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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 19IM4DCSFE **Max Marks: 100**
Course: Statistics for Engineers

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of statistical tables permitted.

UNIT - I

1 a) Discuss briefly the role of statistics in decision making **04**

   b) The percentage of cotton in material used to manufacture men's shirts follows. **06**

34.7	32.7	36.4	34.1	34.5	35.0	36.9
33.1	35.8	33.6	36.1	34.1	35.7	31.5
33.0	36.8	33.4	33.5	34.5	34.4	35.0
32.3	35.5	33.1	31.9	37.6	34.4	32.1
34.7	34.5	35.9	36.5	35.3	32.8	34.9
35.7	33.7	35.5	34.6	35.4	33.8	35.6

Construct a frequency distribution and histogram for the cotton content. Use seven Bins with starting value of bin as 31.5 with increment 1.0

   c) The nine measurements that follow are furnace temperatures recorded on successive batches in a semiconductor manufacturing process (units are): **10**

953   950   948   955   951   949   957   954   955

i). Calculate the sample mean, sample variance, and standard deviation.
ii). Find the median. How much could the largest temperature measurement increase without changing the median value?
iii). Construct a box plot of the data.

UNIT - II

2 a) Define Poisson Distribution and state its applications. **04**

   b) Marketing estimates that a new instrument for the analysis of soil samples will be very successful, moderately successful, or unsuccessful, with probabilities 0.3, 0.6, and 0.1, respectively. The yearly revenue associated with a very successful, moderately successful, or unsuccessful product is Rs.10 million, Rs.5 million, and Rs.1 million, respectively. Let the random variable X denote the yearly revenue of the product. **06**
   a) Determine the probability mass function of X
   b) Determine the cumulative distribution function,
   c) Determine the mean and variance of the random variable X and following probabilities:

c) A manufacturing process has 100 customer orders to fill. Each order requires one component part that is purchased from a supplier. However, typically, 2% of the components are identified as defective, and the components can be assumed to be independent. **05**

   i). If the manufacturer stocks 100 components, what is the probability that the 100 orders can be filled without reordering components?

   ii). If the manufacturer stocks 102 components, what is the probability that the 100 orders can be filled without reordering components?

d) A lot of 75 washers contain 5 in which the variability in thickness around the circumference of the washer is unacceptable. A sample of 10 washers is selected at random, without replacement. **05**

   i). What is the probability that at least one unacceptable washer is in the sample?

   ii). What is the mean number of unacceptable washers in the sample?

OR

3 a) The probability density function for the diameter of a drilled hole in millimeters is $f(x) = 10e^{-10(x-5)}$ for $x > 5$ mm. Although the target diameter is 5 mm, vibrations, tool wear, and other nuisances produce diameters larger than 5 mm. **07**

   i). Determine the cumulative distribution function.

   ii). Determine the mean and variance of the diameter of the holes.

   iii). Determine the probability that a diameter exceeds 5.1 mm.

b) The manufacturing of semiconductor chips produces 2% defective chips. Assume the chips are independent and that a lot contains 1000 chips. **06**

   i). Determine the probability that more than 25 chips are defective.

   ii). Approximate the probability that between 20 and 30 chips are defective.

c) The thickness of a flange on an aircraft component is uniformly distributed between 0.95 and 1.05 millimeters. **07**

   i). Determine the cumulative distribution function of flange thickness.

   ii). Determine the proportion of flanges that exceeds 1.02 millimeters.

   iii). What thickness is exceeded by 90% of the flanges?

UNIT - III

4 a) Distinguish between Point Estimate and interval Estimate with Example. **04**

b) A machine produces metal rods used in an automobile suspension system. A random sample of 15 rods is selected, and the diameter is measured. The resulting data (in mm) are as follows: **08**

8.24	8.25	8.2	8.23	8.24
8.21	8.26	8.26	8.2	8.25
8.23	8.23	8.19	8.28	8.24

Find a 95% two-sided confidence interval on mean rod diameter.

c) Define method of moments and method of likely hood used in estimation of parameters. **08**

UNIT - IV

5 a) A semiconductor manufacturer produces controllers used in automobile engine applications. The customer requires that the process fallout or fraction defective at a critical manufacturing step not exceed 0.05 and that the manufacturer demonstrate process capability at this level of quality using $\alpha = 0.05$. The semiconductor manufacturer takes a random sample of 200 devices **08**

and finds that four of them are defective. Can the manufacturer demonstrate process capability for the customer?

b) A postmix beverage machine is adjusted to release a certain amount of syrup into a chamber where it is mixed with carbonated water. A random sample of 25 beverages was found to have a mean syrup content of fluid ounces and a standard deviation of s = 0.015 fluid ounces. Find a 95% CI on the mean volume of syrup dispensed. **04**

c) A research engineer for a tire manufacturer is investigating tire life for a new rubber compound and has built 16 tires and tested them to end-of-life in a road test. The sample mean and standard deviation are 60,139.7 and 3645.94 kilometers. Can you conclude, using α =0.05, that the standard deviation of tire life exceeds 200 kilometers? State any necessary assumptions about the underlying distribution of the data. **08**

OR

6 a) The production of radar component is checked by sample of four. The following table shows the number of defective found in 300 samples. **10**

Number of defectives	0	1	2	3	4
Number of samples	90	130	58	20	2

Fit the distribution for the data and test the goodness of the fit at level of significance of 0.05

b) The diameter of steel rods manufactured on two different extrusion machines is being investigated. Two random samples of sizes n_1 = 15 and n_2 = 17 are selected, and the sample means and sample variances are $\bar{x}_1$ 8.73, $s_1^2 = 0.35$, $\bar{x}_2$= 8.68, and $s_2^2 = 0.40$, respectively. Assume that $\sigma_1^2 = \sigma_2^2$ and that the data are drawn from a normal distribution. Is there evidence to support the claim that the two machines produce rods with different mean diameters? Use α = 0.05 in arriving at this conclusion. **06**

c) Two catalysts may be used in a batch chemical process. Twelve batches were prepared using catalyst 1, resulting in an average yield of 86 and a sample standard deviation of 3. Fifteen batches were prepared using catalyst 2, and they resulted in an average yield of 89 with a standard deviation of 2. Assume that yield measurements are approximately normally distributed with the same standard deviation. **04**

UNIT - V

7 a) Distinguish between correlation and regression. **04**

b) A study was made to model the relation between weekly advertising expenditures and sales. During the study following data were recorded: **12**

Advertising cost	20	25	30	35	40	45	50	55	60
Weekly sales.	400	420	405	480	475	490	525	560	515

i). Find the equation of the regression line to predict weekly sales from advertising expenditures.
ii). Estimate the weekly sales when advertising costs are 35.
iii).Compute Coefficient of determination R^2 and interpret about model.
iv).Determine coefficient of correlation and comment on correlation.

c) Enumerate the strategies of experimentation. **04**

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