SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

I SEMESTER

Master of Business Administration

MA3127 – STATISTICS FOR MANAGEMENT

Regulation – 2023

Academic Year – 2025- 2026

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SUBJECT : MA3127 – STATISTICS FOR MANAGEMENT
SEM / YEAR: Ist SEMESTER / Ist Year M.B.A.

UNIT- I: PROBABILITY AND DISTRIBUTIONS									
Basic definitions and rules for probability- conditional probability independence of events - random variables- Probability distributions: Binomial, Poisson and Normal distributions.									

Q.No.	Question	BT Level	Competence	COs
	PART – A			
1.	Define Probability of an event.	BTL -1	Remembering	CO1
2.	State the Axioms of Probability.	BTL -1	Remembering	CO1
3.	State the addition theorem on probability.	BTL -1	Remembering	CO1
4.	Define independent events.	BTL -1	Remembering	CO1
5.	Define mutually exclusive events.	BTL -1	Remembering	CO1
6	Define Conditional Probability.	BTL -1	Remembering	CO1
7.	State the theorem of total probability.	BTL -1	Remembering	CO1
8	State Baye's theorem.	BTL -1	Understanding	CO1
9.	A ball is drawn at random from a box containing 5 red balls, 3 white balls and 4 blue balls. Find the probability that the ball drawn is not red.	BTL -2	Understanding	CO1
10	What is the Probability that a leap year selected at random will have 53 Sundays?	BTL -2	Understanding	CO1
11.	If a box contains 75 good items and 25 defective items , and 12 items are selected at random, find the probability that at least one item is defective	BTL -2	Understanding	CO1
12.	A and B are events with $P(A) = \frac{5}{8}, P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{4}$. Find $P(\bar{A} \cap B)$	BTL -2	Understanding	CO1
13.	The number of hardware failures of a computer system in a week of operations has the following pmf.. Calculate the value of k. <table><tr><td>No.of failures</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Probability</td><td>k</td><td>2 k</td><td>2 k</td><td>k</td><td>3 k</td><td>k</td><td>4 k</td></tr></table>	BTL -2	Understanding	CO1
14.	If $p(x) = kx^2, x = 0,1,2,3$, is to be a density function, find the value of k.	BTL -2	Understanding	CO1
15.	Write the probability function of Binomial Distribution.	BTL -1	Remembering	CO1
16.	The mean of Binomial distribution is 36 and standard deviation is 6. Find the parameters of the distribution.	BTL -2	Understanding	CO1

17.	For a Binomial distribution the mean is 6 and standard deviation is $\sqrt{2}$. Find parameters of the distribution	BTL -2	Understanding	CO1
18.	If 20% of the bolts produced by a machine are defective, Determine the probability that out of 4 bolts chosen at random exactly one defective.	BTL -2	Understanding	CO1
19.	If the mean and variance of a binomial distribution are respectively 6 and 2.4, find P(x=2).	BTL -2	Understanding	CO1
20.	Write the probability function of Poisson Distribution.	BTL -1	Remembering	CO1
21.	Suppose that, on an average, in every three pages of a book there is one typographical error. If the number of typographical errors on a single page of the book is a Poisson random variable. What is the probability if at least one error on a specific page of the book?	BTL -2	Understanding	CO1
22.	If X is a Poisson distribution such that $P(x = 1) = 4\,P(x = 2)$. Find its mean and variance.	BTL -2	Understanding	CO1
23.	Suppose that X has a Poisson distribution with parameter $\lambda = 2$. Compute $P[X \geq 1]$.	BTL -1	Remembering	CO1
24.	Define Normal distribution.	BTL -1	Remembering	CO1
25.	State any two properties of normal distribution.	BTL -1	Remembering	CO1
PART – B				
1.(a)	Given: The probabilities of three events A, B and C occurring are P(A) = 0.35, P(B) = 0.45 and P(C) = 0.2. Assuming that A, B, or C has occurred, the probabilities of another event X occurring are P(X/A) = 0.8, P(X/B) = 0.65 and P(X/C) = 0.3. Find P(A/X), P(B/X) and P(C/X)	BTL -3	Applying	CO1
1.(b)	The probability mass function of a discrete R. V X is given in the following table:	BTL -3	Applying	CO1
2.(a)	Three machines all turn out nonferrous castings. Machine A produces 1% defective and Machine B- 2% and machine C – 5%. Each machine produces 1/3 of the output. An inspector examines a single casting, which he determines as non-defective. Estimate the probabilities of its having been produced by each machine	BTL - 4	Analyzing	CO1
2.(b)	Out of 800 families with 4 children each, how many families would be expected to have (i) 2 boys and 2 girls (ii) at least 1 boy (iii) at most 2 girls (iv) children of both sexes? Assume equal probabilities for boys and girls.	BTL - 4	Analyzing	CO1
3.(a)	In a bolt factory machines A, B, C manufacture respectively 25, 35 and 40 percent of the total. Of their output 5, 4 and 2 percent are defective bolts respectively. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A, B or C?	BTL -3	Applying	CO1
3.(b)	The contents of urns I, II, III are as follows: 2 white, 3 black and 4 red balls;	BTL -4	Analyzing	CO1

Within cell 1.(b):

X	-2	-1	0	1	2	3
P(X=x)	0.1	K	0.2	2k	0.3	k

Find (1) Find the value of k, (2) P(X<1)

	1 white, 2 black and 1 red balls; 2 white, 4 black and 3 red balls; One urn is chosen at random and two balls drawn. They happen to be white and red. What is the probability that they come from urns I, II, III?			
4.	In 1989, there were three candidates for the position of principal Mr. Chatterji, Mr. Ayangar and Dr. Singh. Whose chances of getting the appointment are in the proportion 4:2:3 respectively. The probability that Mr. Chatterji is selected, would introduce co-education in the college is 0.3. The probabilities of Mr. Ayangar and Dr. Singh doing the same are respectively 0.5 and .08. What is the probability that there was co-education in the college in 1990?	BTL -3	Applying	CO1

5. (a)	4 cards are drawn from a well shuffled pack of cards. Find the probability that
	    (i) All the four are queens
	    (ii) There is one card from each suit.
	    (iii) Two cards are diamonds and two are spades
	All the four cards are hearts and one of them is jack
		BTL -3	Applying	CO1

5.(b)	Given $\lambda = 4$, for a Poisson distribution. Find (i) $P(X \le 3)$ (ii) $P(X \ge 4)$ (iii) $P(X = 6)$.	BTL -4	Analyzing	CO1
6.(a)	Two dice are thrown together once. Find the probabilities for getting the sum of the two numbers (i) equal to 5, (ii) multiple of 3, (iii) divisible by 4.	BTL -3	Applying	CO1
6.(b)	Messages arrive at a switch board in a Poisson manner at an average rate of 6 per hour. Find the probability that exactly 2 messages arrive within one hour, no messages arrives within one hour and at least 3 messages arrive within one hour	BTL -3	Applying	CO1
7.	A random variable X has the following probability distribution: 	X	0	1	2	3	4	5	6	7
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P(X)	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$	 Find (i) the value of k (ii) $P(1.5 < X < 4.5 / X > 2)$	BTL -1	Remembering	CO1

8.(a)	A bank manager has learnt that the length of time the customers have to wait for being attended by the teller is normally distributed with mean time of 5 minutes and standard deviation of 0.8 minutes. Find the probability that a customer has to wait
	    (i) For less than 6 minutes
	    (ii) For more than 3.5 minutes and
	    (iii) Between 3.4 and 6.2 minutes.
		BTL -4	Analyzing	CO1

8.(b)	A box contains 4 bad and 6 good tubes. Two are drawn out from the box at a time. One is tested and found to be good. What is the probability that the other one is also good?	BTL -3	Applying	CO1
9.	The probability mass function of a discrete R. V X is given in the following table 	X	0	1	2	3	4	5	6	7	8
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P(X)	a	3a	5a	7a	9a	11a	13a	15a	17a | Find (i) the value of a (ii) $P(X < 3)$ (iii) Mean of X	BTL - 4	Analyzing	CO1

	(iv) Variance of X.			
10.	The atoms of a radioactive element are randomly disintegrating. If every gram of this element, on average, emits 3.9 alpha particles per second, then what is the probability that during the next second the number of alpha particles emitted from 1 gram is (i) at most 6 (ii) at least 2 and (iii) at least and atmost5	BTL -3	Applying	CO1
11.	If the discrete random variable X has the probability function given by the table. 	x	1	2	3	4
$P(x)$	$k/3$	$k/6$	$k/3$	$k/6$ | Find the value of k and Cumulative distribution of X.	BTL -3	Applying	CO1
12.(a)	A coin is biased so that a head is twice as likely to appear as a tail. If the coin is tosed 6 times, find the probabilities of getting (1) Exactly 2 heads (2) at least 3 heads (3) at most 4 heads.	BTL -4	Analyzing	CO1
12.(b)	If the random variable X takes values 1, 2, 3, 4 such that 2 P(X = 1) = 3 P(X = 2) = P(X=3) = 5 P(X = 4), find the probability distribution and cumulative distribution of X	BTL -3	Applying	CO1
13.(a)	The atoms of a radioactive element are randomly disintegrating. If every gram of this element, on average, emits 3.9 alpha particles per second, then what is the probability that during the next second the number of alpha particles emitted from 1 gram is (1) at most 6 (2) at least 2 and (3) at least 2 and at most 5	BTL -3	Applying	CO1
13.(b)	The probability mass function of a RV X is given by $P(X = r) = kr^3, r = 1,2,3,4$. Find (1) the value of k, (2)$P\left(\frac{1}{2} < X < \frac{5}{2}\right)$ (3) $P(X > 2)$	BTL -3	Applying	CO1
14.	In a test of 2000 electric blubs 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 blubs likely to burn for (1) More than 2150 hours (2) Less than 1950 hours (3) More than 1920 hours but less than 2160 hours	BTL -4	Analyzing	CO1
15.	4 coins were tossed simultaneously. What is the probability of getting (i) 2 heads, (ii) at least 2 heads, (iii) at most 2 heads?	BTL -3	Applying	CO1
16.	A normal distribution has mean $\mu = 20$ and standard deviation $\sigma = 10$. Find$P(15 \le X \le 40)$.	BTL -3	Applying	CO1
17.(a)	Out of 2000 families with 4 children each, Find how many family would you expect to have (i) at least 1 boy (ii) 2 boys (iii) 3 boys (iv) no boys	BTL -4	Analyzing	CO1
17.(b)	In a certain factory manufacturing razor blades, there is a small chance of 1/500 for any blade to be defective. The blades are supplied in packets of 10. Use Poisson distribution to calculate the approximate number of packets containing (i) No defective (ii) One defective (iii) Two defective blades	BTL -4	Analyzing	CO1

	Respectively in a consignment of 10,000 packets.			
18(a).	X is a normal variable with mean 30 and standard deviation of 5. Find (i) P[26 ≤ X ≤ 40] (ii) P [X ≥ 45] (iii) P[X < 30]	BTL -4	Analyzing	CO1
18(b).	If X follows a normal distribution with mean 12 and variance 16 cm, find the probabilities for (i)P(X ≤ 20)(ii) P(X ≥ 20), and (iii) P(0 ≤ X ≤ 12)	BTL -4	Analyzing	CO1

UNIT-II: SAMPLING DISTRIBUTION AND ESTIMATION

Introduction to sampling distributions, sampling distribution of mean and proportion-Application of central limit theorem-sampling techniques - Estimation: Point and Interval estimates for population parameters of large sample and small samples-determining the sample size.

Q.No.	Question	BT Level	Competence	COs
	PART – A			
1.	Define estimator.	BTL -1	Remembering	CO2
2.	Define estimate.	BTL -1	Remembering	CO2
3.	Define estimation.	BTL -1	Remembering	CO2
4.	Distinguish between parameter and statistic.	BTL -1	Remembering	CO2
5.	What are the different types of Sampling methods?	BTL - 2	Understanding	CO2
6	Define Point estimate.	BTL -1	Remembering	CO2
7.	Define Interval estimate.	BTL -1	Remembering	CO2
8	How large sample is useful in estimation and testing.	BTL -2	Understanding	CO2
9.	Distinguish between point estimation and interval estimation	BTL -1	Remembering	CO2
10	Mention the properties of a good estimator.	BTL -2	Understanding	CO2
11.	Briefly describe the significance level.	BTL -1	Remembering	CO2
12.	Define stratified sampling technique	BTL -1	Remembering	CO2
13.	Define Sampling distribution of proportion.	BTL - 2	Understanding	CO2
14.	Define Probable standard error.	BTL -1	Remembering	CO2
15.	Define standard error and mention its importance.	BTL -1	Remembering	CO2
16.	Define central limit theorem	BTL -1	Remembering	CO2
17.	Define confidence Interval.	BTL - 2	Understanding	CO2
18.	What is the level of significance in testing of hypothesis	BTL - 2	Understanding	CO2
19.	State the conditions under which a binomial distribution becomes a normal distribution	BTL - 2	Understanding	CO2
20.	If the random sample comes from a normal population, what can be said about the sampling distribution of the mean?	BTL - 2	Understanding	CO2
21.	Given a population with a standard deviation of 8.6, what sample size is needed to estimate the mean of population within ± 0.5 with 99% confidence?	BTL -1	Remembering	CO2
22.	Write the formula of confidence interval for the difference between two population means for large samples.	BTL -1	Remembering	CO2
23.	Write the formula of confidence interval for the population mean for large samples.	BTL -1	Remembering	CO2
24.	Write the formula of confidence interval for the difference between two population means for small samples.	BTL -2	Creating	CO2
25.	Given a population with a standard deviation of 5.9, what sample size is needed to estimate the mean of population within ± 0.5 with 95% confidence?	BTL -2	Creating	CO2

	PART – B			
1.	A bank has kept records of the checking balances of its customers and determined that the average daily balances of its customers is Rs.300 with a standard deviation of Rs. 48. A random sample of 144 checking accounts is selected. (i) What is the probability that the sample mean will be more than Rs. 306.60? (ii) What is the probability that the sample mean will be less than Rs. 308? (iii) What is probability that the sample mean will between Rs. 302 and Rs. 308? What is probability that the sample mean will be atleast Rs. 296?	BTL -3	Applying	CO2
2.(a)	In a test given to two group of students the marks obtained were as follows, First group : 18 20 36 50 49 36 34 47 61 Second group: 29 28 26 35 30 44 46 Construct a 95% confidence interval on the mean marks secured by students.	BTL -4	Analyzing	CO2
2.(b)	A random sample of size 9 is obtained from a Normal population with mean 25 and if the variance 100 find the probability that the sample mean exceeds 31.2.	BTL -3	Applying	CO2
3.	In a quality department of manufacturing paints at the time of dispatch of decorators 30% of the containers are found to be defective. If a random sample of 500 is drawn with replacement from the population. What is the probability that the sample proportion will be less than 25% defective?	BTL -3	Applying	CO2
4.	A manufacturer of watches has determined from experience that 3% of the watches he produces are defective. If a random sample of 300 watches is examined, what is the probability that the proportion defective is between 0.02 and 0.035.	BTL -4	Analyzing	CO2
5.(a)	A random sample of size 100 is taken from a population whose mean is 60 and variance is 400. Using central limit theorem find what probability that we can assert that the mean of the sample will not differ from μ more than 4?	BTL -4	Analyzing	CO2
5.(b)	An economist wishes to estimate the average the family income in a certain population. The population SD is known to be $4.500, and the economist uses a random sample of size $n = 225$. What is the probability that the sample mean will fall within $800 of the population mean.	BTL -3	Applying	CO2
6.	In a certain factory there are two independent process manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 O_{zs} with a S.D of 12 O_{zs}. While the corresponding figures in a sample of 400 items from the other process are 124 O_{zs} and 14 O_{zs}. Find the 95% and 99% confidence limits for the difference in the average weight of items produced by the processes respectively.	BTL - 4	Analyzing	CO2

7.	A survey of 748 randomly selected employees of dot.com companies showed that 35% feel secure about their jobs. Give a 90% confidence interval for the proportion of dot.com company employees who feel secure about their jobs.	BTL-2	Understanding	CO2
8.	Two operators perform the same operation of applying plastic coating to a part. A random sample of 100 parts from the first operator shows that 6 are non-conforming. A random sample of 200 parts from the second operator shows that 8 are non-conforming. Find a 90% confidence interval for the difference in the proportion of non-conforming parts produced by the two operators.	BTL -3	Applying	CO2
9.	A market research firm wants to estimate the share that foreign companies have in the U.S market for certain products. A random sample of 100 consumers is obtained, and 34 people in the sample are found to be users of foreign-made products; the rest are users of domestic products. Give 95% and 99% confidence level for the share of foreign products in this product.	BTL - 4	Analyzing	CO2

10.	A sample poll of 100 voters chosen at random from all voters in a given district indicated that 55% of them were in favor of a particular candidate. Find
	  i. 95% confidence limits for the proportion of all the voters in favor of this candidate
	  ii. 99% confidence limits for the proportion of all the voters in favor of this candidate.
		BTL - 4	Analyzing	CO2

11.	A manufacturer of pens has determined from experience that 4% of the pens produced are defective. If a random sample of 400 pens is examined, what is the probability of proportion of defects between 0.025 and 0.048	BTL -4	Analyzing	CO2
12.	Two independent samples are chosen from two schools A and B and a common test is given in a subject. The scores of the students are as follows. School A : 76 68 70 43 94 68 33 School B : 40 48 92 85 70 76 68 22 Construct a 95% and 99% confidence interval on the mean marks secured by students.	BTL -4	Analyzing	CO2
13.	From a population of 540, a sample of 60 individual is taken. From this sample, the mean is found to 6.2 and the standard deviation 1.368 (i) Find the estimated standard error of the mean. (ii) Construct a 95% confidence interval for the mean.	BTL -4	Analyzing	CO2
14.(a)	A cigarette manufacturer wishes to use a random sample to estimate the average nicotine content. The sampling error should not be more than 1 mg above or below the true mean with a 99% confidence. The population SD is 4mg. What sample size should company use to satisfy these requirements.	BTL -4	Analyzing	CO2
14.(b)	For a test market find the sample size needed to estimate the true proportion of consumers satisfied with a certain new product within ± 0.04 at 90% confidence level.	BTL -3	Applying	CO2

Q.No.	Question	BT Level	Competence	COs
15.	The average travel time taken based on a random sample of 10 people working in a company to reach the office is 40 minutes with the SD of 10 minutes. Establish the 95% confidence interval for the mean travel time of everyone in the company to design the working hours.	BTL -4	Analyzing	CO2
16.(a)	For a particular brand of TV picture tube, it is known that the mean operating life of the tubes is 1000 hours with a standard deviation of 250 hours, what is the probability that the mean for a random sample of size 25 will be between 950 and 1050 hours?	BTL -4	Analyzing	CO2
16.(b)	Strength of wire were produced by a company A has a mean of 4500kg and a S.D of 200kg, company B A has a mean of 4000kg and a S.D of 300kg. If 50 wires of company A and 100 wires of company B are selected at random and tested for strength. what is the probability that the mean strength of A will be at least 600kg more than that of B.	BTL -3	Applying	CO2
17.(a)	A sample of 100 measurements at breaking strength of cotton threads gave a mean of 7.4 and SD of 1.2gms. Find 95% confidence limits for the mean breaking strength.	BTL - 4	Analyzing	CO2
17.(b)	A mining company needs to estimate the average amount of copper are per ton mined. A random sample of 50 tons gives a sample mean of 146.75 pounds. The population SD is assumed to be 35.2 pounds. Give a 95% confidence interval for the average amount of copper in the population of tons mined.	BTL -3	Applying	CO2
18.	The life time of a certain brand of an electric bulb may be considered as a random variable with mean 1200 hours and standard deviation 250 hours. Find the probability using central limit theorem that the average life time of 60 bulbs exceed 1250 hours.	BTL -3	Applying	CO2

UNIT-III: TESTING OF HYPOTHESIS

Hypothesis testing: one sample and two sample tests for means of large samples (z-test)- one sample and two sample tests for means of small samples (t-test), F-test for two sample standard deviations.

Q.No.	Question	BT Level	Competence	COs
	PART – A			
1.	Define Test of Significance.	BTL-1	Remembering	CO3
2.	What are the Type I and Type II errors?	BTL-1	Remembering	CO3
3.	What do you mean by one tailed test?	BTL-1	Remembering	CO3
4.	State the applications of Z-test.	BTL-1	Remembering	CO3
5.	Define critical region.	BTL-1	Remembering	CO3
6	Distinguish between one tail and two tail tests.	BTL-2	Understanding	CO3
7.	When does the Z-test apply?	BTL-1	Remembering	CO3
8	Describe any two applications of t-distribution.	BTL-2	Understanding	CO3
9.	Write the uses of F-test?	BTL-1	Remembering	CO3
10	Define the level of significance.	BTL-1	Remembering	CO3
11.	Write the properties of t-distribution?	BTL-2	Understanding	CO3
12.	What is standard error?	BTL-1	Remembering	CO3
13.	Mention any four applications of t-distribution in tests of hypothesis.	BTL-2	Understanding	CO3

14.	Write down the formula of t- statistic to test the significance of difference between sample mean and population mean.	BTL-2	Understanding	CO3
15.	Write down the formula of t- statistic to test the significance of difference between two sample means	BTL-1	Remembering	CO3
16.	Write down the test statistic for F- test.	BTL-1	Remembering	CO3
17.	Define null hypothesis and Alternative hypothesis?	BTL-2	Understanding	CO3
18.	Estimate the standard error of difference between two proportion if $p_1=0.10$, $p_2=0.133$ and $n_1=50$, $n_2=75$.	BTL-1	Remembering	CO3
19.	A random sample of 25 cups from a certain coffee dispensing machine yields a mean 6.9 occurs per cup. Use 0.05 level of significance to test, on the average, the machine dispense $\mu = 7.0$ ounces against the null hypothesis that, on the average, the machine dispenses $\mu < 7.0$ ounces. Assume that the distribution of ounces per cup is normal, and that the variance is the known quantity $\sigma^2=0.01$ ounces. Find the test statistics of the above problem.	BTL-2	Understanding	CO3
20.	If $n = 30, \bar{x} = 10, \mu = 8.79$, find the test statistics for student t - test.	BTL-2	Understanding	CO3
21.	A standard sample of 200 tins of coconut oil gave an average weight of 4.95 kg with a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kg per tin at 5% level of significance?	BTL-2	Understanding	CO3
22.	If $S_1^2 = 13. S_2^2 = 11.25$, find the test statistic for F- test.	BTL -1	Remembering	CO3
23.	If $S_1^2 = 21.467. S_2^2 = 19.214$, find the test statistic for F- test.	BTL -1	Remembering	CO3
24.	If $n = 40, \bar{x} = 130$, $\mu = 26$, compute the standard error.	BTL -1	Remembering	CO3
25.	If $n = 50, \bar{x} = 58.56$, $\mu = 60.102$, compute the standard error.	BTL -1	Remembering	CO3

PART – B

1.(a)	The mean lifetime of a sample of 100 lite tubes produced by a Company is found to be 1580 hours with standard deviation of 90 hours. Test hypothesis that the mean lifetime of tubes produced by the company is 1600 hours.	BTL - 4	Analyzing	CO3
1.(b)	Samples of two types of electric bulbs were tested for length of life and following data were obtained. 		Type I	Type II
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Sample Size	8	7
Sample Mean	1234hrs	1036hrs
Sample S.D	36hrs	40hrs | Analyze that, is the difference in the means sufficient to warrant that type I is superior to type II regarding the length of life?	BTL - 4	Analyzing	CO3
2.(a)	In a certain factory there are two independent processes manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 Ozs, with a standard deviation of 12 Ozs, while the corresponding figures in a sample of 400 items from the other process are 124 and 14. Is the difference between the two sample means significant?	BTL3	Applying	CO3

2.(b)	A sample of 100 students is taken from a large population. The mean height of the students in this sample is 160 cm. Can it be reasonably regarded that this sample is from a population of mean 165 cm and SD 10 cm?	BTL - 4	Analyzing	CO3
3.(a)	A sample of heights of 6400 Englishmen has a mean of 170cm and a SD of 6.4cm, while a sample of height of 1600 American has mean of 172cm and SD of 6.3cm. Do the data indicate the Americans are an average taller than English men?	BTL -3	Applying	CO3
3.(b)	Ten oil tins are taken at random from an automatic filling machine. The mean weight of the tins is 15.8kg and SD is 0.5kg. Does the sample mean differ significantly from the intended weight of 16kg?	BTL -3	Applying	CO3
4.	The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the average height is greater than 64 inches?.	BTL -3	Applying	CO3
5.(a)	A certain stimulus administered to each of 12 patients resulted in the following increase of blood pressure 5,2,8,-1,3,0,-2, 1,5,0,4 and 6. Can it be concluded that the stimulus will, in general, be accompanied by an increase in blood pressure?	BTL -3	Applying	CO3
5.(b)	The following data represents the biological values of protein from cow's milk and buffalo's milk at a certain level Cow's milk : 1.82 2.02 1.88 1.61 1.81 Buffalo's milk : 2.00 1.83 1.86 2.03 2.19 Examine the variance of protein in the two milks significantly differ.	BTL -3	Applying	CO3
6.	In a test given to two groups of students the marks obtained were as follows, First group : 18 20 36 50 49 36 34 49 41 Second group: 29 28 26 35 30 41 46 Examine the significance difference between the means of marks secured by students of the above two groups.	BTL - 4	Analyzing	CO3
7.	Two independent samples of 8 and 7 items respectively had the following values. Sample I : 9 11 13 11 15 9 12 14 Sample II: 10 12 10 14 9 8 10 Is the difference between the means of samples significant?	BTL - 4	Analyzing	CO3
8.	A random sample is selected from each of two makes of ropes and their breaking strength (in pounds) are measured with the following results Sample I : 70 72 75 80 83 Sample II : 100 110 108 112 113 120 107 Test whether the mean breaking strength of the ropes differs significantly?	BTL-2	Understanding	CO3
9.	Ten persons were appointed in the officer cadre in an office. Their performance was noted by giving a test and marks were recorded out of 100. Employee : A B C D E F G H I J Before Training : 80 76 92 60 70 56 74 56 70 56 After	BTL - 4	Analyzing	CO3

	Training : 84 70 96 80 70 52 84 72 72 50 By applying t-test can it be concluded that the employees have been benefited by the training?			
10.	Two random samples drawn from two normal populations are Sample I : 20 16 26 27 23 22 18 24 25 19 Sample II: 27 33 42 35 32 34 38 28 41 43 30 37 Obtain the estimates of variances of the population and test whether the populations have the same variances	BTL-4	Analyzing	CO3
11.	For the following three samples, Sample I : 90 82 79 98 83 91 Sample II : 105 89 93 104 89 95 86 Perform an analysis of variance to test at 5% level of significance	BTL - 4	Analyzing	CO3
12.	Two samples of size 9 and 8 gave the sum of squares of deviation from the respective means as equal to 160 and 91 respectively. Do the sample variances differ significantly?	BTL-4	Analyzing	CO3
13.	Two independent samples of sizes 8 and 7 contained the following values. Test if the two populations have the same mean. 	Sample I	19	17	15	21	16	18	16	14
Sample II	15	14	15	19	15	18	16			BTL -3	Applying	CO3
14.	The nicotine content in milligram of two samples of tobacco where found to be as follows, test the significant difference between means of the two samples. 	Sample I	21	24	25	26	27	-
Sample II	22	27	28	30	31	36		BTL -3	Applying	CO3
15.	Two random samples gave the following results: | Sample	Size	Sample mean	Sum of squares of deviation from the mean
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1	10	15	90
2	12	14	108	 Analyze whether the samples have come from the same normal population.	BTL -4	Analyzing	CO3
16.	Two independent samples of sizes 8 and 7 contained the following values. 	Sample I	19	17	15	21	16	18	16	14
Sample II	15	14	15	19	15	18	16		 Test if the two populations have the same mean.	BTL -3	Applying	CO3
17.	Two different types of injection A and B where tried on certain patients for increasing weight, 5 persons were given injection A and 7 persons were given injection B in weight is given below Injection A : 8 12 13 9 3 Injection B : 10 8 12 15 6 8 11 Do the 2 injections differ significantly with regard to their effect in increasing weight?	BTL -3	Applying	CO3

Q.No.	Question	BT Level	Competence	COs
18.	In one sample of 8 observations the sum of the squares of deviations of the sample values from the sample mean was 84.4 and in the other sample of 10 observations it was 102.6. Test whether this difference is significant at 5% level, given that the 5% point of F for $v_1=7$ and $v_2=9$ degrees of freedom is 3.29?	BTL -3	Applying	CO3

UNIT- IV: PARAMETRIC TESTS

Chi-square tests for independence of attributes and goodness of fit- Design of experiments one way classification – Two way classification

Q.No.	Question	BT Level	Competence	COs
	PART – A			
1.	State the formula of test statistics for the chi- square test.	BTL-1	Remembering	CO4
2.	Write any two uses of ψ^2-test.	BTL-1	Remembering	CO4
3.	Write the contingency 2*2 table for $\aleph^2$ test.	BTL -2	Understanding	CO4
4.	Define Replication.	BTL-1	Remembering	CO4
5.	Define Randomization.	BTL-1	Remembering	CO4
6.	Define Local control.	BTL-1	Remembering	CO4
7.	Define Experimental error.	BTL-1	Remembering	CO4
8	What are the components of design of experiment?	BTL-1	Remembering	CO4
9.	What is the aim of design of experiments?	BTL -2	Understanding	CO4
10	What is ANOVA?	BTL-1	Remembering	CO4
11.	Write the basic assumptions in analysis of variance.	BTL -2	Understanding	CO4
12.	What are the uses of ANOVA?	BTL-1	Remembering	CO4
13.	State the formula for correction factor.	BTL-1	Remembering	CO4
14.	Compare RBD over CRD.	BTL-2	Understanding	CO4
15.	What is a completely randomized design?	BTL-1	Remembering	CO4
16.	Write the short notes on RBD	BTL-1	Remembering	CO4
17.	What is meant by tolerance limits?	BTL-1	Remembering	CO4
18.	What are the basic elements of an Completely Randomized Experimental Design?	BTL-1	Remembering	CO4
19.	What is the degrees of freedom for Sum of Squares due to Treatments in One–way Classification?	BTL -2	Understanding	CO4
20.	What is the degrees of freedom for Error in one way classification?	BTL -2	Understanding	CO4
21.	What is the TSS degrees of freedom for Two–way Classification with r – rows and c – columns?	BTL-1	Remembering	CO4
22.	What is the degrees of freedom for Error in Two way classification?	BTL-1	Remembering	CO4
23.	State the formula for Sum of squares between treatment in one way classification.	BTL-1	Remembering	CO4
24.	State the formula for Sum of squares in Error in two way classification.	BTL -2	Understanding	CO4
25.	Distinguish between one-way and two-way analysis of variance.	BTL-1	Remembering	CO4
	PART – B			
1.	The following data gives the number of aircraft accidents that occurred during the various days of a week. Find whether the accidents are uniformly distributed over the week			

	Days	Sun	Mon	Tue	Wed	Thu	Fri	Sat		
	No. of accidents	14	16	08	12	11	9	14		
									BTL -4	Analyzing	CO4

No.	Question	BTL	Level	CO
2.	The theory predicts that the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four groups was 882,313,287 and 118. Do the experimental results support the survey?	BTL -4	Analyzing	CO4
3.	A brand manager is concerned that her brand's share may he unevenly distributes through the country. In a survey in which the country was divided into four geographic regions, a random sampling of 100 consumers in each region was surveyed, with the following results: 		NE	NW	SE	SW	TOTAL
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Purchase the brand	40	55	45	50	190
Do not purchase	60	45	55	50	210
Total	100	100	100	100	400	 (i) Develop a table of observed and expected frequencies for this problem. (ii) Calculate the sample χ^2 value. (iii) State the null and alternative hypothesis. At 0.05 *LOS,* test whether brand share is the same across the four regions	BTL -3	Applying	CO4
4.	Given the following table for hair color and eye color, identify the value of Chi-square. Is there good association between hair color and eye color? 			Hair color			
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		Fair	Brown	Black	Total
Eye color	Blue	15	5	20	40
	Grey	20	10	20	50
	Brown	25	15	20	60
	Total	60	30	60	150		BTL -3	Applying	CO4
5.	Test of fidelity and selectivity of 190 radio receivers produced the results shown in the following table |	Fidelity		
---	---	---	---
Selectivity	Low	Average	High
Low	6	12	32
Average	33	61	18
High	13	15	0	 Use 0.01 level of significance to test whether there is a Relationship between fidelity and selectivity	BTL -4	Analyzing	CO4

6.	Two researchers adopted different sampling techniques while investigating the same group of students to find the no of students falling in different intelligence level. The results are as follows: No. of students in each level	BTL -3	Applying	CO4

Researchers	Below Average	Average	Above Average	Genius	
X	86	60	44	10	200
Y	40	33	25	2	100
Total	126	93	69	12	300

Would you say that the sampling techniques adopted by the two researchers are independents (Use Chi-Square test at $\alpha = 0.05$).

7.	The number of defects in printed circuit boards in hypothesized to follow a Poisson distribution. A random sample of 60 printed boards have been collected and the number of defects observed. The following table gives the results.	BTL -3	Applying	CO4

No. of defects	Observed Frequency
0	32
1	15
2	9
3	4

Does the assumption of a Poisson distribution seem appropriate as a probability model for this process?

8.	Mechanical engineers testing a new arc welding technique, classified welds both with respect to appearance and an X-ray inspection	BTL -4	Analyzing	CO4

X-ray/Appearance	Bad	Normal	Good
Bad	20	7	3
Normal	13	51	16
Good	7	12	21

Test for independence using 0.05 level of significance.

9.	The following are the number of mistakes made in 5 successive days by four technicians working for a photographic laboratory. Test whether the difference among the four sample means can be attributed to chance. Test at a level of significance $\alpha = 0.01$.	BTL -3	Applying	CO4

Technician			
I	II	III	IV
6	14	10	9
14	9	12	12
10	12	7	8
8	10	15	10
11	14	11	11

10.	Apply ANOVA technique and write your comment regarding the performance of the 4 machines? Test at 1% level of significance.							BTL - 4	Analyzing	CO4

Machines:

	A	8	9	11	12
	B	6	8	10	4
	C	14	12	18	9
	D	20	22	25	23

11.	In order to determine whether the significant difference in the durability of 3makes of computers, samples of size 5 are selected from each make and the frequency of repair during the first year of purchase is observed. The results are as follows: In view of the above data, what conclusion can you draw?	BTL -4	Analyzing	CO4

Makes

A	B	C
5	8	7
6	10	3
8	11	5
9	12	4
7	4	1

12.	The following table shows the lives in hours of four brands of electric lamps brand A : 1610,1610,1650, 1680, 1700, 1720, 1800 B : 1580,1640,1640, 1700, 1750 C : 1460,1550,1600, 1620, 1640, 1660, 1740, 1820 D : 1510,1520,1530, 1570, 1600, 1680 Identify an analysis of variance and test the homogeneity of the mean lives of the four brands of lamps.	BTL -3	Applying	CO4

13.	A Company appoints 4 salesmen A, B, C, D and observes their sales in 3 seasons, summer, winter and monsoon. The figures (in lakhs) are given in the following table:	BTL -4	Analyzing	CO4

Season	Salesmen			
	A	B	C	D
Summer	45	40	38	37
Winter	43	41	45	38
Monsoon	39	39	41	41

Carry out the analysis of variance.

14.	A completely randomized design experiment with 10 plots and 3 treatments gave the results given below. Analyze the results for the effects of treatments.	BTL-3	Applying	CO4

Treatment	Replications			
A	5	7	1	3
B	4	4	7	
C	3	1	5	

15.	Analyze the RBD at 5% level of significance.			

Q.No.	Question	BT Level	Competence	Course Outco
		BTL -4	Analyzing	CO4

	Variety		
Treatment	1	2	3
1	8	10	12
2	2	6	7
3	4	10	9
4	3	5	9

16. The following data represent the number of units of production per day turned out by different workers using four different types of machines.

1. Test whether the five men differ with respect to mean productivity
2. Test whether the mean productivity is the same for the four different machine types.

BTL -4 | Analyzing | CO4

Workers		Machine Type			
		A	B	C	D
	1	44	38	47	36
	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

17. A laboratory technician measures the breaking strength of each of five kinds of linen threads by using four different measuring instruments, and obtain the following results.

BTL -3 | Applying | CO4

Thread		Instruments			
		I_1	I_2	I_3	I_4
	1	20.9	20.4	19.9	21.9
	2	25	26.2	27.0	24.8
	3	25.5	23.1	21.5	24.4
	4	24.8	21.2	23.5	25.7
	5	19.6	21.2	22.1	22.1

Perform a 2-way ANOVA using the 0.05 level of significance.

18. A chemist wishes to test the effect of four chemical agents on the strength of a particular type of cloth. Because there might be variability from one bolt to another , the chemist decides to use a randomized block design ,with the bolts of cloth consider as blocks ,she selects five bolts and applies all four chemical in random order to each bolt, The resulting tensile strength follows

BTL-3 | Applying | CO4

		BOLT				
		1	2	3	4	5
CHEMICAL	1	73	68	74	71	67
	2	73	67	75	72	70
	3	75	68	78	73	68
	4	73	71	75	75	69

Does the tensile strength depend on chemical? Test at 10% level of significance.

UNIT-V: NON-PARAMETRIC TESTS

Sign test for paired data- Rank sum test.-Kolmogorov-Smirnov – test for goodness of fit-comparing two populations- Mann – Whitney U test and Kruskal Wallis test. One sample run test.

Q.No.	Question	BT Level	Competence	Course Outco

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PART – A				
1.	When are non-parametric tests used?	BTL -1	Remembering	CO5
2.	State the advantages of Non - parametric Tests.	BTL -1	Remembering	CO5
3.	What is the other name of non-parametric test?	BTL -1	Remembering	CO5
4.	Explain sign test.	BTL -1	Remembering	CO5
5.	What are the non-parametric tests available?	BTL -2	Understanding	CO5
6	How do the nonparametric methods differ from parametric methods?	BTL -2	Understanding	CO5
7.	State any three Non Parametric test.	BTL -2	Understanding	CO5
8	Write a note on non parametric test.	BTL -1	Remembering	CO5
9.	How can you perform sign Test?	BTL -2	Understanding	CO5
10	Define Rank-Sum test.	BTL -2	Understanding	CO5
11.	What is the null hypothesis framed in Mann-Whitney test?	BTL -1	Remembering	CO5
12.	When is Mann- Whitney U test used?	BTL -2	Understanding	CO5
13.	Write the formula of test statistics for Mann- Whitney U test.	BTL -2	Understanding	CO5
14.	Define the statistic used in U test and give its mean.	BTL -1	Remembering	CO5
15.	Define H test .	BTL -1	Remembering	CO5
16.	Write down the working rule for Mann-Whitney U-test and Krushkal-Wallis test.	BTL -1	Remembering	CO5
17.	When is Krushkal-Wallis test used?	BTL -1	Remembering	CO5
18.	Distinguish between Mann-Whitney U-test and Krushkal-Wallis test.	BTL -1	Remembering	CO5
19.	Explain Kolmogorov-Smirnov Test for one sample problem.	BTL -1	Remembering	CO5
20.	Write a short note of Krushkal Wallis test.	BTL -1	Remembering	CO5
21.	Write the formula of test statistics for Krushkal Wallis test	BTL -1	Remembering	CO5
22.	Define One Sample Run test.	BTL -1	Remembering	CO5
23.	State the short notes of Run test.	BTL -2	Understanding	CO5
24.	Write the formula of test statistics for Kolmogorov-Smirnov Test	BTL -2	Understanding	CO5
25.	Mention the disadvantages of Non parametric Tests.	BTL -2	Understanding	CO5
PART – B				
1.	The following is an arrangement of 25 men and 15 women lined up to purchase tickets for a premier picture show. Test the randomness of the arrangement for the following data. MWWMMMWMMWMWMWWWMMMWMMWWWMMMMMMWWWMMMMMMM.	BTL -3	Applying	CO5
2.	In 30 tosses of a coin, the following sequence of head and tails is obtained HTTHTHHHTHHTTHTHTHHTHTTHTHHHTHT (i) Determine the number of runs (ii) Test at 0.10 level of significance, whether the sequence is random	BTL -4	Analyzing	CO5
3.	On tossing a coin 15 times the following sequence of heads H and tails T was obtained TTHHHTHTHHHTTHH. Test whether the coin is unbiased by the run test.	BTL - 4	Analyzing	CO5
4.	25 individual were sample as two whether they liked or did not like a product. The resulting sample is obtained below LLNNNNLLLLNLNNLNNNNNNLLLLLNN.	BTL -2	Understanding	CO5

	(i) Determine the number of runs, (ii) Test at the 0.05 level of significance, whether the responses are random.												

5.	Sand I	63	17	35	49	18	43	12	20	47	BTL -1	Remembering	CO5
	"	136	51	45	84	32	40	44	25				
	Sand II	113	54	96	26	39	88	92	53	101			
	"	48	89	107	111	58	62						

In a study of sedimentary rocks, the following data were obtained from samples of 32 grains from two kinds of sand. Apply Mann-Whitney U test with suitable null and alternative hypotheses.

6.	The following are the prices in Rs. per kg of a commodity from 2 random samples of shops from 2 cities *A&B*.								BTL -2	Understanding	CO5

City A	2.73	3.82	4.35	3.23	4.74	3.65	3.8	4.15	
	2.76	2.85	3.25	3.45	3.85	4.45	4.95	3.95	4.72
City B	3.75	5.37	4.78	3.69	4.75	4.85	6.0	4.8	4.9
	3.84	3.9	4.8	5.23	6.1	3.6	3.83		

Apply the run test to examine whether the distribution of prices of commodity in the two cities is the same.

7.	Independent random samples of ten day students and ten evening students at a university showed the following age distributions. We want to use the Mann-Whitney-Wilcoxon test to determine if there is a significant different in the age distribution of the two groups.	BTL -2	Understanding	CO5

Day	Evening
26	32
18	24
25	23
27	30
19	40
30	41
34	42
21	39
33	45
31	35

(i)   Compute the sum of the ranks for the day students.
(ii)   Compute the mean μT.
(i)   Compute σT.

Use $\alpha = 0.05$ and test to determine if there is a significant difference in the population of the sales of the two groups

8.	The following are the measurements of breaking strength of a certain kind of 2 inch cotton ribbon in pounds. Use the sign test to test the hypothesis of 0.05 LOS that the mean breaking strength is 160 pounds.	BTL -3	Applying	CO5

163	165	160	189	161	171	158	151	169	162
163	139	172	165	148	166	172	163	187	173

9.	An experiment designed to compare three preventative methods against corrosion yielded the following maximum depths of pits (in thousands of an inch) in pieces of wire subjected to the respective treatments:	BTL -3	Applying	CO5

Method A:	77	54	67	74	71	66	

Method B:	60	41	59	65	62	64	52		
Method C:	49	52	69	47	56				

Use the Kruskal-Wallis test at the 5% level of significance to test the null hypothesis that the three samples come from identical populations.

No.	Question	BTL	Level	CO
10.	A company's trainees are randomly assigned to groups which are taught a certain industrial inspection procedure by 3 different methods. At the end of the inspection period they are tested for inspection performance quality. The following are their scores. Method A: 80 83 79 85 90 68 Method B: 82 84 60 72 86 67 91 Method C: 93 65 77 78 88 Use H test to determine at 0.05 LOS whether the three methods are equally effective.	BTL -3	Applying	CO5
11.	Melisa's Boutique has three mall locations. Melisa keeps a dairy record for each location of number of customers who actually make a purchase. A sample of those data follows. Using the Krushkal-Wallis test, can you say at the 0.05 level of significance that her stores have the same number of customers who busy?	BTL-3	Applying	CO5

DSF Mall	99	64	101	85	79	88	97	95	90	100
Forest Mall	83	102	125	61	91	96	94	89	98	75
Big-Ben Mall	89	98	56	105	87	90	87	101	76	89

12.	The production volume of units assembled by three different operators during 9 shifts is summarized below.	BTL -4	Analyzing	CO5

Operator I	29	34	34	20	32	45	42	24	35
Operator II	30	21	23	25	44	37	34	19	38
Operator III	26	36	41	48	27	39	28	46	15

Check whether there is significant difference between the production volumes of units assembled by the three operators using Krushkal-Wallis test at a significant level of 0.05.

13.	The scores of a written examination of 24 students, who were trained by using three different methods, are given below.	BTL -3	Applying	CO5

Video cassetteA	74	88	82	93	55	70	65		
Audio cassetteB	78	80	65	57	89	85	78	70	
Class Room C	68	83	50	91	84	77	94	81	92

Use Krushkal-Wallis test at $\alpha = 5\%$ level of significance, whether the three methods of training yield the same results.

14.	Apply the K-S test to check that the observed frequencies match with the expected frequencies which are obtained from Normal distribution. (Given at n=7, $D_n = 0.486$ at 5% LOS).	BTL -3	Applying	CO5

	25-30	31-36	37-42	43-48	49-54	55-60	61-66
Observed Frequency	9	22	25	30	21	12	6
Expected Frequency	6	17	32	35	18	13	4

15. (a)	Apply the K-S test to check that the observed frequencies match with the expected frequencies which are obtained from Normal distribution. (Given at n=5, D_n = 0.510 at 10% LOS). | Test Score	51-60	61-70	71-80	81-90	91-100 | |---|---|---|---|---|---| | Observed Frequency | 30 | 100 | 440 | 500 | 130 | | Expected Frequency | 40 | 170 | 500 | 390 | 100 |	BTL -3	Applying	CO5
15.(b)	The sales records of two branches of a department store over the last 12 months are shown below.(sales figures are in thousands of dollars). We want to use the Mann-Whitney-Wilcoxon test to determine if there is a significant difference in the sales of the two branches. 	Month	Branch A	Branch B	 |---|---|---| | 1 | 257 | 210 | | 2 | 280 | 230 | | 3 | 200 | 250 | | 4 | 250 | 260 | | 5 | 284 | 275 | | 6 | 295 | 300 | | 7 | 297 | 320 | | 8 | 265 | 290 | | 9 | 330 | 310 | | 10 | 350 | 325 | | 11 | 340 | 329 | | 12 | 372 | 335 | (ii) Compute the sum of the ranks for branch A (iii) Compute the mean μT. (iv) Compute σT. (v) Use $\alpha = 0.05$ and test to determine if there is a significant difference in the population of the sales of the two branches	BTL-2	Understanding	CO5
16.	The following are the year of experience (X) and the average customer satisfaction (Y) for 10 service providers. Is there a significant rank correlation between two measures? Use the 0.05 level of significance. X: 6.3 5.8 6.1 6.9 3.4 1.8 9.4 4.7 7.2 2.4 Y: 5.3 8.6 4.7 4.2 4.9 6.1 5.1 6.3 6.8 5.2	BTL -4	Analyzing	CO5
17.	From a Maths class of 12 equally capable students using a programmed material, 5 are selected at random and given additional instructions by the teacher. The results on the final exam is as follows. Additional Instruction: 87 69 78 91 80 No Additional Instruction: 75 88 64 82 93 79 67 Use the Rank Sum test at 5% LOS to determine if the additional instruction affects the average grade.	BTL -3	Applying	CO5

| 18. | The nicotine content of two brands of cigarettes, measured in milligrams was found as follows.
Brand A: 2.1 4.0 6.3 5.4 4.8 3.7 6.1 3.3
Brand B: 4.1 0.6 3.1 2.5 4.0 6.2 1.6 2.2 1.9 5.4
Use the Rank Sum test at 5% LOS. | BTL -4 | Analyzing | CO5 |