposure because of their jobs. In an independent simple random sample of 250 industrial workers from the same area who had no history of cancer, 31 worked in "high exposure", jobs 60 worked in "moderate exposure", jobs and 159 worked in jobs involving no known exposure to suspected cancer causing agents. Does it appear from these data that persons working in jobs expose them to suspect cancer causing agents have an increased risk to contracting cancer by 5% LOS ?

- (b) Two independent samples of sizes 8 soldiers and 6 sailors contained the following values :—

| | Mean height | SD |
|----------|-------------|------|
| Soldiers | 166.9 cms | 8.29 |
| Sailors | 170.3 cms | 8.50 |

Based on this data can we conclude that soldiers are shorter than sailors by 5% LOS, find 99% confidence limits for the test statistic used.

- (c) The following serum albumin values were obtained from 17 normal and 13 hospitalized subjects :—

| | | | | | | | | | | | | | | | | | |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Normal subjects | 2.4 | 3.5 | 3.1 | 4.0 | 4.2 | 3.0 | 3.2 | 3.5 | 3.8 | 3.9 | 3.4 | 4.5 | 5.0 | 2.9 | 4.0 | 3.5 | 3.6 |
| Hospitalized subjects | 1.5 | 2.0 | 3.4 | 1.7 | 2.0 | 3.1 | 1.3 | 1.5 | 1.8 | 2.0 | 3.8 | 3.5 | 1.5 | | | | |

Would you like to conclude at the 0.05 level of significance that the medians of the two populations are different ? Use Median Test.