

**KHYBER PAKHTOON KHWA, PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR THE POSTS OF PROVINCIAL
MANAGEMENT SERVICE (BPS-17), 2010**

STATISTICS

Time Allowed: 3 Hours

Maximum Marks: 100

- NOTE:** (i) Attempt any **FIVE** questions in all. All the questions carry equal marks.
(ii) Statistical table may be provided on request.
(iii) The use of calculator is **ALLOWED**.

- Q-1**
- a) Why do we study the probability theory? Explain.
 - b) Three applicants are to be selected at random out of 4 boys and 6 girls. Compute the probability of selecting (i) all boys (ii) at least one boy.
 - c) A student applies for a fellowship at two different universities. The probability is $\frac{1}{3}$ that he will be awarded a fellowship by the first university, $\frac{1}{4}$ that he will be awarded a fellowship by the second, and $\frac{1}{6}$ that he will be awarded a fellowship by both. What is the probability that the student is awarded at least one fellowship? What is the probability that he is not awarded any fellowship?

(05+05+10 = 20)

- Q-2**
- a) Two secretaries who work in an office type many things. A carbon copy is always placed in the files. Suppose that it is known that secretaries 1 and 2 type $\frac{3}{8}$ and $\frac{5}{8}$ of the material, respectively, and that the probabilities that a sheet of their work contains at least one error are respectively 0.03 and 0.02. One sheet of paper is randomly selected from the files. What is the probability that it contains an error? Suppose that after examining the sheet of paper and an error is found. What is the probability that it was the work of secretary 2?
 - b) If a random variable X has the probability function $P(X = x) = \frac{1}{5}$, $x = 1, 2, 3, 4, 5$. Find $E(X)$, $E(X - 3)$ and $E(X - 3)^2$.

(10+10 = 20)

- Q-3**
- a) Suppose, it is estimated that 40% of a certain large group are strong supporters of a project and willing to volunteer their services if asked. The remaining 60% decline to volunteer. The local government will start the project if at least 7 persons, among 10 randomly selected persons of this group, are ready to volunteer their services for the project. What is the probability that the project will be started? What is the probability that only 3 persons, out of 10, are ready to volunteer their services?
 - b) Prove that for Poisson distribution, mean and variance are equal.

(10+10 = 20)

- Q-4**
- a) What is Statistical Inference? Explain.
 - b) A city planner working on bikeways needs information about local bicycle commuters. He designs a questionnaire. One of the questions asks how many minutes it takes the rider to pedal from home to his or her destination. A random sample of 20 bicycle commuters yields the mean time 25.82 minutes (from home to destination). Suppose that the commuting time (in minutes) follows normal distribution with standard deviation 7.71. Compute 95% confidence interval for the mean commuting time for all the local commuters in the city.
 - c) A battery retailer has received a large shipment of automobile batteries from supplier. The supplier claims that the batteries have a mean life of 36 months. A test on 10 batteries randomly sampled from the shipment yields the following lifetimes in months:

27.6, 28.7, 34.7, 29.0, 22.9, 29.6, 29.4, 30.2, 36.5 and 34.7.

Do the data indicate that the mean life of the supplier's batteries is less than the claimed 36 months? Perform the hypothesis test at 5% level of significance.

(P.T.O)

(05+05+10=20)

Q-5 a) Researchers in obesity wanted to compare the effectiveness of dieting with exercise against dieting without exercise. Total 73 patients were randomly divided into two groups. Group I, numbering 37 patients, was put on a program of dieting with exercise. Group II, numbering 35 patients, dieted only. The results of weight loss (in pounds) after two months are summarized by the following statistics:

Group I: $n_1 = 37, \bar{x}_1 = 16.8, s_1 = 3.5$;

Group II: $n_2 = 35, \bar{x}_2 = 17.1, s_2 = 5.2$.

Test, at 5% level of significance that whether there is a difference between the average weight losses of two groups.

b) An exercise physiologist wants to decide whether a certain type of running program will reduce heart rates. He measures the heart rates of 10 randomly selected people who are then placed on the running program. One month later the exercise physiologist again measures the heart rates of the 10 people. The heart rates, both before and after the running program, are displayed as below:

Before Program: 68, 76, 74, 71, 71, 72, 75, 83, 75, 74;

After Program: 67, 77, 74, 74, 69, 70, 71, 77, 71, 74.

Do the data provide sufficient evidence to conclude that the running program will reduce heart rates? (Use 5% level of significance.)

(08+12=20)

Q-6 a) The general manager of an engineering firm wants to know whether a draftsman's experience influences the quality of his work. He selects 10 draftsmen at random and records their years of work experiences and their work quality rating (excellent = 5, very good = 4, good = 3, average = 2, and poor = 1). The data recorded are given as follows:

Experience: 1 17 20 9 2 13 9 23 7 10

Rating: 1 4 4 5 2 4 3 5 2 5

Find correlation coefficient between experience and rating. Also interpret the result.

b) An economist is interested in the relation between the disposable income (X : in thousand dollars) of a family and the amount of money (Y : in hundred dollars) spent annually on food. For a preliminary study, the economist takes a random sample of 8 families of the same family size. The results are as follows:

X : 30, 36, 27, 20, 16, 24, 19, 25;

Y : 55, 60, 42, 40, 37, 26, 39, 43.

Fit a simple linear regression line of Y on X and interpret the results.

(10+10=20)

Q-7 a) Explain the advantages and disadvantages of sampling.

b) What is sampling frame and characteristics of a good sampling frame?

c) Differentiate between simple random sampling and stratified random sampling by giving examples.

(10+05+05=20)

Q-8 Write note on any FOUR of the following

a) Applications of Statistics in handling social problems

b) Type-I and Type-II errors

c) Maximum likelihood estimator

d) Conditional probability

e) Applications of normal distribution

f) Partial and multiple correlation

(20)