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MSTL-002/S1

Post Graduate Diploma in Applied Statistics (PGDAST)

Term-End Examination

December, 2018

INDUSTRIAL STATISTICS LAB

Time : 3 Hours *Maximum Marks : 50*

Note **:** (i) Attempt any *two* questions.

(ii) Solve the questions in Microsoft Excel.

(iii) Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.

(iv) Mention hypotheses, interpretations, etc.

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1. (a) A company makes iron plates weighing 500 gm each. It has installed a new machine for speeding up production. The company's quality control officer has taken a random sample of 7 plates every hour for checking the efficiency of the new machine. In this manner, a total of 22 random samples of size 7 each were taken and the weights of the plates are recorded and given in the following table :

Sample No.	I	II	III	IV	V	VI	VII
1	500.00	500.25	500.39	500.13	500.00	500.00	500.12
2	500.11	500.14	500.12	500.00	500.15	500.11	500.17
3	500.11	500.13	500.12	500.19	500.00	500.00	500.15
4	500.12	500.21	500.14	500.17	500.18	500.19	500.21
5	500.00	500.16	500.19	500.00	500.14	500.00	500.19
6	500.14	500.18	500.00	500.00	500.00	500.15	500.17
7	500.12	500.14	500.13	500.14	500.31	500.21	500.00
8	500.12	500.13	500.00	500.00	500.32	500.31	500.21
9	500.00	500.00	500.19	500.32	500.31	500.22	500.23
10	500.23	500.32	500.31	500.43	500.41	500.39	500.37
11	500.43	500.42	500.21	500.13	500.17	500.16	500.18
12	500.14	500.17	500.12	500.13	500.00	500.00	500.00
13	500.31	500.32	500.32	500.14	500.12	500.11	500.12
14	500.12	500.12	500.00	500.00	500.11	500.17	500.15
15	500.00	500.00	500.13	500.12	500.14	500.31	500.00
16	500.32	500.24	500.23	500.22	500.21	500.22	500.15
17	500.12	500.15	500.12	500.00	500.00	500.12	500.14
18	500.15	500.14	500.16	500.17	500.12	500.00	500.13
19	500.00	500.15	500.00	500.12	500.12	500.13	500.12
20	500.00	500.13	500.15	500.13	500.14	500.16	500.00
21	500.12	500.13	500.00	500.00	500.12	500.17	500.18
22	500.13	500.15	500.00	500.13	500.13	500.12	500.15

Draw suitable control charts for process variability and process–mean and comment whether the process is under control. If not, draw the revised charts. 15

(b) A cable wire company has spent heavily on advertisements. The sales and advertisement expenses (in thousand rupees) for 12 randomly selected months are given as follows : 10

Months	Advertisement Cost (in thousand rupees)	Sales (in thousand rupees)
January	920	9,300
February	940	9,000
March	970	10,200
April	980	9,900
May	1,000	11,000
June	1,020	10,500
July	1,040	11,500
August	1,050	11,200
September	1,050	11,300
October	1,070	12,000
November	1,070	12,500
December	1,100	12,200

(i) Construct scatter plot between sales and advertisement.

(ii) Develop a linear regression model to predict the impact of advertisement on sales.

(iii) Perform residual analysis.

(iv) Calculate coefficient of determination, standard error of the estimate and interpret the results.

(v) Perform t-test for the result testing slope of the model at 1% level of significance.

2. (a) A consumer electronic company has developed an aggressive policy to increase sales of a newly launched product. The company has invested in advertisements as well as employed salesmen for increasing sales rapidly. The sales, the total salary and expenditure on advertisement for 24 randomly selected months are given in the following table :

Months	Sales (in thousand ₹)	Total Salary (in thousand ₹)	Advertisement Expenditure (in thousand ₹)
1	5,000	250	180
2	5,200	350	250
3	5,700	150	150
4	6,300	270	240
5	6,000	200	185
6	6,400	110	160
7	6,100	80	177
8	6,400	110	315

9	6,900	290	170
10	7,300	310	240
11	6,950	60	184
12	7,350	100	218
13	6,920	140	216
14	8,450	80	246
15	9,600	180	229
16	10,900	70	269
17	10,200	90	244
18	12,200	100	305
19	10,500	60	303
20	12,800	80	320
21	12,600	120	322
22	11,500	140	460
23	13,800	110	430
24	14,000	90	422

(i) Prepare a scatter matrix to get an idea about the relationship among variables. 3

(ii) Develop a multiple linear regression model and test significance of the fitted model at 5% level of significance. 12

(b) On a particular day, 24 items from a production process were selected randomly and examined. The number of defects found in each item were as follows :

Item No.	Number of Defects
1	6
2	2
3	5
4	1
5	2
6	2
7	3
8	5
9	3
10	4
11	12
12	4
13	4
14	1
15	3
16	5
17	4
18	1
19	4
20	3
21	5
22	4
23	2
24	3

Draw suitable control chart and check whether the process is under control ? If not, draw the revised charts. 10

3. The data given below represent the number of persons visiting a place of interest on a monthly basis from January, 2015 to December, 2017 :

Months	No. of Persons (in thousands)		
	2015	2016	2017
January	90	100	110
February	85	89	93
March	70	74	78
April	60	62	66
May	55	55	58
June	45	47	40
July	30	30	35
August	40	43	45
September	70	65	72
October	120	127	130
November	115	118	118
December	118	120	124

(i) Calculate seasonal indices using ratio-to-moving average method. 10

(ii) Obtain deseasonalised values and then fit a linear trend line to the deseasonalised data using method of least squares. 12

(iii) Plot original data and deseasonalised data. 3