U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 23MA4BSBDE/22MA4BSBDE **Max Marks: 100**
Course: Biostatistics and Design of Experiments

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables are permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

<table>
<tr><th></th><th></th><th>UNIT - 1</th><th>CO</th><th>PO</th><th>Marks</th></tr>
<tr><td>1</td><td>a)</td><td>Fit a straight line $y=a+bx$ to the following data:
<table>
<tr><td>x</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr>
<tr><td>y</td><td>16</td><td>19</td><td>23</td><td>26</td><td>30</td></tr>
</table></td><td>1</td><td>1</td><td>06</td></tr>
<tr><td></td><td>b)</td><td>Obtain the co-efficient of correlation for the data and hence find the lines of regression.
<table>
<tr><td>x</td><td>1</td><td>3</td><td>4</td><td>2</td><td>5</td><td>8</td><td>9</td><td>10</td><td>13</td><td>15</td></tr>
<tr><td>y</td><td>8</td><td>6</td><td>10</td><td>8</td><td>12</td><td>16</td><td>16</td><td>10</td><td>32</td><td>32</td></tr>
</table></td><td>1</td><td>1</td><td>07</td></tr>
<tr><td></td><td>c)</td><td>The mean and standard deviation weight of 1,000 students during medical examination was found to be 70kg and 6kg. Assume that the weight is normally distributed, find the number of students having weight (i) more than 75kg (ii) less than 65kg.</td><td>1</td><td>2</td><td>07</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>a)</td><td>If X is a Poisson variate with probability mass function $P(X)$ then prove that the mean and variance of a Poisson distribution are same.</td><td>1</td><td>1</td><td>06</td></tr>
<tr><td></td><td>b)</td><td>Fit a second degree parabola $y=a+bx+cx^2$ for the following data:
<table>
<tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>y</td><td>10</td><td>12</td><td>13</td><td>16</td><td>19</td></tr>
</table></td><td>1</td><td>1</td><td>07</td></tr>
<tr><td></td><td>c)</td><td>Given $8x-10y+66=0$ and $40x-18y=214$ are the two regression lines. Find the mean of x's, y's and the correlation coefficient. Find σ_y if $\sigma_x=3$.</td><td>1</td><td>1</td><td>07</td></tr>
<tr><td></td><td></td><td>UNIT – 2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>a)</td><td>A sample of 200 voters is chosen at random from all voters in a given city. 60% of them were in favour of a particular candidate. If large number of voters cast their votes then find 90% confidence intervals for the proportion of voters in favour of a particular candidate.</td><td>1</td><td>2</td><td>06</td></tr>
</table>

b) Two random samples drawn from 2 normal populations are given below. Test whether the 2 populations have the same variance. *1* *2* **07**

x	20	16	26	27	23	22	18	24	25	19	-	-
y	17	23	32	25	22	24	28	6	31	33	20	27

c) A sample analysis of examination results of 500 students was made. It was found that 220 students had failed, 170 had secured third class, 90 had secured second class and 20 had secured first class. Do these figures support the general examination result which is in the ratio 4:3:2:1 for the respective categories? Use 5% level of significance. *1* *2* **07**

UNIT – 3

4 a) A random sample for 1000 workers in company *A* has mean wage of Rs. 50 per day and standard deviation of Rs.15. Another sample of 1500 workers from company *B* has mean wage of Rs. 45 per day and standard deviation of Rs.20. At 5% level of significance, test whether the mean rate of wages company *A* is more than company *B*. *1* *2* **06**

b) Test the effectiveness of the leadership training for a group of 7 employees at 5% significance level. The score of the employee's performance before and after the training are given below. *1* *2* **07**

Employee	1	2	3	4	5	6	7
Before	97	91	65	76	69	75	90
After	90	96	77	84	79	69	79

c) In a study, 12 participants were divided into three groups of 4 each, they were subjected to three different conditions, *A* (Low Noise), *B* (Average Noise), and *C* (Loud Noise). They were given a test and the errors committed by them on the test were noted and are given in the table below. *1* *2* **07**

Condition *A* (Low Noise)	3	5	6	3
Condition *B* (Average Noise)	2	7	9	8
Condition *C* (Loud Noise)	10	8	7	11

Apply Kruskal-Wallis test to test whether these three conditions differ amongst themselves. Use 1% level of significance.

OR

5 a) In a clinical trial conducted to evaluate the effectiveness of a new pain relief medication, 8 patients were given the medication and rated their pain level on a scale of 1 to 10 both before and after taking the drug. Test at 1% level of significance that there are differences between the pairs by applying Wilcoxon's signed rank test. *1* *2* **06**

Patient ID	1	2	3	4	5	6	7	8
Before	8.0	6.0	3.5	9.5	10.0	8.0	9.0	7.0
After	6.5	5.0	5.5	4.0	6.5	3.5	5.0	10.0

b) An experiment designed to compare two treatments against corrosion yielded the following data in pieces of wire subjected to the two treatments. *1* *2* **07**

Treatment 1	65.2	67.1	69.4	78.2	74	80.3
Treatment 2	59.4	72.1	68	66.2	58.5	-

Apply Mann-Whitney test to test whether there is a significant difference in the median corrosion of wires by the two treatments. Use 1% level of significance.

c) An auto rental firm is using 15 identical motors that are adjusted to run at a fixed speed to test 3 different brands of gasoline. Each brand of gasoline is assigned to exactly 5 of the motors. Each motor runs on 10 gallons of gasoline until it is out of fuel. The following represents the total mileages obtained by the different motors:

Gas 1	220	251	226	246	260
Gas 2	244	235	232	242	225
Gas 3	252	272	250	238	256

Apply one-way ANOVA to test the hypothesis that the average mileage obtained is not affected by the type of gas used. Use 5 % level of significance.

1 *2* **07**

UNIT – 4

6 a) Explain the following types of variables with an example.

(i) Intervening variable (ii) Extraneous variable (iii) Composite variable

1 *1* **06**

b) Find all the relative measures of dispersion for the following data:
72, 110, 134, 190, 238, 287, 305 and 324.

1 *1* **07**

c) Researchers are conducting a prospective cohort study of the association between being an office worker who uses a computer daily and carpal tunnel syndrome. A total of 300 exposed and 300 unexposed participants are enrolled and followed for 10 years. A total of 25 exposed and 17 unexposed had the outcome of interest over the follow-up period.

(i) What is the relative risk for developing carpal tunnel syndrome?

(ii) What is the incidence attributable to daily computer use?

If 60% of the population uses a computer daily at work, how much carpal tunnel could we prevent if we implemented a national work-place ergonomics program (and thus eliminated the exposure of daily computer use)?

1 *2* **07**

UNIT - 5

7. a) The petrol consumption by different makes of cars for illustrating randomized block designs has been converted to one with 5 makes of cars to illustrate Latin square design. The effects of day and driver on consumption rate have been eliminated in addition to the effect of speed by suitable modification of the experimental situation. For this purpose, 5 drivers were chosen and each driver was used on one of 5 days. On that day, he drove 5 cars each of different make and each car with a different speed. The arrangement of the drivers, speeds and makes was as in the following table:

		Speeds in miles per hour				
		25	35	50	60	70
Drivers and Days	D1	B(19.5)	E(21.7)	A(18.1)	D(14.8)	C(13.7)
	D2	D(16.2)	B(19.0)	C(16.3)	A(17.9)	E(17.5)
	D3	A(20.6)	D(16.5)	E(19.5)	C(15.2)	B(14.1)
	D4	E(22.5)	C(18.5)	D(15.7)	B(16.7)	A(16.0)
	D5	C(20.5)	A(19.5)	B(15.6)	E(18.7)	D(12.7)

Analyze the data at 5% level of significance.

1 *2* **10**

<table>
<tr>
<td></td>
<td></td>
<td>b)</td>
<td>An experiment was conducted on the yield of potatoes in a randomized block design with four replications. Analyze the following 2^2 - factorial design.
<table>
<tr><th>Block</th><th colspan="4">Treatment Combinations</th></tr>
<tr><td>(1)</td><td>(1)
23</td><td>K
25</td><td>P
22</td><td>KP
38</td></tr>
<tr><td>(2)</td><td>P
40</td><td>(1)
26</td><td>K
36</td><td>KP
38</td></tr>
<tr><td>(3)</td><td>(1)
29</td><td>K
20</td><td>KP
30</td><td>P
20</td></tr>
<tr><td>(4)</td><td>KP
34</td><td>K
31</td><td>P
24</td><td>(1)
28</td></tr>
</table>
Analyze the data at 1% level of significance.</td>
<td>*1*</td>
<td>*2*</td>
<td>**10**</td>
</tr>
</table>

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