

Engineering Mathematics and Biostatistics
(BIOT 5104) 26

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Questions)

1. Choose the correct alternatives for the following: 10 x 1=10

- (i) If X is a random variable with distribution $N(0,1)$ then $2X + 1$ has distribution
(a) $N(0,2)$ (b) $N(1,2)$ (c) $N(1,4)$ (d) none of these.
- (ii) Euler's method is used to solve
(a) a system of linear equations
(b) algebraic equations
(c) partial differential equations
(d) ordinary differential equations.
- (iii) The eigen values of the matrix $A = \begin{pmatrix} 2 & 4 \\ 3 & 1 \end{pmatrix}$ are
(a) -2,-5 (b) 2,-5 (c) -2,5 (d) 2,5.
- (iv) If X is a random variable with distribution $N(0,1)$ then $P(X>0)$ is
(a) 0.25 (b) 0.50 (c) 0.75 (d) 1.00.
- (v) The difference between the smallest and largest values of distribution is referred as
(a) coefficient of variation (b) range
(c) average (d) None of these.
- (vi) Both the regression coefficients b_{xy} and b_{yx} should be of
(a) same sign (b) opposite sign
(c) huge value difference (d) None of these.
- (vii) If $P[A] = 0$, then the event is A is said to be a
(a) sure event (b) unsure event
(c) null event (d) not sure.
- (viii) In contingency chi-square analysis, the degree of freedom is
(a) n-1 (b) $(R-1)(C-1)$
(c) n-2 (d) $(R-2)(C-2)$.

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- (ix) Two-way Anova involves
(a) Two dependent variables
(b) Two independent variables
(c) One dependent and one independent variable
(d) None of these.
- (x) is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample
(a) Contingency chi-square analysis
(b) Simple chi-square analysis
(c) Paired t test
(d) Unpaired t test.

Group - B

2. (a) Find the dimensions of the right circular cone of minimum volume which can be circumscribed about a sphere of radius 8cm.

(b) Determine the eigen values of the matrix $A = \begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$

(c) Find $\lim_{x \rightarrow 1} \frac{\cos \frac{\pi x}{2}}{1-x}$

6 + 3 + 3 = 12

3.(a) $f(x) = \begin{cases} x \sin \frac{1}{x} & \text{for } x \neq 0 \\ 0 & \text{for } x = 0 \end{cases}$

Show that $f(x)$ is continuous at $x=0$, but $f'(0)$ does not exist.

- (i) Find the equation of the tangent to the curve $y = x^3 - 2x^2 - x + 5$ at the point (0,5)
- (b) (ii) Use Runge-Kutta method of order 2 to calculate $y(0.1)$ for the equation

$$\frac{dy}{dx} = x + y^2, y(0) = 1 \text{ (take } h=0.1)$$

6 + (3 + 3) = 12

Group - C

- 4.(a) The first of two samples has 100 items with mean 15 and S.D. 3. If the whole group has 250 items with mean 15.6 and S.D. 3.66, find the S.D. of the second group.

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- (b) The mean of 30 values was 150. It was detected on rechecking that the value 165 was wrongly copied as 135 for the computation of the mean. Find the correct mean.
- (c) Calculate the mean, median and mode and standard deviation from the following data:

Value	Frequency	Value	Frequency
Above0-Below 10	2	Above50-Below 60	303
Above10-Below 20	21	Above60-Below 70	333
Above20-Below 30	56	Above70-Below 80	351
Above 30-Below 40	133	Above 80-Below 90	358
Above 40-Below 50	233	Above 90-Below 100	350

$$4 + 4 + 4 = 12$$

- 5.(a) An institute have 4 sections in a class having 40, 35, 45, 42 students. The mean marks obtained in a subject are 50, 60, 55, 45 respectively for those sections. Determine the overall average of the marks per student.
- (b) A couple is heterozygous for albinism (Aa). What is the probability that
- 4 out of 6 children born to them are normal?
 - 4 normal & 2 albino out of 6 children?
- (c) In a genetics research laboratory, radioactive emission occurs at an average rate of one particle per minute. If emission continues for several hundred minutes during which time the particles are emitted randomly, in what proportion of these minutes would we expect
- Exactly one particle emitted?
 - Exactly two particles per minute?
 - More than two particles per minute?
- (given $e^{-m} = e^{-1} = 0.36788$)

$$4 + 4 + 4 = 12$$

Group - D

- 6.(a) A sample of 100 members is found to have a mean of 3.42 cm. Could it be reasonably regarded as a simple sample from a large population whose mean is 3.30 cm and S.D. is 2.6 cm? ($Z_{0.05} = 1.96$)
- (b) For a random sample (A) of 10 albino rats fed on vitamins, the increase in weight in grams in 15 days and increase in weight from another sample (B) of 12 albino rats fed on another vitamin are given in the table:

A	10	06	16	17	13	12	08	14	15	09		
B	07	13	22	15	12	14	21	08	18	17	23	10

Test whether both the samples came from population having same variance.

$$F_{0.05} \text{ for } v_2 = 11 \text{ and } v_1 = 9 \text{ is } 3.11$$

$$6 + 6 = 12$$

7.(a) In a microbiology laboratory experiment two samples gave the following results.

Sample	Size	Sum of squares of deviation from the mean
1	08	84.4
2	10	102.6

Test whether this difference is significant at 5% level. Given that F for 7, 9 is 3.29.

(c) The students of two schools were measured for their heights; one school was on east coast and another in west coast where there is a slight difference in weather. The sampling results are as follows:

East coast	43	45	48	49	51	52			
West coast	47	49	51	53	54	55	55	56	57

Find whether there is any impact of weather on height taking other variables constant. Given that $t_{0.05}$ at $df 18 = 2.16$.

6 + 6 = 12

Group - E

8.(a) Ten students got the following marks in Ecology and Genetics.

Students (Roll no.)	1	2	3	4	5	6	7	8	9	10
Marks in Ecology	78	36	98	25	75	82	90	62	65	39
Marks in Genetics	84	51	91	60	68	62	86	58	53	47

Calculate the correlation coefficient.

(c) Marks obtained by 9 students of a college in Botany and Zoology are given below:

Botany	35	23	47	17	10	43	09	06	28
Zoology	30	33	45	23	08	49	12	04	31

Calculate the Spearman's coefficient of rank correlation and interpret.

6 + 6 = 12

9.(a) The equation for two lines are $8X - 10Y + 66 = 0$ and $40X - 18Y = 214$. The variance of x is 9. Find:

- (i) The mean of X and Y
- (ii) Regression coefficient byx and bxy.

(b) The following data showed the tracheal ventilation of two groups of *Anopheles subpictus* from two different habitats.

Group A (X_1)	86	75	78	80	75	81	85	78	80	82
Group B (X_2)	82	71	72	70	70	73	74	65	70	73

Is there any significant difference in the mean tracheal ventilation scores? Given that $F_{0.05}(1, 18) = 4.41$

6 + 6 = 12