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Question Paper Code : 71432

M.E. DEGREE EXAMINATION, JUNE/JULY 2013.

First Semester

CAD/CAM

MA 9213/MA 9317/MA 905/10277 PS 101 – PROBABILITY AND STATISTICS/ PROBABILITY AND STATISTICAL METHODS

(Common to M.E. Industrial Safety Engineering and M.E. Industrial Engineering)

(Regulation 2009/2010)

Time : Three hours   Maximum : 100 marks

(Statistical tables may be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   State the axioms of probability, Using the axioms, show that $P(A) = 1 - P(A^C)$.

2.   A random X has mgf $M_X(t) = (1 - 2t)^{-1}$. Find $E(X)$ and $V(X)$.

3.   Describe the principle of least squares.

4.   Define partial and multiple correlations.

5.   Define Standard error of a statistic.

6.   A test is developed to test the mean of a normal population $N(\mu, \sigma^2)$, σ^2 known based on a random sample of size 15. Which test would you use?

7.   Define a factor, treatments experimental units and response variable.

8.   What do you understand by replication and randomization?

9.   Define a time series.

10.   What is the purpose of a smoothing constant in exponential smoothing?

PART B — (5 × 16 = 80 marks)

11. (a) (i) The time required to assemble a piece of machinery is a random variable having a normal distribution with $\mu = 12.9$ and $\sigma = 2$ minutes. Compute the probabilities that the assembly of a piece of machinery of this kind will take (8)

(1) at least 11.5 mts

(2) anywhere from 11.0 mts to 14.8 mts

(ii) Random variables X and Y have joint pdf $f(x, y) = \begin{cases} \dfrac{6}{5}(x + y^2), & 0 < x < 1 \text{ and } 0 < y < 1 \\ 0 & \text{otherwise} \end{cases}$. Examine whether they are independent. (8)

Or

(b) The following table gives the time to complete a job by 10 technicians in the morning (x) and in the late afternoon (y).

Morning	Afternoon
x	y
8.2	8.7
9.6	9.6
7.0	6.9
9.4	8.5
10.9	11.3
7.1	7.6
9.0	9.2
6.6	6.3
8.4	8.4
10.5	12.3

(i) Compute and interpret the sample correlation coefficient.

(ii) Find the equation of the least squares line that approximates the regression of the time taken in the afternoon (y) on the time taken in the morning. (16)

12. (a) (i) In a trivariate distribution, it is given that $r_{12} = 0.7$, $r_{23} = r_{31} = 0.5$. Compute $r_{23.1}$ and $R_{1.23}^2$. (8)

(ii) Let $X_1, X_2, \cdots X_n$ he a random sample from a normal distribution with mean μ and variance 4. Find the MLE of μ. (8)

Or

(b) (i) Suppose a computer has for a given set of values of x_1, x_2 and x_3

$r_{12} = 0.91$, $r_{13} = 0.33$ and $r_{22} = 0.81$

Examine whether the computations are free from error. (10)

(ii) The following is a random sample from exponential distribution with pdf $f(x) = \lambda e^{-\lambda x}$.

152, 115, 109, 94, 88, 137, 152, 77, 160, 165

Find the method of moments estimate of λ. (6)

13. (a) The following random samples are measurements of the heat producing capacity (in millions of calories per ton) of specimens of coal from two mines.

Mine I : 8260 8130 8350 8070 8340

Mine II : 7950 7890 7900 8140 7920 7840

Test whether the means are equal at 1%, level of significance.

Or

(b) Tests of fidelity and selectivity of 200 radio receivers produced the results shown in the following table.

		Fidelity		
		Low	Average	High
Selectivity	Low	6	12	32
	Average	33	61	18
	High	13	15	10

Test whether there is any relationship between fidelity and selectivity.

14. (a) In order to compare three brands of computer keyboards 4 data entry operators were randomly selected. Each specialist used all the three keyboards to enter the same kind of test materials for 10 minutes and the numbers of words entered per minute was recorded.

		Keyboard		
		A	B	C
	1	77	67	69
Specialist	2	71	62	59
	3	74	63	59
	4	67	57	54

Test the hypothesis that

(i) no differences exist among the effects of the keyboard on the mean number of words and

(ii) no differences exist among the effects of the data specialists on the mean number of words at 5% level of significance. (16)

Or

(b) A marketing company is interested in comparing 4 ways of packing a breakfast food in four different regions. They are also interested in promoting with offers-discounts, lotteries, coupons and 2 for 1 sales. The following are the figures-weekly sales in 100 thousand rupees.

	Discount	Lotteries	Coupons	2-for-1 sales
North east	48 (A)	38 (B)	42 (C)	53 (D)
South east	39 (B)	43 (C)	50 (D)	54 (A)
North west	42 (C)	50 (D)	47 (A)	44 (B)
South west	46 (D)	48 (A)	46 (B)	52 (C)

Analyse the, data using Latin squares design. (16)

15. (a) (i) Write the characteristics of time series. How do you represent them? (6)

(ii) The following time series shows the weekly sales of a product over the past 8 weeks.

Week : 1 2 3 4 5 6 7 8

Sales : 32 34 35 33 36 35 37 35

Compute the 2 and 4 period moving average forecast. Which averaging period results in the least MAD (Mean Absolute Deviation)? Also forecast the next week based on the answer. (10)

Or

(b) (i) For the following data :

Period : 1 2 3 4 5 6

Demand : 45 48 50 53 57 62

Use the exponential smoothing technique to forecast the next month's demand for $\alpha = 0.1$ and $\alpha = 0.3$. (8)

(ii) Explain autoregressive processes with suitable examples. (8)

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