FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2019
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

STATISTICS

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II** by selecting **TWO** questions from **EACH SECTION**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II
SECTION – I

Q. 2. **(a)** What is meant by a frequency distribution? Describe briefly the main steps in the preparation of a frequency table from raw data. (6)

(b) A man travels from A to B at average speed of 30 miles per hour and returns from B to A along the same route at an average speed of 60 miles per hour. Find the average speed of the entire journey. (6)

(c) Define mean-deviation and its co-efficient. Discuss its advantages and uses. (8) **(20)**
Estimate the mean deviation from the arithmetic mean of the following set of examination marks.

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79
No. of students	2	3	8	24	27	40	11	5

Q. 3. **(a)** Define mutually exclusive events. State and prove the theorem of addition of probabilities concerning mutually exclusive events. (6)

(b) Show that the multiplication law $P(A \wedge B)=P(A/B)P(B)$, established for two events, may be generalized to three events as follows; (6)

$$P(A \wedge B \wedge C)=P(A/B \wedge C)\, P(B/C)\, P(C)$$

(c) There are three coins, identical in appearance, one of which is ideal and the other two biased with probabilities 1/3 and 2/3 respectively for a head. One coin is taken at random and tossed twice. If a head appears both the times, what is the probability that the ideal coin was chosen? (8) **(20)**

Q. 4. **(a)** (i) Explain briefly how the principle of least squares is used to find a regression line based on a sample of size n. Illustrate on a rough sketch the distance whose squares are minimized, taking care to distinguish the dependent and independent variables. (6)

(ii) Find the least square estimates of parameters in a simple linear regression model $Y_i=\alpha+\beta X_i+e_i$ where e_i's are distributed independently with mean zero and constant variance.

(iii) What are the properties of least square regression line?

(b) The following means, standard deviations and correlations are found for (6)
X_1 = Seed-hay crops in owts. Per acre
X_2 = Spring rainfall in inches
X_3 = Accumulated temperature above 42^o F in spring in a certain district in England during 20 years.

$$\bar{X}_1 = 28.02, \quad S_1 = 4.42, \quad r_{12} = 0.80,$$
$$\bar{X}_2 = 4.91, \quad S_2 = 1.10, \quad r_{13} = -0.40,$$
$$\bar{X}_3 = 594, \quad S_3 = 85, \quad r_{12} = -0.56,$$

Find the partial correlation and the regression equation for hay-crop on spring rainfall and accumulated temperature.

(c) What do you understand by nonparametric tests? Why such tests are also called distribution-free tests? Give the advantages and disadvantages of nonparametric tests over parametric tests. Describe the Wilcoxon signed-rank test for one sample. How does it differ from the sign test? (8) **(20)**

SECTION-II

Q. 5. **(a)** Explain what you understand by the probability sampling and non probability sampling. What are their relative advantages and disadvantages? (6)

(b) What is a sampling distribution? Describe the properties of the sampling distribution of the means. (6)

(c) A finite population consists of the numbers 2, 4 and 6. Form a sampling distribution of sample mean, when random samples of size 4 is drawn with replacement. Also verify its properties. (8) **(20)**

Q. 6. **(a)** Under what condition is the sampling distribution of $\frac{s_1^2}{s_2^2}$ an F-distribution? Explain the relationship between the F and t distributions, between the F and Chi-Square distributions. (6)

(b) The proportion of families buying milk from company A in a certain city is believed to be p=0.6. If a random sample of 10 families shows that 3 or less buy milk from company A, we shall reject the hypothesis that p=0.6 in favour of the alternative p<0.6. Evaluate α if p=0.6, evaluate β for the alternatives p=0.3, p=0.4 and p=0.5. (6)

(c) Define a Chi-square random variable and its density function. Discuss the important properties of Chi-square distribution. Show that the Chi-square distribution tends to normal distribution for large degrees of freedom. (8) **(20)**

Q. 7. **(a)** Describe the Randomized Complete Block Design, its model and analysis. What are its advantages and disadvantages? (6)

(b) Compare Randomized Complete Block experiments with Completely Randomized experiments, comparing their respective advantages and relative efficiency, with illustrations. (6)

(c) Three varieties A, B and C of a crop are tested in a randomized block design with four replications, the layout being given below. The plot yields in pounds are also indicated therein. Analyze the experimental yields and state your conclusions. (8) **(20)**

Replications	1	A 32.1	C 34.2	B 31.7
	2	C 30.7	A 17.0	B 32.7
	3	A 40.8	B 25.3	C 48.2
	4	B 47.9	C 59.6	A 26.8

Q. 8. **(a)** Define gross and net production rates. Explain how would you compute the net production rate and what interpretations can be made if it is 1, less than 1 or greater than 1. (6)

(b) Explain with suitable illustrations the object of standardizing various vital statistics relating to births, deaths and marriages. (6)

(c) Compute the gross and net reproduction rates for the following data: (8) **(20)**

Age-group (years)	Female Population (000)	Female births	Probability of survival
15-19	1558	18900	0.914
20-24	1112	71100	0.899
25-29	1595	96900	0.884
30-34	1629	64200	0.868
35-39	1627	34900	0.852
40-44	1522	10800	0.834
45-49	1401	800	0.813