CSc.103-2073 ✡

Tribhuvan University
**Institute of Science and Technology**
2073
✡

Bachelor Level / First Year/ First Semester/ Science
**Computer Science and Information Technology (STA. 103)**
(Probability and Statistics)

Full Marks: 60
Pass Marks: 24
Time: 3 hours.

*Candidates are required to give their answers in their own words as for as practicable.*
All notations have the usual meanings.

## Group A

(2×10=20)

**Attempt any Two:**

1. Describe joint and marginal probabilities with suitable examples. Probability that a person has certain disease is 0.03. Medical diagnostic test are available to determine whether the person actually has the disease. If the disease actually present, the probability that the medical diagnostic test will give a positive result (indicating that the disease is present) is 0.09. If the disease is not actually present, the probability of a positive test result (indicating that it is present) is 0.02. What is the probability that the disease is actually present given a positive result has occurred (indicating the disease is present)?

2. Material manufactured continuously before being cut and wound into large rolls must be monitored for thickness (caliper). A sample of 10 measurements each on paper (in mm) in two paper industries in as follows.

| | Thickness (in mm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Paper industry A | 32 | 32 | 30 | 31 | 33 | 29 | 34 | 28 | 32 | 35 |
| Paper industry B | 25 | 24 | 27 | 26 | 24 | 25 | 29 | 28 | 23 | 27 |

By using appropriate descriptive statistical measure, state which industry's paper production has less variability in thickness?

3. The following are the measurements of the air velocity (AV) and evaporation coefficient (EC) of burning fuel droplets in an impulse engine.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AV (cm/sec) | 20 | 60 | 100 | 140 | 180 | 220 | 260 | 300 | 340 | 380 |
| EC ($mm^2$/sec) | 0.2 | 0.4 | 0.3 | 0.8 | 0.5 | 0.7 | 1.2 | 1.3 | 1.2 | 1.7 |

Fit a straight line to the given data by the method of ordinary least squares (OLS) and with the help of the fitted line, estimate the evaporation coefficient(EC) of a droplet when the air velocity (AV) is 190 cm/sec.

## Group B

**Answer any eight questions:** (8×5=40)

4. A.A. Michelson (1852-1931) made many series of measurements of the speed of light. Using a revolving mirror technique, he obtained the following measurements of velocity of light in air:
12, 30, 30, 27, 30, 39, 18, 27, 48, 24, 18
Compute, mean, median, mode, standard deviation and skewness. Also comment about the shape of the distribution.

5. An agricultural cooperative claims that 90% of the watermelons shipped out are ripe and ready to eat. Find the probability that among 18 watermelons shipped out:
   (a) all 18 are ripe and ready to eat
   (b) at least 16 are ripe and ready to eat

6. Obtain the maximum likelihood estimate for the parameter P (proportion of success) of binomial distribution.

7. A construction firm has recently sent in bids for 3 jobs worth (in profits) 10, 20, and 40 (thousand) dollars. If its probabilities of winning the jobs are respectively 0.2, 0.8, and 0.3, what is the firm's expected total profit? Also obtain the standard deviation of the profit.

8. It is believed that 90% of government job holders in Nepal government do not have life insurance. Suppose X be the number with no life insurance. Find the probability in a sample of 12 government job holders; at least 10 do not have life insurance. Also compute the mean and variance of X.

9. If X is a normal random variable with mean $\mu = 3$ and variance $\sigma^2 = 16$, find
   (a) Prob $(X < 11)$
   (b) Prob $(X > -1)$
   (c) Prob $(2 < X < 7)$

10. Define the term interval estimation. The standard deviation of test scores on a certain achievement test is 11.3. If a random sample of 81 students had a sample mean score of 74.6, fine 90% confidence interval estimate for the average score of all students.

11. Define Chi square distribution and its density function. For what purposes Chi-square test is used?

12. If two random variables have the joint density

$$f(x_1, x_2) = \frac{6}{5}\left(x_1 x_2^{\,2}\right) \qquad \text{for } 0 < x < 1, \quad 0 < x_2 < 1$$

$$= 0, \quad \text{elsewhere}$$

Find the probability that $0.2 < x_1 < 0.5$ and $0.4 < x_2 < 0.6$

13. Explain the properties of standard deviation. How it is useful in inferenctial statistical analysis?