



PUNJAB PUBLIC SERVICE COMMISSION

**COMBINED COMPETITIVE EXAMINATION
FOR RECRUITMENT TO THE POSTS OF
PROVINCIAL MANAGEMENT SERVICE -2020**

SUBJECT: STATISTICS (PAPER-I)

TIME ALLOWED: THREE HOURS

MAXIMUM MARKS: 100

NOTE:

- All the parts (if any) of each Question must be attempted at one place instead of at different places.
- Write Q. No. in the Answer Book in accordance with Q. No. in the Q. Paper.
- No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
- Extra attempt of any question or any part of the question will not be considered.

ATTEMPT FIVE QUESTIONS IN ALL. CALCULATOR IS ALLOWED (NOT PROGRAMMABLE)

Q. No. 1 a) Differentiate between quantitative variable and qualitative variable.

b) The ages of 30 patients admitted to a certain hospital during a particular week were as follows:

48, 31, 54, 37, 18, 64, 61, 43, 40, 71, 51, 12, 52, 65, 53, 42, 39, 62, 74, 48, 29, 67, 30, 49, 68, 35, 57, 26, 27, 58.

Construct a stem and leaf display from the data and list the data in an array.

c) Find Median for the following data.

Marks	10-19	20-29	30-39	40-49	50-59	60-69	70-79
No. of Students	2	3	5	6	6	6	2

(4 + 8 + 8 = 20 Marks)

Q. No. 2 a) Write down the properties of variance.

b) Goals scores by two teams A and B in a football season were as follows.

Goals Scored	No. of Matches (Team A)	No. of Matches (Team B)
0	27	17
1	9	9
2	8	6
3	5	5
4	4	3

By calculating the coefficient of variation in each case, find which team may be considered more consistent.

(8 + 12 = 20 Marks)

Q. No. 3 a) Four items are taken at random from a box of 12 items and inspected. The box is rejected,

if more than 1 item is found to be faulty. If there are 3 faulty items in the box, find the probability that the box is accepted.

b) Find the probability distribution and distribution function for the number of heads when 3 balanced coins are tossed.

(8 + 12 = 20 Marks)

Q. No. 4 a) Find the value of k so that the function $f(x)$ defined as follows may be a density function.

$$f(x) = \begin{cases} kx, & 0 \leq x \leq 2 \\ 0, & \text{elsewhere} \end{cases}$$

Find its mean and variance.

b) The joint probability distribution function of two discrete random variables X and Y is given by:

$$f(x, y) = \frac{xy^2}{30} \text{ for } x = 1, 2, 3 \text{ and } y = 1, 2.$$

Are X and Y independent?

(12 + 8 = 20 Marks)

Q. No. 5 a) Derive mean and variance of the poisson distribution.

b) An urn contains 4 red balls and 6 black balls. A sample of 4 balls is selected from the urn without replacement. Let X be the number of red balls contained in the sample. Then find the probability distribution of X . **(10 + 10 = 20 Marks)**

Q. No. 6 a) Prove that area under the normal distribution curve is unity.

b) A random variable X is normally distributed with $\mu = 50$ and $\sigma^2 = 25$. Find the probability that

(i) It will fall between 55 and 100.

(ii) It will be larger than 54.

(iii) It will be smaller than 57.

(10 + 10 = 20 Marks)

Q. No. 7 a) Prove that correlation coefficient is independent of origin and scale. i.e. $r_{xy} = r_{uv}$

b) Compute the least square regression equation of y on x for the following data.

x	5	6	8	10	12	13	15	16	17
y	16	19	23	28	36	41	44	45	50

Also show that $\sum(Y - \hat{Y}) = 0$

(10 + 10 = 20 Marks)

Q. No. 8 a) Fit an equation of the form $Y = aX^b$ to the following data.

x	1	2	3	4	5	6
y	2.98	4.26	5.21	6.10	6.80	7.50

b) Fit a second degree parabola to the following data taking x as independent variable.

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

(8 + 12 = 20 Marks)



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TIME ALLOWED: THREE HOURS

MAXIMUM MARKS: 100

NOTE:

- i. All the parts (if any) of each Question must be attempted at one place instead of at different places.
- ii. Write Q. No. in the Answer Book in accordance with Q. No. in the Q. Paper.
- iii. No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
- iv. Extra attempt of any question or any part of the question will not be considered.

ATTEMPT FIVE QUESTIONS IN ALL. ANSWER SHOULD BE SUPPORTED BY WORKING. CALCULATOR IS ALLOWED. (NOT PROGRAMMABLE)

Q NO. 1: a) Explain the concept of standard error. Discuss its role in large sample.

b) A soft drink vending machine is set so that the amount of drink dispensed is a random variable with a mean of 200 milliliters and a standard deviation of 15 milliliters. What is the probability that the average (mean) amount dispensed in a random sample of size 36 is at least 204 milliliters?

c) The television picture tubes of manufacturer A have a mean lifetime of 6.5 years and a standard deviation of 0.9 years, while those of manufacturer B have a mean lifetime of 6.0 years and a standard deviation of 0.8 years what is probability that a random sample of 36 tubes from manufacturer A will have a mean lifetime that is at least one year more than the life time of the sample of 49 tubes from manufacturer B?
(6+7+7 = 20 Marks)

Q NO. 2: a) Explain what is meant by Mean square Error of an estimate. Prove that

$$MSE(T) = \text{Var}(T) + (\text{Bias})^2$$

b) Samples of two types electric bulbs were tested for length of life and the following data were obtained: Test at 0.05 level of significance?

	Type I	Type II
Number in the sample	8	7
Mean of the sample (in hours)	1134	1024
Standard deviation of the sample in hours	12	25

c) Show that \bar{x} is a minimum variance unbiased estimator of the mean μ of a normal population.
(6+7+7 = 20 Marks)

Q NO. 3: a) Write down the relationship between confidence interval and tests of hypothesis

b) Two independent samples of sizes 9 and 8 gave the sum of squares of deviations from their respective means as 160 and 91 respectively. Can the samples be regarded as drawn from the normal populations with equal variances?

c) Use the data shown in the following table to test at the 0.05 level of significance whether a person's ability in mathematics is independent of his or her interest in statistics

		Ability in Mathematics		
		Low	Average	High
Interest of Statistics	Low	63	42	15
	Average	58	61	31
	High	14	47	29

(5+5+10 = 20 Marks)

P.T.O

- Q NO. 4:** a) Define an index number. Discuss the main steps involved in the construction of wholesale price index number.
b) How do nonparametric tests differ from parametric tests? Discuss the advantages and disadvantages of non-parametric tests. **(10+10 = 20 Marks)**

- Q NO. 5:** a) What is meant by Analysis of variance and degree of freedom? What are the assumptions underlying a one –way analysis of variance.
b) From the following table

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Route 1	22	26	25	25	31	129
Route 2	25	27	28	26	29	135
Route 3	26	29	33	30	33	151
Route 4	26	28	27	30	30	141
Total	99	110	113	111	123	556

test at the 0.05 level of significance whether difference among means obtained for the different routes (treatments) are significant and also whether the differences among the means obtained for the different days of week(blocks) are significant.

(8+12 = 20 Marks)

- Q NO. 6:** a) Describe in brief the application of statistics in economic development of Pakistan
b) Calculate seasonal indices by Link-relative method

Price of Rice (in Rupees per 10 kg)				
Quarter /Years_	2001	2002	2003	2004
1	75	86	90	100
2	60	65	72	78
3	54	63	66	72
4	59	80	82	93

(8+12 = 20 Marks)

- Q NO. 7:** a) What are Vital statistics? Describe the system for Collection of Vital Statistics in Pakistan. Discuss its strong and weak points and suggest remedies.
b) Test the significance of the correlation $r = 0.5$ from a sample of size 18 against hypothesis correlation $\rho = 0.7$. table value=1.96

(15+5 = 20 Marks)