

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
FIRST SEMESTER M.TECH DEGREE EXAMINATION, APRIL 2021

**Mechanical Engineering**

**Streams: (1) Industrial Engineering (2) Financial Engineering**

**01ME6401: Statistics for Engineering Applications**

Max. Marks: 60

Duration: 3 Hours

*Answer any two full questions from each Part.  
Use of Statistical Tables permitted.  
Any missing data shall be assumed. All assumptions shall be clearly stated.*

**PART A**

1. (a) The following are determinations of a river's annual maximum flow in cubic meters per second: 405, 356, 419, 266, 370, 391, 613, 383, 435, 462, 289, 318, 540, 295, and 508. Construct a stem-and-leaf display with two-digit leaves. Interpret the display.

**(3 marks)**

- (b) The administrator of a hospital surveyed the number of days 200 randomly chosen patients stayed in the hospital following an operation. The data are as follows:

Hospital stay in days	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24
Frequency	18	90	44	21	9	9	4	5

- (i) Calculate the mean and standard deviation.

- (ii) According to Chebyshev's theorem, how many stays should be between 0 and 17 days? How many are actually in the interval?

**(4.5 marks)**

2. (a) The following information is obtained from a person on his home loan application:

- (i) Monthly income; (ii) Marital Status; (iii) Term of loan; (iv) Occupation

Classify by type of data and indicate the measurement scale.

**(3 marks)**

- (b) From the following data on age of employees, calculate the coefficient of skewness and comment on the result:

<b>Age below (Years)</b>	<b>25</b>	<b>30</b>	<b>35</b>	<b>40</b>	<b>45</b>	<b>50</b>	<b>55</b>
<b>No. of Employees</b>	<b>8</b>	<b>20</b>	<b>40</b>	<b>65</b>	<b>80</b>	<b>92</b>	<b>100</b>

(4.5 marks)

3. (a) Distinguish between Exclusive type and Inclusive type class intervals. (3 marks)
- (b) Consider two different businesses with equal initial investment and equal lives, whose expected cash flows (in Rs. crores) are summarized as follows. Identify the business which is more consistent in terms of cash flow:

<b>Period</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Business A</b>	<b>80</b>	<b>85</b>	<b>70</b>	<b>100</b>	<b>115</b>
<b>Business B</b>	<b>100</b>	<b>70</b>	<b>90</b>	<b>80</b>	<b>150</b>

(4.5 marks)

### PART B

4. (a) In a normal distribution with mean 375 and standard deviation 48, how large a sample must be taken so that the probability will be at least 0.95 that the sample mean falls between 370 and 380? (3 marks)
- (b) Seven homemakers were randomly sampled, and it was determined that the distances they walked in their housework had an average of 39.2 miles per week and a sample standard deviation of 3.2 miles per week. Construct a 95% interval for the population mean. (4.5 marks)
5. (a) QC department of a paint manufacturing company, at the time of despatch of decorative paints, discovered that 30 per cent of the containers are defective. If a random sample of 500 containers is drawn with replacement from the population, what is the probability that the sample proportion will be less than or equal to 25 per cent defective? (3 marks)
- (b) Two independent samples of students representing Region 1 and Region 2 of a program are taken from normal populations with the same variance. The variance of marks of 16 students of a sample taken from the Region 1 is 225 and the variance of marks of 12 students of another sample taken from the Region 2 is 144. Check whether the variance of the marks of the first sample is less than the variance of the marks of the second sample at a significance level of 0.01. (4.5 marks)
6. (a) Illustrate multi-stage sampling with an example. (3 marks)
- (b) Two salesmen, A and B are working in a certain district. From a sample survey conducted by the head office, following results were obtained. State whether there is any significant difference in the average sales between the two salesmen. Take  $\alpha=0.05$ .

	Salesman A	Salesman B
No. of samples	20	18
Average Sales (Rs.'000)	170	205
Standard Deviation (Rs.'000)	20	25

(4.5 marks)

### PART C

7. (a) The following is an observed frequency distribution. Using a normal distribution with  $\mu = 98.6$  and  $\sigma = 3.78$ ,

Value of the variable	< 92	92-95.99	96-99.99	100-103.99	$\geq 104$
Observed Frequency	69	408	842	621	137

- (i) Find the probability of falling into each class.
- (ii) From part (i), compute the expected frequency of each category.
- (iii) Calculate K-S statistic.
- (iv) At the 0.10 significance level, does the distribution seem to be well described by the suggested normal distribution?

(7.5 marks)

- (b) The weight (in pounds) and systolic blood pressure of 26 randomly selected males in the age group 25 to 30 are given below. Assume that weight and blood pressure are jointly normally distributed.

Subject	Weight	Systolic BP	Subject	Weight	Systolic BP
1	165	130	14	172	153
2	167	133	15	159	128
3	180	150	16	168	132
4	155	128	17	174	149
5	212	151	18	183	158
6	175	146	19	215	150
7	190	150	20	195	163
8	210	140	21	180	156
9	200	148	22	143	124
10	149	125	23	240	170
11	158	133	24	235	165
12	169	135	25	192	160
13	170	150	26	187	159

- (i) Estimate the correlation coefficient.
- (ii) Test the hypothesis that  $\rho = 0$ , using  $\alpha = 0.05$ .
- (iii) Construct a 95% confidence interval for the correlation coefficient.

(7.5 marks)

8. (a) Consider a two-factor factorial experiment used to investigate the effect of pH and catalyst concentration on product viscosity (cSt). The data are as follows:

		Catalyst Concentration			
		2.5		2.7	
pH	5.6	192	199	178	186
		189	198	179	188
	5.9	185	193	197	196
		185	192	204	204

Test the main effects and interactions using  $\alpha = 0.05$ . What are your conclusions?

(7.5 marks)

- (b) Consider the following data, where the cost accountants have collected information on overhead expenses and the units produced at different plants:

Overhead	191	170	272	155	280	173	234	116	153	178
Units	40	42	53	35	56	39	48	30	37	40

- Develop an estimating equation that best describes these data.
- Find the coefficient of determination and interpret it.
- Calculate the standard error of estimate.
- Predict overhead when 50 units are produced.

(7.5 marks)

9. (a) In fifteen randomly selected retail shops, incremental daily sales in thousands of rupees using two different selling strategies are summarized:

Retail Shop	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Price discount	35	40	56	50	75	55	43	45	51	61	74	76	87	92	86
Door delivery	40	42	52	57	72	63	39	44	64	67	73	80	90	88	83

Check whether the two samples are from the populations with the same median at a significance level of 0.01.

(7.5 marks)

- (b) Explain the following with respect to cluster analysis:

- Euclidean Distance;
- Clustering algorithm;
- Dendrogram

(7.5 marks)

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