1974—IV S STA—Pr—MAY 2019

FOURTH SEMESTER M.A./M.Sc. DEGREE EXAMINATION, MAY/JUNE 2019

(CBCS)

Statistics

STCP 4.1—PRACTICALS (Based on STCT 4.1)

Time : Two Hours Maximum : 30 Marks

Question Nos. 1 and 2 *are* **compulsory.**
Answer any **one** *from the remaining, using Matlab / R software.*
Each question carries 10 *marks.*

1. Suppose $\underline{X} \sim N_3(\underline{\mu}, \Sigma)$, where :

$$\underline{\mu} = \begin{pmatrix} 3 \\ 1 \\ 4 \end{pmatrix} \text{ and } \Sigma = \begin{pmatrix} 6 & 1 & -2 \\ & 13 & 4 \\ & & 4 \end{pmatrix}.$$

(a) Find the correlation between X_1 and $\frac{X_2}{3} + \frac{X_3}{2}$.

(b) Assuming that the random vector $\underline{X} \sim N_3(\underline{\mu}, \Sigma)$,

(i) obtain the joint distribution of $Y_1 = 2X_1 + X_2 + 3X_3$ and $Y_2 = 3X_1 - X_2 - 2X_3$,

(ii) find the marginal distribution of $\underline{X}^{(1)} = (X_2, X_3)^T$, are the random variables X_2 and X_3 independent.

(iii) determine the multiple correlation co-efficient between X_1 and (X_2, X_3).

(3 + 7 = 10 marks)

2. Consider a 3-variate population with covariance matrix :

$$\Sigma = \begin{pmatrix} \sigma^2 & \sigma^2 p & 0 \\ \sigma^2 p & \sigma^2 & \sigma^2 p \\ 0 & \sigma^2 p & \sigma^2 \end{pmatrix}$$

where $\sigma^2 > 0$ and $\rho > 0$. Show that :

(a) $\rho < \frac{1}{\sqrt{2}}$,

(b) the proportion of the total population variance explained by the first two principal components is $\frac{\sqrt{2}}{3}(\rho + \sqrt{2})$.

(6 + 4 = 10 marks)

Turn over

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Statistics

STCP 4.2—PRACTICALS BASED ON STCT 4.2

Time : Two Hours Maximum : 30 Marks

Answer the following questions.
Each question carries 10 marks.

1. Given three independent stochastic varieties having common variance σ^2 such that $E(y_1) = \theta_1 + \theta_2, E(y_2) = \theta_1 + \theta_3$, and $E(y_3) = \theta_1 + \theta_2$. Examine the estimability of the following linear parametric functions.

   (i) $2\theta_1 + \theta_2 + \theta_3$. (ii) $\theta_1 + 2\theta_2 - \theta_3$.

   If estimable, obtain BLUEs and the variance of the BLUE.

   Or

   (a) If $E(y_1) = \beta_1 - \beta_2, E(y_2) = \beta_1 + \beta_2 + \beta_3, E(y_3) = \beta_2 + \beta_3$, is $3\beta_1 + \beta_2 - \beta_3$ estimable. If so, obtain its BLUE. Find variance of BLUE, for given $y_1 = 56$, $y_2 = 77$, $y_3 = 43$.

   (b) $E(y_1) = \theta_1 + \theta_3, E(y_2) = \theta_1 + \theta_2, E(y_3) = \theta_1 + \theta_2, E(y_4) = \theta_1 + \theta_3$ Verify whether $\theta_1 - \theta_3$ is estimable. If so obtain BLUE of $\theta_1 - \theta_3$. Also obtain variance of BLUE, for given $y_1 = 92$, $y_2 = 95$, $y_3 = 97$ and $y_4 = 88$.

   (5 + 5 = 10 marks)

2. Sixteen observations on the viscosity of a polymer (y) and two process variables- reaction temperature (x_1) and catalyst feed rate (x_2) are given in the following table. The following linear model is assumed :

   $y = \mu(x_i) + \epsilon_i$

   $= \beta_0 + \beta_1 x_{1i} + \beta_1 x_{2i} + \epsilon_1$, ϵ_i's are distributed N~ID (0, σ^2) i = 1, 2.... 16

Observation	Viscosity	Temperature $(x_1)^0$C	Catalyst Feed Rate $(x_2)^{(lb/h)}$
1.	2256	80	8
2.	2340	93	9
3.	2426	100	10
4.	2293	82	12

5.	2330	90	11
6.	2368	99	8
7.	2250	81	8
8.	2409	96	10
9.	2364	94	12
10.	2379	93	11
11.	2440	97	13
12.	2364	95	11
13.	2404	100	8
14.	2317	85	12
15.	2309	86	9
16.	2328	87	12

(i) Find the normal equations.

(ii) By least squares method find $\hat{\beta}, \hat{\sigma}^2, \hat{u}(x)$

(iii) Test the hypothesis : $\beta_1 = \beta_2 = 0$ at $\alpha = 0.05$

(iv) Set simultaneous C.I for $\beta_1 = \beta_2$ and β_2

Or

A varietal trial was conducted in a Laboratory with 8 varieties of hybrid maize. The trial was laid out in a randomized block design with 4 replications. At the time of harvest the number of plants per plot of size 48 ' x 12' was also recorded along with the plot yield. The data of grain yield in lbs per plot and the number of plants given in brackets are presented below:

Replications				
Varieties	I	II	III	IV
A	32.25 (205)	48.27 (239)	38.34 (229)	47.50 (140)
B	83.50 (230)	65.50 (208)	34.50 (224)	58.50 (197)
C	35.50(221)	49.50 (226)	48.50 (240)	57.50 (248)
D	42.50 (234)	33.50 (252)	40.20(231)	63.00 (251)
E	71.31(219)	45.25 (253)	55.13 (229)	46.06 (194)
F	57.31 (289)	46.50 (250)	52.88 (239)	45.25 (101)
G	34.19(229)	46.00 (259)	49.69 (214)	49.50 (211)
H	29.50(232)	35.50(247)	28.50 (233)	39.13 (201)

Analyse the data and test whether the varieties are significantly different in respect of yield.

3. The experiment on the application of commercial fertilizers to the Dunlap Variety of strawberries was conducted using 5 × 5 LSD.

	1	2	3	4	5
1	A	D	C	B	E
	31	58	56	44	40
2	B	C	E	D	A
	39	51	48	54	35
3	C	B	A	E	D
	51	47	51	74	53
4	E	A	D	C	B
	40	-	65	52	51
5	D	E	B	A	C
	55	53	41	46	47

The yield of strawberry for 4th row, 2nd Column and for treatment A is missing. Estimate the missing observation and carry out the analysis.

Or

A varietal trial involving six varieties of wheat crop was conducted in an agricultural college in India in a Balanced Incomplete Block Design (BIBD) with 10 blocks of three plots each. Each variety was replicated five times and each variety occurred together in 2 blocks.

Blocks	Varieties					
	1	2	3	4	5	6
1	54	50	46			
2	73	62		35		
3	70		43		52	
4	60			57		36
5	66				61	50
6		60	63			62
7		57		60	62	
8		56			59	61
9			75	62	61	
10			59	55		56

(i) Carry out intra block analysis and draw your conclusions.

(ii) Test the significance of the difference between the main effects of 2nd and 5th variety.

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Statistics

Paper STCP 4.3—PRACTICALS BASED ON STCT 4.3

Time : Two Hours Maximum : 30 Marks

Answer any **two** *questions.*
Each question carries 15 *marks.*

1. Inside diameter measurements (mm.) on Automobile Engine Piston Rings are as follows :

Sample number	*Observations*				
1	44.030	44.002	44.419	43.992	44.058
2	43.995	43.992	44.201	-	-
3	43.988	44.024	44.021	44.005	44.062
4	44.002	43.996	43.993	44.015	
5	46.992	44.007	44.015	43.989	44.014
6	44.009	43.994	43.997	43.985	-
7	47.995	45.006	43.994	44.000	-
8	43.985	44.003	43.993	44.015	43.988
9	44.008	43.995	45.009	44.005	
10	43.998	44.000	43.990		
11	43.994	43.998	43.994	43.995	43.990
12	43.004	45.000	45.007	45.000	43.996
13	43.983	45.002	43.998	-	-
14	45.006	43.967	43.994	44.000	43.984
15	44.012	44.014	43.998	-	-
16	44.000	43.984	45.005	43.998	43.996
17	42.994	44.012	43.986	44.005	
18	44.006	45.010	44.018	44.003	44.000
19	43.984	45.002	44.603	44.005	43.997
20	44.000	44.010	44.013	-	-
21	43.982	44.001	44.015	44.005	
22	45.004	43.999	43.990	44.406	45.009
23	44.010	43.989	43.990	44.109	44.714
24	44.015	44.108	43.993	45.000	
25	43.982	43.984	43.995	44.017	44.813

Construct $\overline{X}$ and s control charts.

Turn over