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QP Code : 31768

(3 hours)

[Total Marks: 80]

- Note: 1) Attempt any 4 Questions
 2) All questions carry equal marks
 3) Figures to the right indicated marks
 4) Assume any suitable data if required

Q1) a) Four technicians regularly make repairs when breakdowns occur on an automated production line. Janet, who services 20% of the breakdowns, makes an incomplete repair 1 time in 20; Tom, who services 60% of the breakdowns, makes an incomplete repair 1 time in 10; Georgia, who services 15% of the breakdowns, makes an incomplete repair 1 time in 20. For the next problem with the production line diagnosed as being due to an initial repair that was incomplete, what is the probability that this initial repair was made by Janet? [5]

b) The density function for a random variable X is [5]

$$F(x) = \begin{cases} ce^{-3x} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

Find i) the constant c

ii) the probability that $1 < X < 2$

iii) the probability that $X \geq 3$

iv) the probability that $X < 1$

c) Explain the Rule of Total Probability. Also Show that the mean and variance of the Beta distribution are given by [10]

$$i) \mu = \frac{\alpha}{\alpha + \beta} \quad ii) \sigma^2 = \frac{\alpha\beta}{(\alpha + \beta)^2(\alpha + \beta + 1)}$$

Q2) a) A population consists of the five numbers 3, 7, 11, 15. Consider all possible samples of size two which can be drawn with replacement from this population. [10]

Find i) The mean of the population

ii) the standard deviation of the population.

iii) the mean of the sampling distribution of the means.

iv) the standard deviation of sampling distribution of means; i.e. the standard error of means.

b) Table shows respective heights x and y of a sample of 12 fathers and their oldest sons. [10]

i) Find the correlation coefficient

ii) Find the least squares regression line of x on y.

Height x of Father (inches)	65	63	67	64	68	62	70	66	68	67	69	71
Height y of Son (inches)	68	66	68	65	69	66	68	65	71	67	68	70

Peter
who
services
5%
1 time in 20

Four

Q3) a) Explain application of Cox Model, Nunally and Vorster-Sears models in predicting and controlling construction equipment breakdown costs with practical examples [6]

b) Prepare a simulation model based on Monte-Carlo simulation to generate a range of random numbers, for the mean for the actual cost of 20 projects of similar nature as given below. Select suitable range for each. Run the simulation. (refer random number table given below) [14]

Project No.	Project cost (in Lakh Rs.)	Project No.	Project cost (in Lakh Rs.)
1	23.87	11	41.23
2	34.51	12	58.71
3	18.90	13	62.27
4	9.80	14	13.48
5	43.18	15	88.91
6	58.99	16	43.01
7	33.36	17	69.81
8	98.90	18	5.22
9	31.89	19	78.23
10	19.21	20	42.28

20	17	42	01	72	33	94	55	89	65	58	60
74	49	04	27	56	49	11	63	77	79	90	31
94	70	49	49	05	74	64	00	26	07	23	00
22	15	78	49	74	17	50	94	13	90	08	14
93	29	12	20	26	22	66	98	37	53	82	62
45	04	77	48	87	77	66	91	42	98	17	26
44	91	99	08	72	87	33	58	12	08	91	12
16	23	91	95	97	98	52	49	40	37	21	46
04	50	65	37	99	57	74	96	93	99	78	30
32	70	17	05	79	58	50	26	54	30	01	88
03	64	39	55	85	63	49	46	61	89	33	79
62	49	00	67	28	96	19	65	13	44	78	39
61	60	95	85	86	94	64	17	47	67	87	59
85	03	90	40	10	60	18	43	97	37	68	97

Q4) a) The density function of a random variable X is $f(x) = \begin{cases} 3x^2 & x \geq 0 \leq 1 \\ 0 & \text{otherwise} \end{cases}$ [5]

Find a) $E(X)$ b) $E(3X-2)$ c) $E(X^2)$ $E(X^2)$

b) An urn holds 5 white & 3 black marbles. If two marbles are drawn at random without replacement & X denote the number of white marbles, Find the probability distribution for X. [5]

- c) The following are data on the number of twists required to break a certain kind of forged alloy bar and the percentages of two alloying elements present in the metal: [10]

Number of twists (y)	41	49	69	65	40	50	58	57	31	36	44	57	19	31	33	43
Percentage of element A (x_1)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Percentage of element B (x_2)	5	5	5	5	10	10	10	10	15	15	15	15	20	20	20	20

Fit a least squares regression plane and use its equation to estimate the number of twists required to break one of the bars when $x_1 = 2.5$, $x_2 = 12$

- Q5) a) When the construction of bridge first started in 2011, the cost of sand was estimated to be Rs. 3100/brass in 2015, i.e. in the final stages of construction. But due to increase in royalties to be paid by sand suppliers, the sand prices went up abruptly.

Hence, the actual sand prices in 2015 far exceeded the estimated prices. The contractor had to shell out Rs. 4700/brass on an average and this itself lead to a tremendous increase in cost. Moreover, due to increase in diesel and petrol prices, the inventory carrying cost which was estimated to be 15%, actually turned out to be 28%.

The ordering cost which was estimated to be Rs. 50/truck (i.e. 2 brass), increased to Rs 100/truck. The annual consumption of sand in the Year 2015 was estimated to be 640 brass, but in actual due to pilferage, bulking of sand, and defective supply, 672 brass was required.

Hence, it is desired to do sensitivity analysis for the above data set and find out the % increase in the cost of the project, based on these variations. [10]

- b) i) The Income Distribution of workers in a certain factory was found to be normal with Mean of Rs 500 and standard Deviation equal to Rs 50. There were 228 persons above Rs 600. How many Persons were there in all. [5]

ii) Assuming that the diameters of 1000 brass plugs taken consecutively from a Normal Distribution with mean 0.7515cm & Standard Deviation .0020 cm. How many plus are likely to be rejected if the approved diameter is 0.752 ± 0.004 cm. [5]

Q6) a) Explain different types of risks associated with construction projects with practical examples and elaborate on how and which mathematical tools will enable project managers to predict and hence mitigate these risks. [10]

b) If the least squares regression line of y on x is given by $y = a+bx$, Prove that the Standard error of estimate s_{yx} is given by [10]

$$s_{yx}^2 = \frac{\sum y^2 - a\sum y - b\sum xy}{n}$$

26-11-2015

Name of student	seat Roll. NO	Signature
1. Sushant S. Patil	262	<u>Patil</u>
2. Nazneen S. Ansari	254	<u>Naz</u>
(3) Jalosra Qureshi (JS)	10 Block no	<u>JN</u>

Course: M.E. (CIVIL) (CONSRTU ENGG. & MANAGE.) (SEM - I) (CBSGS (Prog T6211)

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Correction:

Q4) a) pls read as ...

$$0 \leq x \leq 1 \text{ instead of } x \geq 0$$

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Course: M.E. (CIVIL) (CONSRTU ENGG. & MANAGE.) (SEM - I) (CBSGS (Prog T6211)

QP Code: 31768(2ND query)

Correction:

Q1 a) Four technicians regularly make repairs when breakdowns occur on an automated production line. Janet, who.....repair 1 time in 20.* and peter who services 5% of the breakdowns makes an incomplete repair 1 time in 20.....* made by Janet.

(Pls note the above underlined sentence is missing in the question.)

*Q2 a) pls read ... A population consists of the four numbers ... *instead of five.

Q4 a) pls read c) E (X2)

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