

**2010**  
**STATISTICS - II (Optional)**

200043

Standard : Degree

Total Marks : 200

Nature : Conventional

Duration : 3 Hours

**Note :**

- (i) Answers must be written in **English**.
- (ii) Question No. 1 is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each section**.
- (iii) Figures to the **RIGHT** indicate marks of the respective question.
- (iv) Use of log table, Non-Programmable calculator is permitted, but any other Table / Code / Reference book are not permitted.
- (v) Make suitable assumptions, wherever be necessary and state the same.
- (vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.
- (vii) Credit will be given for orderly, concise and effective writing.
- (viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

**1. Answer any four of the following (10 marks)**

- (a) For a linear programming problem explain what you understand by **10**
  - (i) feasible solution
  - (ii) optimum solution
  - (iii) unbounded solution
- (b) Explain the control chart for fraction defective. **10**
- (c) Discuss the importance of randomisation and replication in design of experiments. **10**
- (d) What is a time-series ? Describe the methods of least squares for estimating the trend component. **10**
- (e) Describe a two person zero-sum game. What do you understand by the terms **10**
  - (i) pure strategy    (ii) mixed strategy ?

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## SECTION - A

2. Answer the following sub questions :

(a) Solve the following L.P.P graphically 10

$$\text{minimize } Z = 20x_1 + 40x_2$$

$$\text{subject to } 6x_1 + x_2 \geq 18$$

$$20x_1 + 10x_2 \geq 100$$

$$x_1 + 4x_2 \geq 12$$

$$x_1, x_2 \geq 0$$

(b) Four petrol dealers A,B, C and D require 50, 40, 60 and 40 KL of petrol respectively. 15  
It is possible to supply these from locations P,Q and R which have 80, 100 & 50 KL respectively. The cost (in Rs) for shipping every KL is shown in table below :

	Dealer			
Location	A	B	C	D
P	7	6	6	6
Q	5	7	6	7
R	8	5	8	6

Obtain the initial basic feasible solution using :

(i) the North-West Corner Rule

(ii) the matrix minima method.

Which method gives a superior answer ?

(c) Discuss the advantages and limitation of the simulation technique. 15

3. Answer the following sub-questions :

(a) Solve the following LPP using Simplex Method 10

$$\text{max } Z = 4x_1 + 3x_2 + 5x_3$$

Subject to :

$$2x_1 + 3x_2 + 2x_3 \leq 400$$

$$3x_1 + 2x_2 + 2x_3 \leq 350$$

$$x_1 + 4x_2 + 2x_3 \leq 300$$

$$x_1, x_2, x_3 \geq 0$$

- (b) Consider the problem of assigning four clerks to four tasks. The time (hours) required to complete the tasks is given below. 15

	Tasks			
Clerks	A	B	C	D
1	4	7	5	6
2	-	8	7	4
3	3	-	5	3
4	6	6	4	2

Clerk 2 can't be assigned to task A and clerk 3 can't be assigned to task B. Find the optimum assignment schedule.

- (c) A shop selling Maharashtra sweets orders 25 units of a particular sweet daily. The daily demand is uniformly distributed between 20 and 30. Each unit costs Rs.10 and is sold for Rs. 18. Each stock-out causes a loss of Rs.4. As no proper storage facilities exist unsold units have to be thrown away. Using the following random numbers simulate the demand for 6 days and obtain the average daily profit or loss. 15

Random numbers:- 9, 5, 8, 1, 2, 4

#### SECTION - B

4. Answer the following sub questions :

- (a) The following table shows the number of missing rivets noted at the final inspection of 12 aircrafts. Find the control limits for the control charts for defects, plot the control chart and comment on the state of control. 10

Aircraft no. :	1	2	3	4	5	6	7	8	9	10	11	12
No. of missing rivets :	7	15	13	18	10	14	13	10	20	11	22	15

- (b) (i) Describe the control chart for process variability. 5  
(ii) In the context of sampling plans explain, in brief, O.C, AOQ and ASN. 5
- (c) Discuss the objectives of an analysis of process capability. 10
- (d) Obtain the expressions for reliability of series and parallel systems of 'n' components with reliabilities  $R_1, R_2, \dots, R_n$ . 10

5. Answer the following sub-questions :

- (a) Write a note on cumulative sum charts. 10
- (b) (i) Write a note on the  $\bar{X}$ -chart 5  
(ii) Discuss the single sampling plan. 5
- (c) How does one conduct an analysis of process capability ? 10
- (d) Explain the concept and utility of measurement of reliability. 10

9. Answer the following sub-questions :

(a) Calculate the price index number for the following data using -

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(i) Weighted aggregative method.

(ii) Simple average of price relatives method.

Commodity	Price per unit in 2001 (base year)	Price per unit in 2007	Weights
A	10	12	18
B	6	9	12
C	12	17	10
D	15	20	20
E	20	22	10

(b) Discuss the uses of vital statistics and critically examine the methods of obtaining them.

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(c) The following table gives the population of a country comprising of 3055101 males and 3024916 females for the year 2001.

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Age Group	Female Population	Male births	Female births
15 - 19	314056	3578	3343
20 - 24	269340	7293	6690
25 - 29	231887	6775	6361
30 - 34	203477	4233	4187
35 - 39	176534	2999	2685
40 - 44	145037	593	725
45 - 49	122946	129	128

Calculate (i) crude birth rate (ii) general fertility rate.

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## SECTION - C

6. Answer the following sub questions :

- (a) (i) Describe a randomized block design (R.B.D.). 5  
(ii) What are main effects and interactions in factorial experiments. 5
- (b) What is a Balanced Incomplete Block Design (B.I.B.D.). Define the different parameters involved. 10
- (c) A  $2^2$  factorial experiment in factors A and B was conducted in four replications with the following results : 10

Replication 1	(1)	a	b	ab
	60	57	55	71

Replication 2	a	(1)	ab	b
	46	56	65	48

Replication 3	b	ab	(1)	a
	63	48	59	70

Replication 4	ab	a	b	(1)
	59	64	54	80

Analyze the data and report on your findings.

- (d) What do you understand by analysis of covariance ? 10

7. Answer the following sub questions :

- (a) (i) Describe a Latin Square Design. 5  
(ii) In the factorial experiment explain the need and utility of confounding. 5
- (b) For a Randomized Block Design obtain an expression for the estimate of one missing plot. 10
- (c) For a  $2^3$  factorial experiment with 3 factors A, B & C each at two levels over 3 replications with 2 blocks each, the design and yield per plot are given below. Analyze the experiment. 10

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	Block 1				Block 2			
Replication I	ab	ac	bc	1	c	abc	b	a
	49	59	46	39	40	62	33	55
	Block 3				Block 4			
Replication II	ac	(1)	bc	ab	b	abc	c	a
	50	40	52	50	32	48	52	54
	Block 5				Block 6			
Replication III	a	b	abc	c	bc	ac	(1)	ab
	47	37	47	47	39	50	39	51

- (d) Discuss the analysis of covariance in a one-way layout with one concomitant variable. 10

## SECTION D

8. Answer the following sub-questions : 15
- (a) The following is a data on prices and quantities consumed for 4 commodities in base year 1993 and year 1995

Commodity A	1993		1995	
	Price	Quantity	Price	Quantity
A	12	60	15	50
B	8	40	12	32
C	15	80	20	70
D	20	35	26	30

Calculate the following price index numbers

- (i) Laspayre's (ii) Fisher's  
 (iii) Walsh's (iv) Dorbish-Bowley's methods
- (b) What is a life table ? Which are the different columns that constitute a life table and how are they obtained ? 15
- (c) The following is data on deaths in two places A and B : 10

Age	A		B	
	Population in '000	Specific death rate	Population in '000	Specific death rate
0 - 10	12	50	15	47
10 - 25	14	15	17	13
25 - 60	28	10	25	7
60 and above	6	60	3	64

- Find the : (i) crude death rate for place A  
 (ii) Standardized death rate for place A taking place B as the standard population.

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