

Q.No.1:- An extrusion die is used to produce aluminum rods. Specifications are given for the length and the diameter of the rods. For each rod, the length is classified as too short, too long, or OK, and the diameter is classified as too thin, too thick, or OK. In a population of 1000 rods, the number of rods in each class is as follows:

Length	Diameter		
	Too Thin	OK	Too Thick
Too Short	10	3	5
OK	38	??	4
Too Long	2	25	13

- Find missing value (??) in the table.
- If a rod is selected at random, what is the probability that it is either too short or too thick?
- Given that a rod is selected and found to meet the length specification, what is the probability that the rod also meets the diameter specification?
- Let A is the event that rod meets the length specification and B is the event that rod meets the diameter specification. Are A and B independent events? How?

Q.No.2:- A manufacturing firm employs two analytical plans for the design and development of a particular product. For cost reasons, both the plans are used at different times. In fact, plans 1 and 2 are used for 40% and 60% of the products, respectively. The defect rate for the plans 1 and 2 are 1% and 0.9%, respectively. If a random product was observed and found to be defective, which plan was most likely used and thus responsible?

Q.No.3:- In a large shipment of automobile tires, 10% have a flaw.

- If we select 30 tires at random without replacement from a lot of 600 tires, what is the probability that more than 4 tires will have flaws?
- If we select 30 tires at random with replacement from a lot of 600 tires, what is the probability that any two tires will have flaws?
- If we keep selecting tires, what is the probability that the first flawed one will be selected on the 6th trial?

Q.No.4:- The electricity power failures occur according to a Poisson distribution with an average of 3.5 failures per week. Let X denotes the number of electricity power failures in a given week.

- Find the probability of at most one failure per week.
- Find the probability of 7 failure per week.
- If samples of size 35 are selected, find the probability that the mean failure time is less than 3.5 per week.

Q.No.5:- Let the continuous random variable X denote the current measured in a thin copper wire in milliamperes. Assume that the range of X is $[0, 20]$, and assume that the density function of X is $f(x) = 1/20, 0 \leq x \leq 20$.

- The probability that current is more than 5 mA and less than 10 mA is?
- 48th percentile of X is?
- Lower quartile of X is?

- d. If sample of 36 copper wires are selected, the probability that the mean current is less than 9 equals?

Q.No.6:- The lifetime of a mechanical assembly in a vibration test is exponentially distributed with a mean of 400 hours.

- a. What is the probability that an assembly on test fails in less than 100 hours?
- b. What is the probability that an assembly operates for more than 500 hours before failure?
- c. If an assembly has been on test for 400 hours without a failure, what is the probability of a failure in the next 100 hours?

Q.No.7:- The fraction strength of a certain type of glass average 14 (in thousands of pounds per square inch) and have a standard deviation of 2. If a sample of 100 pieces of this glass is randomly selected then,

- a. What is the probability that the average fraction strength for the 100 pieces exceeds 14.5?
- b. Given that the fraction strength is normally distributed, what is the probability that a randomly selected piece will have a strength more than 13?
- c. What is the approximate probability that at most 45 pieces, out of the 100, each will have a strength of no more than 13 thousand pounds per square inch?

Q.No.8:- The diameter of steel rods (measured in inches) manufactured on two different extrusion machines is being investigated. Two random samples of sizes n_1 and n_2 are selected. The sample information for the two machines in the form of sample sizes, means and variances is given as:

Machine 1: $n_1 = 32$, $\bar{x}_1 = 8.73$, $s_1^2 = 0.35$

Machine 2: $n_2 = 10$, $\bar{x}_2 = 8.68$, $s_2^2 = 0.40$.

Use this sample information to answer the following questions.

- a. Point estimate
 - I. for the mean diameter of steel rods produced by machine 1:-----
 - II. for the mean diameter of steel rods produced by machine 2:-----
 - III. for the difference in mean rod diameters:-----
- b. Standard error
 - I. for the mean diameter of steel rods produced by machine 1:-----
 - II. for the mean diameter of steel rods produced by machine 2:-----
 - III. for the difference in mean rod diameters:-----
 - IV. Pooled estimate of standard deviation for the diameters of steel rods produced by machines 1 and 2: -----
- c. Test the hypothesis that the mean diameter of steel rods produced by machine 1 is 8 inches. Use table value (critical value) approach at type I error rate of 0.03.
- d. Construct a 98% confidence interval for the mean diameter of steel rods produced by machine 2. Also interpret the interval.
- e. How large a sample is needed if we wish to be 95% confident that the sample mean diameter of steel rods produced by machine 1 will be within 2 inches of the true mean?

- f. Is there evidence to support the claim that the mean diameters of two machines differ by at most 0.10 inches? Use p value approach to make your decision at 2% level of significance.
- g. Construct a 99% confidence interval for the difference in mean rod diameters produced by two machines. Use this interval to test the hypothesis of no difference in mean rod diameters.
- h. The two extrusion machines are supposed to produce an equal proportion of defectives. Two random samples of sizes n_1 and n_2 are selected. The sample information for the two machines in the form of sample sizes and number of defectives is given as:
Machine 1: $n_1 = 80, x_1 = 3$
Machine 2: $n_2 = 100, x_2 = 2$
Using this sample information:
- I. Test the hypothesis of equal proportion of defectives produced by two extrusion machines, with 0.04 as type I error rate.
 - II. Construct a 96% confidence interval for the difference in the proportions of defectives produced by two extrusion machines. Interpret this interval and use it to verify the decision of part (i) above.
- i. What assumptions did you use to solve the problems in:
- I. parts c and d:
 - II. parts f and g:
 - III. part h