

B.E. Production Engineering 2nd Year 1st Semester Examination, 2025

Ex/PROD/BS/B/T/215/2025

INDUSTRIAL STATISTICS

Time : Three hours

Full marks: 100

- 1 The factors that influence the breaking strength of a synthetic fiber are being studied. Four production machines and three operators are chosen and a factorial experiment is run using fiber from the same production batch. The results are as follows: (20)

Operator	Machine			
	1	2	3	4
1	109, 110	110, 115	108, 109	110, 108
2	110, 112	110, 111	111, 109	114, 112
3	116, 114	112, 115	114, 119	120, 117

Analyze the data and draw conclusions at 5% level of significance. (Given $F_{0.05} = 9.41$ for (2, 12) df, $F_{0.05} = 5.22$ for (3, 12) and $F_{0.05} = 2.90$ for (6, 12))

- 2(a) An industrial engineer is investigating the effect of four assembly methods (A, B, C and D) on the assembly time for a color television component. Four operators are selected for the study. Furthermore, the engineer knows that each assembly method produces such fatigue that the time required for the last assembly may be greater than the time required for the first, regardless of the method. That is, a trend develops in the required assembly time. To account for this source of variability, the engineer uses the Latin square design shown below. Analyze the data from the experiment at 5% level of significance and draw appropriate conclusions. (Given $F_{0.05} = 8.94$ for (3, 6) df) (15)

Order of assembly	Operator			
	1	2	3	4
1	C = 10	D = 14	A = 7	B = 8
2	B = 7	C = 18	D = 11	A = 8
3	A = 5	B = 10	C = 11	D = 9
4	D = 10	A = 10	B = 12	C = 14

- (b) Develop a real-time Greeco-Latin square design plan with five factors. (5)
- 3(a) A study was conducted to compare the mean lifetimes of males with the mean lifetimes of females. Random samples were collected from the obituary pages and the data in the following are obtained. (20)

Males		Females	
85	53	64	93
60	51	64	60
55	99	61	84
90	72	105	90
49	72	71	99
90	74	98	61
62	65	66	74
78	49	81	86
53	82	92	77
72	104	91	93

Based on the above data, test at 5% level of significance whether the males and females come from the same population having same mean and variance. Also determine the 95% confidence interval for the difference of the population means. (Given $t_{0.05} = 1.69$ for 38 df, $F_{0.05} = 1.83$ for (19, 19)) (5+5+4)

- (b) Distinguish between the following: (3×2)

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- (i) Type I and Type II errors
(ii) Estimation and test of hypothesis.

- 4(a) A group of 30 Internet shoppers were asked how much they spent per year on the Internet. Their responses are shown in the following table. It is desired to test that they spent \$325 per year versus it is different from \$325. Draw your conclusion at 5% level of significance. (10)

418	158	151	212	257	378
363	523	310	245	221	341
331	331	150	423	406	247
351	266	195	330	202	257
307	301	434	391	432	406

- (b) Based on the following data, determine the correlation coefficient. (10)

Age	56	42	72	36	63	47	55	49	38	42
Pressure	147	125	160	118	149	128	150	145	115	140

- 5(a) Based on the following information, develop the corresponding regression equation in the form of $PV^v = C$. (10)

Volume (V) (in^3)	54.3	61.8	72.4	88.7	118.6
Pressure (P) (lb/in^2)	61.2	49.2	37.6	28.4	19.2

- (b) Samples of 45 are taken from a lot, which is on the average 25 percent defective. What is the probability that a sample of 45 will contain exactly 13 defectives? What is the probability that it will contain 13 or more defectives? Use the following data: $\Phi(0.7745) = 0.7807$ and $\Phi(0.4305) = 0.6665$. (10)
- 6(a) A survey of 320 families with five children revealed the distribution as shown below. Is the result consistent with the hypothesis that male and female births are equally probable? (Given $X^2_{0.95} = 11.1$ at 5 df) (10)

No. of boys and girls	5 boys and 0 girl	4 boys and 1 girl	3 boys and 2 girls	2 boys and 3 girls	1 boy and 4 girls	0 boy and 5 girls
No. of families	18	56	110	88	40	8

- 7(a) The following table shows the heights of a sample of 10 fathers and their oldest adult sons. Find the coefficient of rank correction. (10)

Father (in)	65	63	67	64	68	62	70	66	68	67
Son (in)	68	66	68	65	69	66	68	65	71	67

- (b) A sample of 30 grades from a state-wise examination is shown in the following table. Test the hypothesis at 5% level of significance that the median grade for all the participants is 66. (10)

71	46	70	70	60	74
78	95	78	82	61	78
67	40	64	64	52	48
73	55	93	42	83	55
67	84	43	48	66	60