

MODULE-1**PROBABILITY DISTRIBUTION**

1. Define i) Random variable ii) Discrete probability distribution with an example. **(6M) (JUN-09)**

2. Suppose a random variable X takes the values: -3, -1, 2 and 5 with respective probabilities

$$\frac{2k-3}{10}, \frac{k-2}{10}, \frac{k-1}{10}, \frac{k+1}{10}. \text{ Find the value of } k \text{ and i) find } P[-3 < X < 4] \text{ and ii) } P[X \leq 2].$$

(6M) (JUN-10, DEC-18)

3. Find the constant c, such that the function $f(x) = \begin{cases} cx^2, & 0 < x < 3 \\ 0, & \text{otherwise} \end{cases}$ is a p.d.f. Also compute

$$p(1 < x < 2), p(x \leq 1), p(x > 1).$$

(5M) (JAN-18)

4. The probability distribution of a finite random variable X is given by the following table:

X_i	-2	-1	0	1	2	3
$P(x_i)$	0.1	K	0.2	2k	0.3	k

Determine the value of k and find the mean, variance and standard deviation. **(6M)(DEC-12)**

5. The probability density function of a variate x is

X	0	1	2	3	4	5	6
P(x)	K	3K	5K	7K	9K	11K	13K

Find k.

Find $P(x < 4)$, $P(x \geq 5)$ and $P(3 < x \leq 6)$.

(6M)(DEC-08, 10, 18, 19, JUN-11, 16)

6. A Random variable x has the following distributions:

x:	-2	-1	0	1	2	3	4
P(x)	0.1	0.1	k	0.1	2k	k	k

Find k, mean and S.D of the distribution.

(6M)(JUN-15)

7. The probability distribution of a finite random variable X is given by the following table:

x	0	1	2	3	4	5	6	7
P(x)	0	K	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

Find k, $p(x < 6)$, $p(x \geq 6)$, $p(3 < x \leq 6)$ **(6M)(DEC 13,19)**

8. Find the value of 'K' such that the following distribution represents a finite probability distribution.

Hence find the mean(μ) and standard deviation (σ). Also find $p(x \leq 1)$, $p(x > 1)$ and $p(-1 < x \leq 2)$.

x	-3	-2	-1	0	1	2	3
P(x)	K	2k	3k	4k	3k	2k	k

(6M)(JAN-18)

9. The probability density of a continuous random variable is given by

$p(x) = y_0 e^{-|x|}$, $-\infty < x < \infty$. Find y_0 . Also find the mean?

(6 M)(DEC-14)

10. Obtain mean and variance of binomial distribution function.

(7M)(JUN-10, DEC-14, JAN-17, JAN-18, DEC-18)

11. The probability that a man aged 60 will live up to 70 is 0.65. What is the probability that out of 10 men, now aged 60, i) exactly 9, ii) atmost 9 iii) atleast 7, will live up to the age of 70 years.

(7M)(JUN-09)

12. The probability that an individual suffers a bad reaction from an injection is 0.001. Find the probability that out of 2000 individuals, more than 2 will get a bad reaction.

(6M)(JUN-08, JAN-18)

13. Derive mean and variance for the Poisson distribution.

(7M)(JAN-10, 13, 20, JUNE-16, 17)

14. Given that 2% of the fuses manufactured by a firm are defective, find by using Poisson

- distribution, the probability that a box containing 200 fuses has i) No defective fuses
ii) 3 or more effective fuses iii) At least one defective fuse. **(7M)(DEC-10, DEC-18)**
- 15.** A die is tossed thrice. A success is getting 1 or 6 on a toss. Find the mean and variance of the number of successes. **(7M)(DEC-11)**
- 16.** For the Poisson distribution, prove that, $P(r) = \frac{e^{-m} m^r}{r!}$, where m is the mean of distribution. **(6M)(DEC-11)**
- 17.** Alpha – particles are emitted by a radioactive source at an average of 5 emissions in 20 minutes. What is the probability that there will be i) exactly two emissions ii) at least two emissions in 20 minutes? **(7M)(JUN-11)**
- 18.** The probability that a pen manufactured by a company will be defective is 0.1 if 12 such pens are selected, find the probability that i) exactly 2 will be defective, ii) at least 2 will be defective, iii) none will be defective. **(7M)(DEC-12,19)**
- 19.** A die is thrown 8 times. Find the probability that ‘3’ falls
i) Exactly 2 times ii) At least once iii) At the most 7 times **(7M)(JUL-13)**
- 20.** In a certain town the duration of shower has mean 5 minutes. What is the probability that shower will last for i) 10 minutes or more; ii) less than 10 minutes; iii) between 10 and 12 minutes. **(7M)(JUL-13)**
- 21.** In a quiz contest of answering ‘YES’ or ‘NO’, what is the probability of guessing atleast 6 answers correctly out of 10 questions asked? Also find the probability of the same if there are 4 options for a correct answer? **(7M)(JUN-14)**
- 22.** The probability that a bomb dropped hits the target is 0.002. Find the probability that out of 600 bombs dropped i) Exactly 2 will hit the target ii) Atleast 3 will hit the target **(7M)(JUN-15)**
- 23.** The life of an electric bulb is normally distributed with average life of 2000 hours and standard deviation of 60hours. Out of 2500 such bulbs, find the number of bulbs that are likely to last between 1900 and 2100 hours. Given $[0 \leq z \leq 1.67] = 0.4525$. **(7M)(JUN-08, DEC-13, JUN-17)**

24. Suppose that the student IQ scores form a normal distribution with mean 100 and standard deviation 20. Find the percentage of students whose i) score is less than 80 ii) score falls between 90 and 140, iii) score more than 120. **(7M)(JUN-10)**
25. In a test on 2000 electric bulbs, it was found that the life of a particular make was normally distributed with an average life of 2040 hours and S.D. of 60 hours. Estimate the number of bulbs likely to burn for a) More than 2150 hours b) Less than 1950 hours and c) More than 1920 hours, but less than 2160 hours. **(7M)(DEC-08,JAN-10,DEC-14, DEC-18)**
26. The mark of 100 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be i) less than 65 ii) more than 75 iii) Between 65 and 75. **(7M)(DEC-10)**
27. Fit a normal distribution to the following data: **(6M)(DEC-11)**

X:	1	3	5	7	9
Y:	2	2	3	2	1

28. The mark of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be i) less than 65 ii) more than 75 (iii) Between 65 and 75. **(7M)(JAN-17)[**
29. A sample of 100 dry battery cells tested to find the length of life produced by a company and following results are recorded: mean life=12 hours, standard deviation=3 hours. Assuming data to be normally distributed, find the expected life of a dry cell :i)Have more than 15 hours ii. between 10 and 14 hours. **(7M)(JUN-11)**
30. If X is normal variate with mean 30 and S.D 5, find the probabilities that i) $26 \leq X \leq 40$, ii) $X \geq 45$, iii) $|X - 30| > 5$. (Given $\phi(0.8) = 0.2881, \phi(2.0) = 0.4772, \phi(3.0) = 0.4987, \phi(1.0) = 0.3413$) **(6M)(JUN-14)**
31. If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students are 2.5 and $\sqrt{1.875}$. Find an estimate of the number of candidates answering correctly (i) 8 or more questions (ii) 2 or less (iii) 5 questions. **(7M)(JAN-18)**
32. In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation, given that $A(0.5) = 0.19$ and $A(1.4) = 0.42$. **(7M)(JUN-09,DEC-12)**

33. In an examination 7% of students scores less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation of the marks are normally distribute, it is given that $P(0 < z < 1.2263) = 0.39$ and $P(0 < z < 1.4757) = 0.43$.

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MODULE-2

JOINT PROBABILITY DISTRIBUTION & MARKOV CHAINS

Joint Probability distribution for two discrete random variables, expectation and covariance.

JOINT PROBABILITY DISTRIBUTION

1. The joint distribution of two variables X and Y are given below:

X \ Y	-4	2	7
1	1/8	1/4	1/8
5	1/4	1/8	1/8

Compute the following: (i) $E(X)$ and $E(Y)$ (ii) $E(XY)$ (iii) $COV(X, Y)$ (iv) $\rho(X, Y)$

(7M)(JUL-07, DEC-18, JUL-22)

2. The joint distribution of two variables X and Y are given below:

X \ Y	2	3	4
1	0.06	0.15	0.09
2	0.14	0.35	0.21

Determine Marginal distributions of X and Y. Also verify that X and Y indep

(7M,JAN-05,09,JUL-04)

3. The joint distribution of two variables X and Y are given below:

X \ Y	1	3	6
1	1/9	1/6	1/18
3	1/6	1/4	1/12
6	1/18	1/12	1/36

Determine Marginal distributions of X and Y. Also verify that X and Y independent.

(7M)(JAN-06)

4. The joint distribution of two variables X and Y are given below:

X \ Y	1	3	9
2	1/8	1/24	1/12
4	1/4	1/4	0
6	1/8	1/24	1/12

Determine Marginal distributions of X and Y and evaluate COV(XY).

(7M)(DEC-18,

JUL-09,11)

5. The joint distribution of two variables X and Y are given below:

X \ Y	-3	2	4
1	0.1	0.2	0.2
3	0.3	0.1	0.1

Determine (i) Marginal distributions of X and Y (ii) Covariance of X and Y.

(7M)(JAN-09,JUL-05)

6. The joint probability distribution of two random variables X and Y are given below:

X \ Y	-2	-1	4	5
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Find the Marginal distributions of X, Y. Also find the Covariance of X and Y.

(7M)(JUL-08,DEC-10,19)

7. Compute (i) $P(x = 1, y = 2)$ (ii) $P(x \geq 1, y \leq 2)$ (iii) $P(x \leq 1, y \leq 2)$ (iv) $P(x + y \geq 2)$, using the following joint probability distribution for x and y (7M)(DEC-11)

x \ y	0	1	2	3	Sum
0	0	1/8	1/4	1/8	1/2

1	1/8	1/4	1/8	0	1/2
Sum	1/8	3/8	3/8	1/8	1

8. X and Y are independent random variables, X take the values 1,2 with probability 0.7; 0.3 and Y take the values -2, 5, 8 with probabilities 0.3, 0.5, 0.2. Find the joint distribution of X and Y hence find $\text{cov}(X,Y)$
(6M)(JAN-18)
9. The joint distribution of two discrete variables x and y is $f(x,y)=k(2x+y)$ where x and y are integers such that $0 \leq x \leq 2$; $0 \leq y \leq 3$. Find (i) the value of k; (ii) Marginal distribution of x and y; (iii) Are x and y independent? Also, find $P(X \geq 1, Y \leq 2)$.
(6 M)(JAN-18, JUL-22)

Markov Chain(Stochastic process)

1. Find the unique fixed probability vector of the regular stochastic matrix.
(6M) (JUN-11,JAN-09,JUN-08)
2. Verify the matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$ is a regular stochastic matrix.
(7M)(DEC-10)
3. Explain i) Absorbing state of Markov chain ii) Transient state iii) Recurrent state by means of an example each.
(6 M)(DEC-10,JUN-2010,JAN-09,JUL-07, JUL-04,JAN-05)
4. A man's gambling luck follows a pattern. If he wins a game the probability of winning the next game is 0.6. However if he loses a game, the probability of losing the next game is 0.7. There is an even chance that he wins the 1st game. i) find the Transition matrix of the Markov process .ii) find the probability that he wins the 3rd game . iii) find out how often in the long run he wins.
(7 M) (JUN-10)

5. Find the fixed probability vector of regular stochastic matrix $A = \begin{bmatrix} 0.5 & 0.25 & 0.25 \\ 0.5 & 0 & 0.5 \\ 0 & 1 & 0 \end{bmatrix}$
(7M)(JUN-09)

6. A company executive changes his car every year. If he has a car of make A, he changes over to make B. From make B he changes over to make C. If he has car 'C' then he gives equal preference to change over to make A or make B car. If he had a car of make C in year 2008 find the probability that he will have a car of (i) make A in 2010, (ii) make C in 2010.

(7M)(JUN-09)

7. Three boys A, B and C are throwing a ball to each other. A always throws the ball to B and B always throws the ball to C. But C is just as likely to throw the ball to B as to A. If C was the first person to throw the ball, find the probabilities that (i) A has the ball (ii) B has the ball (iii) C has the ball, for the fourth throw.

(7M) (JUN-08JUL-05)

8. Define stochastic matrix. Find the unique fixed probability vector for the regular stochastic matrix

$$A = \begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{bmatrix} \quad (7M)(JUL-07, DEC-18) \quad P = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{6} & \frac{1}{2} & \frac{1}{3} \\ 0 & \frac{2}{3} & \frac{1}{3} \end{bmatrix} \quad (7M)(JAN-06, 18)$$

9. A student's study habits are as follows. If he studies one night, he is 60% sure not to study the next night; on the other hand if he does not study one night, he is 80% sure to study the next night. In the long run how often does he study?

(6M)(JUL-06, JUL-04, JAN-06, JAN-07, JAN-05, DEC-18)

10. A man's smoking habits are as follows. If he smokes filter cigarettes one week, he switches to non-filter cigarettes the next week with probability 0.2. On the other hand, if he smokes non filter cigarettes one week there is a probability of 0.7 that he will smoke non filter cigarettes the next week as well. In the long run how often does he smoke filter cigarettes?

(6M)(JAN-18)

11. Prove that the Markov chain whose transitive probability matrix is $P = \begin{bmatrix} 0 & \frac{2}{3} & \frac{1}{3} \\ \frac{1}{2} & 0 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$ is

irreducible. Find the corresponding stationary probability vector.

(7M)(JAN-07, 09)

12. Define (i) stochastic matrix, (ii) Periodic state, (iii) Absorbing state of a Markov Chain.

(6M)(JUL-05)

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MODULE-3**STATISTICAL INFERENCE 1**

1. A population consists of the four numbers 3, 7, 11, 15. Consider all possible samples of size 2 which can be drawn from this population without replacement. Find the mean and the standard deviation in the population, and in the sampling distribution of means.
2. Find the probability that in 100 tosses of a fair coin between 45% and 55% of the outcomes are heads.
3. Out of 1000 samples of 200 children each, in how many would you expect to find that (a) less than 40% are boys (b) between 40% and 60% are boys (c) 55% or more girls?
4. A random sample of 400 items chosen from an infinite population is found to have a mean of 82 and a standard deviation of 18. Find the 95% confidence limits for the mean of the population from which the sample is drawn.
5. A random sample of 100 factory workers in a large city revealed a mean weekly earnings of Rs. 487 with a standard deviation of Rs. 48. With what level of confidence can we assert that the average weekly salary of all factory workers in the city is between Rs. 472 and Rs. 502?
6. The standard deviation of the life-times of television tubes manufactured by a company is estimated as 100 hours. Find how large a sample must be taken in order to be 99% confident that the error in the estimated mean life-time will not exceed 20 hours?
7. A biased coin is tossed 500 times and head turns up 120 times. Find the 95% confident limits for the proportion of heads turning up in infinitely many tosses. (Given that $z_c = 1.96$)
(6M)(DEC-12)
8. A coin was tossed 400 times and head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% level of significance.
9. Find how many heads in 64 tosses of a coin will ensure its fairness at 0.05 level of significance.
10. A sample of 900 items is found to have the mean equal to 3.4. Can it be reasonably regarded as a truly random sample from a large population with mean 3.25 and standard deviation 1.61?

11. An unbiased coin is thrown N times. It is desired that the relative frequency of the appearance of heads should lie between 0.49 and 0.51. Find the smallest value of N that will ensure this result with 90% confidence.
12. Define Null hypothesis, significance level, critical region. Type – I and type – II errors in a statistical test.
13. In a sample of 600 men from a certain city, 450 are found smokers. In another sample of 900 men from another city, 450 are smokers. Does this indicate that the cities are significantly different with respect to the habit of smoking among men. Test at 5% significant level.
14. In 324 throws of a six faced die, an odd number turned up 181 times. Is it reasonable to think that the die is unbiased one at 5% level of significance?
15. In an examination given to students at a large number of different schools the mean grade was 74.5 and SD grade was 8. At one particular school where 200 students took the examination the mean grade was 75.9. Discuss the significance of this result at both 5% and 1% level of significance.
16. Define (i) Alternative hypothesis (ii) A statistic (iii) Level of significance and (iv) Two-tailed test.
17. One type of air craft is found to develop engine trouble in 5 flights out of a total of 100 and another type in 7 flights out of a total of 200 flights. Is there a significance difference in the two types of air craft's so far as engine defects are concerned? Test at 5% significance level.s
18. A mechanist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts showed a mean of 0.742 inches with a standard deviation of 0.04 inch. On the basis of this sample, can it be concluded that the work is inferior at 5% level of significance?

(7M)(JUN-09,DEC-08, JAN-10)

19. The daily wages of 3000 workers in a factory or normally distributed with mean equal to 68 and SD equal to 3. If 80 samples consisting of 25 workers each obtained, what would be the mean and SD of the sampling distribution (a) with replacement (b) without replacement. In how many samples will the mean is likely to be (a) between 66.8-68.3 (b) less than 66.4.

20. For the following data test the hypothesis that the accidents are uniformly distributed over all the days of the week for 99% confidence.

Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
No.of accidents	14	16	8	12	11	9	14	84

(7M)

(JUN,JUL-09)

21. The means of simple samples of sizes 1000 and 2000 are 67.5 and 68.0 cm respectively. Can the samples be regarded as drawn from the same population of S.D 2.5cm [given $z_{0.05}=1.96$]

(6M)

(JUNE-16)

22. A Random sample of 10 boys had the following I.Q:70,120,110,101,88,83,95,98,107,100. Do these data support assumption of a population mean I.Q of 100 [Given $t_{0.05}$ for 9d.f=2.26]

(7M) (JUNE-16)

23. The weights of 1500 ball bearings are normally distributed with a mean of 635gms and standard deviation of 1.36gms. if 300 samples of size 36 each are drawn from this population, find the expected mean and standard deviation of the sampling distribution of means, if sampling is done

i) With replacement ii) Without replacement. When sampling is done with replacement, how many samples will have their mean, greater than 635.5 gms. Given $P[0 \leq z \leq 2.203] = 0.4861$.

(7M)(JUN-09)

24. A sample of 100 days is taken from meteorological records of a certain district and 10 of them are found to be foggy. What are the probable 99% confidence limits to the proportion of foggy days in the district (6M)(JUN-10)

25. The life of certain computer is approximately normally distributed with mean 800 hours and standard deviation 40 hours. If a random sample of 30 computer has an average life of 788 hours, test the hypothesis that $\mu=800$ hours against the alternate hypothesis $\mu \neq 800$ hours at i) 0.5% and 1% level of significance.

26. In a city A, 20% of a random sample of 900 school boys has certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Is the difference between the proportions significant at 5% significant level.

(6M)(DEC-08,JAN-10,DEC-14)

27. A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts shows mean diameter 0.742 inch with a S.D. of 0.04 inch on the basis of this sample, would you say that the axle is inferior?

(7M)(DEC-08,JAN-10)

28. Explain the following terms (i) Standard error (ii) Statistical hypothesis (iii) Critical region of a statistical test (iv) Test of significance

29. Explain the following terms :

- i) Null hypothesis ii) Type I and type II error iii) Confidence limits
- iv) Standard error v) test of significance

(7M)(DEC-10 ,JAN-14,JUL-11,JUN-17,JAN-18, DEC-18,19)

30. Define (i) Type I- error and TypeII-error (ii) Level of significance. **(6 M, (JAN-17)**

31. A sample of 100 days is taken from a coastal town of a certain district of which, 10 of them are found to be very hot. What are probable limits of the percentage of hot days in the district? **(7M)(DEC-10)**

32. Find the range of number of heads out of 64 tosses of a coin which will ensure fairness of coin at 5% level of significance using binomial distribution.

33. A coin is tossed 1000 times and head turns up 540 times. Decide on the hypothesis that the coin is unbiased. **(6M)(DEC-18)**

34. A die is thrown 9000 times and a throw of 5 or 6 was observed 3240 times. On the assumption of random throwing, does the data indicate an unbiased die at 1% level of significance?

35. The mean life-time of a sample of 100 fluorescent tube lights manufactured by a company is found to be 1570 hours with a standard deviation of 120 hours. Test the hypothesis that the mean life-time of the lights produced by the company is 1600 hours.

36. The weights of workers in a large factory are normally distributed with a mean of 68 kgs, and standard deviation of 3 kgs. if 80 samples of size 35 workers each are chosen, how many of 80 sample will have the mean between 67 and 68.25 kgs. Given $P[0 < z < 2] = 0.4772$ and $p(0 \leq z \leq 0.5) = 0.7915$ **(7M)(DEC 13)**
37. Certain tubes manufactured by a company have mean life time of 800 hrs and standard deviation of 60 hrs. Find the probability that a random sample of 16 tubes taken from the group will have a mean life time (i) between 790 hrs and 810 hrs, (ii) less than 785 hrs, (iii) more than 820 hrs. ($\phi(0.67) = 0.2486, \phi(1) = 0.3413, \phi(1.33) = 0.4082$).
38. It is required to test whether the proportion of smokers among students is less than that among the lectures. Among 60 randomly picked students, 2 were smokers. Among randomly picked lecturers, 5 were smokers. What would be your conclusion? **(7M)(JUN-14)**
39. A manufacturer claimed that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of a sample of 200 pieces of equipment revealed that 18 of them were faulty. Test his claim at a significance level of 1% and 5% **(7M)(DEC-14)**
40. It has been found that the mean breaking strength of a particular brand of thread is 275.6 gms with $\sigma = 39.7$ gms. A sample of 36 pieces of thread showed a mean breaking strength of 253.2 gms. Test the claim at 1% and 5%. level of significance. **(5M)(JAN-18)**
41. The theory predicts the proportion of beans in the four groups G1, G2, G3, G4 should be in the ratio 9:3:3:1. In an experiment with 1600 beans the numbers in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory? (at 5% LOS for 3 d.f = 7.815). **(6 M,)(JAN-17)**
42. Ten individuals are chosen at random from a population and their height in inches are found to be 63, 63, 66, 67, 68, 69, 70, 71, 71. Test the hypothesis that mean height of the universe is 66 inchs. Given that ($t_{0.05}$ For 9 df = 2.262). **(5M)(DEC-18)**

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MODULE-4**STATISTICAL INFERENCE 2**

43. State Central limit theorem

44. In a recent study reported that on the flurry blog, the mean age of tablet users is 34 years. Suppose the standard deviation is 15 years and sample size, $n=100$. Using central limit theorem, find the probability that the sample mean age is more than 30 years.

45. The nine items of a sample have the following values: 45, 47, and 50, 52, 48, 47, 49, 53, 51.

Does the mean of these differ significantly from the assumed mean of 47.5? Apply student's t-distribution at 5% level of significance. ($t_{0.05}$ for $8df = 2.31$).

(7M)(JUL-13, JUN-15)

46. A certain stimulus administered to each of the 12 patients resulted in the following change in blood pressure. 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4. Can it be concluded that the stimulus will increase the blood pressure? ($t_{0.05}$ For 11 $df=2.201$) **(6M)(DEC-10, 12, JAN-17, 18, 19)**

47. Genetic theory states that children having one parent of blood type M and the other of blood type N will always be one of the three types M, MN, N and that the proportions of these types will on an average be: 1:2:1. A report states that out of 300 children having one M parent and one N parent, 30% are found to be of type M, 45% of type MN and the remainder of type N. Test the theory of χ^2 (chi-square) test. **(7M)(JUN-17)**

48. In experiments on a pea breeding, the following frequencies of seeds were obtained.

Round-Yellow	Wrinkled yellow	Round green	Wrinkled green	Total
315	101	108	32	556

Is the experiment is in the agreement of theory which predicts proportion of frequencies 9:3:3:1 ($\chi^2_{0.05}$, $3df = 7.815$). **(7M)(JUL-13)**

49. A die is thrown 60 times and the frequency distribution for the number appearing on the face x is given by the following table: **(7M) (DEC-12)**

x	1	2	3	4	5	6
Frequency	15	6	4	7	11	17

Test the hypothesis that the die is unbiased. (Given that $\chi^2_{0.05}(5) = 11.07$ and $\chi^2_{0.05}(5) = 15.09$)

50. Four coins are tossed 100 times and the following results were obtained:

x	0	1	2	3	4
Frequency	5	29	36	25	5

Fit a binomial distribution for the data and test the goodness of fit ($\chi^2_{0.05} = 9.49$)

51. A die is thrown 264 times and the number appearing on the face x follows the frequency distribution as mentioned below:

x	1	2	3	4	5	6
Frequency	40	32	28	58	54	60

Calculate the value of Chi square? (7M) (JAN-18)

52. A survey conducted on 64 families with 3 children each and recorded as follows:

No. of Male children	0	1	2	3
No. of families	6	19	29	10

Apply Chi – squares test to test whether male and female children are equiprobable at 5% level of significance (7M)(JUN-11)

53. A set of five similar coins is tossed 320 times and the result is:

No of heads	0	1	2	3	4	5
Frequency	6	27	72	112	71	32

Test the hypothesis that the data follow a binomial distribution. (Given that $\psi^2_{0.05}(5) = 11.07$)

(7M)(DEC-08, JAN-10, DEC-14, JUN-15, JAN 15)

54. The following table gives the number of bus accidents that occurred during the various days of the week. Find whether the accidents are uniformly distributed over the week, using χ^2 test.

Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
No. of accidents	14	16	8	12	11	9	14	84

(7M)(JUN-10)(JUNE-16)

55. Eleven students were given a test in statistics. They were provided additional coaching and then a second test of equal difficulty was held at the end of coaching. Marks scored by them in the two tests are given below:

Test-1	23	20	19	21	18	20	18	17	23	16	19
Test-2	24	19	22	18	20	22	20	20	23	20	17

Do the marks give evidence that the students have benefited by extra coaching? Given $t_{.05}$ is 2.228. Test the hypothesis at 5% level of significance.

(7M)(JUN-08,DEC-13)

56. Fit a Poisson distribution to the following data and test for its goodness of fit at 5% level of significance.

x	0	1	2	3	4
f	419	352	154	56	19

Given $\chi^2_{0.05}$ for $\nu=3$ is 7.8 (7M)(JUN-08)

57. Two samples of size 9 and 8 give the sum of the squares of deviations from the Respective means equal to 160 inches square and 91 inches square respectively. Can these be regarded as drawn from the same normal population?

57. Measurements on the length of a copper wire were taken in 2 experiments A and B as follows.

A's measurements (in mm)	B's measurements (in mm)
12.29	12.39
12.25	12.46
11.86	12.34
12.13	12.22
12.44	11.98

12.78	12.46
12.77	12.23
11.90	12.06
12.47	

Find whether B' measurements are more accurate than A's?

MODULE-5

ANOVA (ANALYSIS OF VARIANCE) AND ANOCOVA

58. Explain ANOVA technique of statistics.
59. Explain the basic principle of ANOVA.
60. Explain one way ANOVA process of statistics.
61. Explain two-way ANOVA process of statistics.
62. Three different kinds of food are tested on three groups of rats for 5 weeks.

The objective is to check the difference in mean weight (in grams) of the rats per week.

Apply one-way ANOVA using a 0.05 significance level to the following data:

Food I	Food II	Food III
8	4	11
12	5	8
19	4	7
8	6	13
6	9	7
11	7	9

63. Calculate the ANOVA coefficient for the following data:

Plant	Number	Average span	s
Hibiscus	5	12	2
Marigold	5	16	1
Rose	5	20	

64. The following data show the number of worms quarantined from the GI areas of four groups of muskrats in a carbon tetrachloride anthelmintic study. Conduct a two-way ANOVA test.

I	II	III	IV
338	412	124	389
324	387	353	432
268	400	469	255
147	233	222	133
309	212	111	265

Enlist the results in APA format after performing ANOVA on the following data set:

65. Set up analysis of variance table for the following per acre production data

For 3 varieties of wheat, each grown on 4 plots and state if the variety significances are significant

Per acre production data			
Plot of land	Variety of wheat		
	A	B	C
1	6	5	5

2	7	5	4
3	3	3	3
4	8	7	4

66. The following are the paired observations for 3 experimental groups. Find the adjusted means for Groups 1, 2 and 3 by using ANACOVA method.

Group I		Group II		Group III	
X	Y	X	Y	X	Y
7	2	15	8	30	15
6	5	24	12	35	16
9	7	25	15	32	20
15	9	19	18	38	24
12	10	31	19	40	30

67. To test the hypothesis that the average number of days a patient is kept in the 3 local hospitals A, B, C and a random check on the number of days those 7 patients stayed in each hospital reveals the following.
Test the hypothesis by using ANOVA at 5% level of significance.

Hospital		Number of Days					
A	8	5	9	2	7	8	2
B	4	3	8	7	7	1	5
C	1	4	9	8	7	2	3

68. Explain the basic principle of ANOCOVA. (Analysis of Covariance).

69. A trucking company wishes to test the average life of each of the 4 brands of tyres. The company uses all brands on randomly selected trucks. The records showing the lives

(thousand of miles) of tyres are as given below.

Test the hypothesis that the average life for each brand of tyres is the same at 1% level of Significance.

Brand 1	Brand 2	Brand 3	Brand 4
20	19	21	15
23	15	19	17
18	17	20	16
17	20	17	18
	16	16	

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