



B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Third Semester

BT/ TXT

U18MAT3103 / Probability and Statistics

(Statistical Tables required)

COURSE OUTCOMES

CO1:	Compute measures of central tendencies, dispersion, and correlation between variables and predict unknown values using regression.
CO2:	Understand and apply the concept of probability and random variables.
CO3:	Construct probabilistic models for observed phenomena through distributions, which play an important role in many engineering applications.
CO4:	Perform hypothesis testing and interpret the results.
CO5:	Understand the principles of design of experiments and perform analysis of variance.
CO6:	Sketch control charts and comment on the process control.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Write the Spearman's formula for the rank correlation coefficient.	CO1	[K ₁]
2.	In a correlation analysis the equations of the two regression lines are $3x + 12y = 19$ and $3y + 9x = 46$. Find mean value of X and Y.	CO1	[K ₂]
3.	When A and B are two mutually exclusive events such that $P(A) = 1/3$ and $P(B) = 1/4$. Find $P(A \cup B)$ and $P(A \cap B)$.	CO2	[K ₂]
4.	If $f(x) = kx^2, 0 \leq x \leq 1$, is to be a density function, find the value of "k".	CO2	[K ₂]
5.	Write two properties of Normal distribution.	CO3	[K ₁]
6.	The number of monthly breakdowns of a computer is a Random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month without a breakdown.	CO3	[K ₂]
7.	The mean value of a random sample of 60 items was found to be 145 with a standard deviation of 40, find the 95% confidence limits for the population mean.	CO4	[K ₂]
8.	Write uses of Chi-square test.	CO4	[K ₁]
9.	Name the basic principles of experimental design.	CO5	[K ₁]
10.	List the control charts for attributes.	CO6	[K ₁]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	<p>Compute the mean, median and mode of the following frequency distribution. Verify whether the empirical relation between them is satisfied.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 10%;">Class</td> <td style="width: 10%;">3.5</td> <td style="width: 10%;">10.5</td> <td style="width: 10%;">17.5</td> <td style="width: 10%;">24.5</td> <td style="width: 10%;">31.5</td> <td style="width: 10%;">38.5</td> <td style="width: 10%;">45.5</td> <td style="width: 10%;">52.5</td> </tr> <tr> <td>Frequency</td> <td>26</td> <td>31</td> <td>35</td> <td>42</td> <td>82</td> <td>71</td> <td>54</td> <td>19</td> </tr> </table>	Class	3.5	10.5	17.5	24.5	31.5	38.5	45.5	52.5	Frequency	26	31	35	42	82	71	54	19	8	CO1	[K ₄]
Class	3.5	10.5	17.5	24.5	31.5	38.5	45.5	52.5															
Frequency	26	31	35	42	82	71	54	19															
	b)	<p>Evaluate Karl Pearson's correlation coefficient from the following data.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 5%;">X</td> <td style="width: 10%;">12</td> <td style="width: 10%;">15</td> <td style="width: 10%;">18</td> <td style="width: 10%;">21</td> <td style="width: 10%;">24</td> <td style="width: 10%;">27</td> </tr> <tr> <td>Y</td> <td>17</td> <td>16</td> <td>18</td> <td>19</td> <td>21</td> <td>20</td> </tr> </table>	X	12	15	18	21	24	27	Y	17	16	18	19	21	20	8	CO1	[K ₅]				
X	12	15	18	21	24	27																	
Y	17	16	18	19	21	20																	
12.	a)	<p>The contents of urns I, II, III are as follows: 1 white, 2 black and 3 red balls; 2 white, 1 black and 1 red balls; 4 white, 5 black and 3 red balls respectively. One urn is chosen at random and two balls are drawn from it. They happen to be white and red. What is the probability that they come from urns I, II, or III?</p>	8	CO2	[K ₃]																		
	b)	<p>A random variable X has the probability distribution</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 10%;">$X = i$</td> <td style="width: 10%;">0</td> <td style="width: 10%;">1</td> <td style="width: 10%;">2</td> <td style="width: 10%;">3</td> <td style="width: 10%;">4</td> <td style="width: 10%;">5</td> <td style="width: 10%;">6</td> <td style="width: 10%;">7</td> </tr> <tr> <td>P_i</td> <td>0</td> <td>k</td> <td>2k</td> <td>2k</td> <td>3k</td> <td>k^2</td> <td>$2k^2$</td> <td>$2k^2 + k$</td> </tr> </table> <p>Find (i) the value of 'k', (ii) $P(1.5 < X < 4.5 / X > 2)$, (iii) The value of 'a' such that $P(X \leq a) > 1/2$.</p>	$X = i$	0	1	2	3	4	5	6	7	P_i	0	k	2k	2k	3k	k^2	$2k^2$	$2k^2 + k$	8	CO2	[K ₂]
$X = i$	0	1	2	3	4	5	6	7															
P_i	0	k	2k	2k	3k	k^2	$2k^2$	$2k^2 + k$															
13.	a)	<p>In a certain factory manufacturing razor blades, there is small chance of 1/500 for any blade to be defective. The blade is in packets of 10. Use Poisson distribution to calculate the approximate number of packets containing (i) no defective (ii) one defective (iii) 2 defective blades respectively in a consignment of 10,000 packets.</p>	8	CO3	[K ₃]																		
	b)	<p>Fit a binomial distribution for the following data:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 10%;">x</td> <td style="width: 10%;">0</td> <td style="width: 10%;">1</td> <td style="width: 10%;">2</td> <td style="width: 10%;">3</td> <td style="width: 10%;">4</td> <td style="width: 10%;">5</td> <td style="width: 10%;">6</td> </tr> <tr> <td>f</td> <td>5</td> <td>18</td> <td>28</td> <td>12</td> <td>7</td> <td>6</td> <td>4</td> </tr> </table>	x	0	1	2	3	4	5	6	f	5	18	28	12	7	6	4	8	CO3	[K ₁]		
x	0	1	2	3	4	5	6																
f	5	18	28	12	7	6	4																
14.	a)	<p>The following table gives the number of air-crafts accidents that occurred during the various days of a week. Test whether the accidents are uniformly distributed over the week.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 15%;">Day</td> <td style="width: 10%;">Mon</td> <td style="width: 10%;">Tues</td> <td style="width: 10%;">Wed</td> <td style="width: 10%;">Thu</td> <td style="width: 10%;">Fri</td> <td style="width: 10%;">Sat</td> </tr> <tr> <td>No of accident</td> <td>15</td> <td>19</td> <td>13</td> <td>12</td> <td>16</td> <td>15</td> </tr> </table>	Day	Mon	Tues	Wed	Thu	Fri	Sat	No of accident	15	19	13	12	16	15	8	CO4	[K ₃]				
Day	Mon	Tues	Wed	Thu	Fri	Sat																	
No of accident	15	19	13	12	16	15																	
	b)	<p>Two samples gave the following data:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 25%;">Sample 1</td> <td style="width: 25%;">$n_1 = 8$</td> <td style="width: 25%;">$\bar{x}_1 = 9.6$</td> <td style="width: 25%;">$s_1^2 = 1.2$</td> </tr> <tr> <td>Sample 2</td> <td>$n_2 = 11$</td> <td>$\bar{x}_2 = 16.5$</td> <td>$s_2^2 = 2.5$</td> </tr> </table>	Sample 1	$n_1 = 8$	$\bar{x}_1 = 9.6$	$s_1^2 = 1.2$	Sample 2	$n_2 = 11$	$\bar{x}_2 = 16.5$	$s_2^2 = 2.5$	8	CO4	[K ₃]										
Sample 1	$n_1 = 8$	$\bar{x}_1 = 9.6$	$s_1^2 = 1.2$																				
Sample 2	$n_2 = 11$	$\bar{x}_2 = 16.5$	$s_2^2 = 2.5$																				

		Can we conclude that the two samples have been drawn from the same normal population?																																				
15.	a)	<p>A completely randomized design experiment with 10 plots and 3 treatments gave the following results:</p> <table border="1"> <tr> <td>Plot No</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>10</td> </tr> <tr> <td>Treatment</td> <td>A</td> <td>B</td> <td>C</td> <td>A</td> <td>C</td> <td>C</td> <td>A</td> <td>B</td> <td>A</td> <td>B</td> </tr> <tr> <td>Yield</td> <td>5</td> <td>4</td> <td>3</td> <td>7</td> <td>5</td> <td>1</td> <td>3</td> <td>4</td> <td>1</td> <td>7</td> </tr> </table> <p>Analyze the results for treatment effects.</p>	Plot No	1	2	3	4	5	6	7	8	9	10	Treatment	A	B	C	A	C	C	A	B	A	B	Yield	5	4	3	7	5	1	3	4	1	7	8	CO5	[K ₄]
Plot No	1	2	3	4	5	6	7	8	9	10																												
Treatment	A	B	C	A	C	C	A	B	A	B																												
Yield	5	4	3	7	5	1	3	4	1	7																												
	b)	<p>Three varieties A, B, C of a crop are tested in a randomized block design with four replications, the layout being given below. The yields are given kilograms. Analyze for significance.</p> <table border="1"> <thead> <tr> <th rowspan="2">Blocks</th> <th colspan="3">Crops</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>47</td> <td>49</td> <td>48</td> </tr> <tr> <td>2</td> <td>51</td> <td>49</td> <td>53</td> </tr> <tr> <td>3</td> <td>49</td> <td>52</td> <td>52</td> </tr> <tr> <td>4</td> <td>49</td> <td>50</td> <td>51</td> </tr> </tbody> </table>	Blocks	Crops			A	B	C	1	47	49	48	2	51	49	53	3	49	52	52	4	49	50	51	8	CO5	[K ₄]										
Blocks	Crops																																					
	A	B	C																																			
1	47	49	48																																			
2	51	49	53																																			
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16.	a)	<p>The following are the sample means and ranges for ten samples, each of size 5. Construct the control chart for mean and range and comment on the nature of control.</p> <table border="1"> <tr> <td>S. No</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>10</td> </tr> <tr> <td>\bar{X}</td> <td>12.8</td> <td>13.1</td> <td>13.5</td> <td>12.9</td> <td>13.2</td> <td>14.1</td> <td>12.1</td> <td>15.5</td> <td>13.9</td> <td>14.2</td> </tr> <tr> <td>R</td> <td>2.1</td> <td>3.1</td> <td>3.9</td> <td>2.1</td> <td>1.9</td> <td>3.0</td> <td>2.5</td> <td>2.8</td> <td>2.5</td> <td>2.0</td> </tr> </table>	S. No	1	2	3	4	5	6	7	8	9	10	\bar{X}	12.8	13.1	13.5	12.9	13.2	14.1	12.1	15.5	13.9	14.2	R	2.1	3.1	3.9	2.1	1.9	3.0	2.5	2.8	2.5	2.0	8	CO6	[K ₆]
S. No	1	2	3	4	5	6	7	8	9	10																												
\bar{X}	12.8	13.1	13.5	12.9	13.2	14.1	12.1	15.5	13.9	14.2																												
R	2.1	3.1	3.9	2.1	1.9	3.0	2.5	2.8	2.5	2.0																												
	b)	<p>The data given below are the number of defectives in 10 samples of size 400 each. Construct a p-chart and np-chart and comment on the results.</p> <table border="1"> <tr> <td>S. No</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>10</td> </tr> <tr> <td>No. of defectives</td> <td>15</td> <td>12</td> <td>4</td> <td>26</td> <td>15</td> <td>9</td> <td>19</td> <td>9</td> <td>14</td> <td>17</td> </tr> </table>	S. No	1	2	3	4	5	6	7	8	9	10	No. of defectives	15	12	4	26	15	9	19	9	14	17	8	CO6	[K ₆]											
S. No	1	2	3	4	5	6	7	8	9	10																												
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