B.E. Production Engineering 2nd Year 1st Semester Examination

Ex/PROD/BS/B/T/215

INDUSTRIAL STATISTICS

Time : **Three hours** Full marks: **100**

Answer Question No. 1 and any four from the rest.

1.(a) What are the different techniques available for sample collection. Highlight the advantages and disadvantages of each of them. (10)

(b) Differentiate between (i) Estimation and test of hypothesis, (ii) Correlation coefficient and rank correlation coefficient (2.5X2)

(c) With numerical data, prove that the value of rank correlation coefficient can be -1. (5)

2.(a) The brake horsepower developed by an automobile engine of a dynamometer is thought to be function of the road octane number of the fuel. An experiment is run in the laboratory and the data that follow are collected. (12)

Brake horsepower	225	216	229	222	219	278	246	237	233	224	223	230
Road octane number	90	94	88	91	86	96	94	90	88	86	90	89

Now, find out how road octane number is related with brake horsepower based on correlation coefficient and estimate the brake horsepower when the road octane number is 92.

(b) Find out Spearman's coefficient of correlation between the two kinds of assessment of graduate students' performance in a college. (8)

Name of students	A	B	C	D	E	F	G	H	I
Internal Exam	51	68	73	46	50	65	47	38	60
External Exam	48	72	74	44	58	66	50	30	35

3.(a) A genetics engineer was attempting to cross a tiger and a cheetah. She predicted a phenotypic outcome of the traits she was observing to be in the following ratio 4 stripes only: 3 spots only: 9 both stripes and spots. When the cross was performed and she counted the individuals she found 50 with stripes only, 41 with spots only and 85 with both. Did she get the predicted outcome? (Corresponding test-statistic value is 5.991 for 2 df at 5% significance level). (8)

(b) Front housings for cell phones are manufactured in an injection molding process. The time the part is allowed to cool in the mold before removal is thought to influence the occurrence of a particularly troublesome cosmetic defect, flow lines, in the finished housing. After manufacturing, the housings are inspected visually and assigned a score between 1 and 10 based on their appearance, with 10 corresponding to a perfect part and 1 corresponding to a completely defective part. An experiment was conducted using two cool-down times, 10 and 20 seconds, and 20 housings were evaluated at each level of cool-down time. All 40 observations in this experiment were run in random order. The data are as follows: (12)

10 seconds		20 seconds	
1	3	7	6
2	6	8	9
1	5	5	5
3	3	9	7
5	2	5	4
1	1	8	6
5	6	6	8
2	8	4	5
3	2	6	8
5	3	7	7

Is there any evidence to support the claim that longer cool-down time results in fewer appearance defects? (Corresponding test-statistic value is 1.691 for 38 df at 5% significance level)

4. An experiment is conducted to study the influence of operating temperature and three types of faceplate glass in the light output of an oscilloscope tube. The following data are collected: (20)

[Turn over

Glass type	Temperature		
	100	125	150
1	580, 568	1090, 1087	1392, 1380
2	530, 579	1035, 1000	1312, 1299
3	546, 575	1045, 1053	867, 904

Use 5% level of significance in the analysis. Is there any significant interaction effect? Dose glass type or temperature affect the response? What conclusions can you draw? What is the optimal operating environment? (Corresponding test-statistic values are 19.39 and 5.999 for (2, 9) and (4, 9) df respectively)

5.(a) A and B play 12 games of chess, of which 6 are won by A, 4 are won by B, and 2 end in a draw. They agree of play a match consisting of 3 games. Find the probability that (a) A wins all games, (b) 2 games end in a draw, (c) A and B win alternatively, and (d) B wins at least 1 game. (8)

(b) Four catalysts that may affect the concentration of one component in a three-component liquid mixture are being investigated. The following concentrations are obtained from a completely randomized experiment. (12)

Catalyst			
1	2	3	4
58.2	56.3	50.3	52.9
57.2	54.5	54.2	49.9
58.4	57.0	55.4	50.0
55.8	55.3		51.5
55.2			

Dose the four catalysts have the same effect on the concentration? (Corresponding test-statistic value is 8.745 for (3, 12) df at 5% significance level)

6.(a) The costs (in thousands of dollars) for tuition, room, and board per year at 15 randomly selected public colleges and 10 randomly selected private colleges are shown in the following table. Test the null hypothesis that the mean yearly cost at private colleges exceeds the mean yearly cost at public colleges at 5% level of significance. (Corresponding test-statistic value is 1.714 for 23 df) (12)

Public colleges			Private colleges	
4.2	9.1	11.6	13.0	17.7
6.1	7.7	10.4	18.8	17.6
4.9	6.5	13.2	13.2	19.8
8.5	6.2	14.4	14.4	16.8
4.6	10.2	17.7	17.7	16.1

(b) Instructors A and B both teach a first course in Chemistry at XYZ University. On a common final examination, their students received the grades shown in the following table. Test at 5% level of significance the hypothesis that there is no difference between the two instructor's grades. (8)

A	88	75	92	71	63	84	55	64	82	96				
B	72	65	84	53	76	80	51	60	57	85	94	87	73	61

7.(a) A sample of 40 grades from a statewide examination is shown in the following table. Test the hypothesis at 5% level of significance that the median grade for all the participants is 75. (Corresponding test-statistic value is 1.714 for 23 df) (8)

71	67	55	64	82	66	74	58	79	61
78	40	84	93	72	72	78	86	48	52
67	95	70	43	70	70	57	64	60	83
73	40	78	70	64	64	76	62	95	66

(b) Seeds of four different types of corn are planted in five blocks. Each block is divided into four plots which are then randomly assigned to the four types. Determine at 5% level of significance whether the yields of the crop per acre, as shown in the following table, vary significantly with difference in (a) soil fertility (five blocks) and (b) type of the corn. (Corresponding test-statistic values are 8.745 and 5.912 for (3, 12) and (4, 12) df respectively) (12)

Block	Type of the corn			
	I	II	III	IV
A	12	15	10	14
B	15	19	12	19
C	14	18	15	12
D	11	16	12	16
E	16	17	11	13