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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E **Semester: IV**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 19MA4BSBSP **Max Marks: 100**
Course: Biostatistics and Probability

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 is permitted.

UNIT - I

1 a) Predict the mean radiation dose at an altitude of 3000 *ft* by fitting an exponential curve $y = ab^x$ to the given data: **6**

Altitude (x)	50	450	780	1200	4400	4800	5300
Dose of radiation (y)	28	30	32	36	51	58	69

b) Suppose a number of fecal bacteria/ml of milk follows a Poisson distribution with mean 3 bacteria. If a random sample of one ml. of milk is examined, find the probability that it contains (i) no bacteria (ii) at least one bacteria (iii) at most two bacteria. **7**

c) If skulls are classified as A, B and C accordingly as the length-breadth index are under 75, between 75 and 80, or over 80. Find approximately the mean and standard deviation of a series of skulls in which A are 58%, B are 38% and C are 4%. **7**

OR

2 a) Calculate the coefficient of correlation between the measurements of water quality of a lake for the following data: **6**

Salinity (%)	2	4	6	8	10	12	14
Dissolved Oxygen (mg/l)	4	2	5	10	4	11	12

b) A radioactive material was observed for α particles in 100 emissions, each time the duration being ten seconds. The data consisting of 100 observations are arranged in a frequency table as follows: **7**

No. of particle (x)	0	1	2	3	4	5
No. of emissions (f)	11	20	28	24	12	5

Fit a Poisson distribution.

c) Derive the expressions for mean and variance of a Gamma distribution. **7**

UNIT - II

3 a) An auto insurance company classifies its customers in three categories: poor, satisfactory and preferred. No one moves from poor to preferred or from preferred to poor in one year. 40% of the customers in the poor category become satisfactory, 30% of those in the satisfactory category moves to preferred, while 10% become poor; 20% of those in the preferred category are downgraded to satisfactory. (i) Write the transition matrix for the model (ii) Define Irreducible Markov Chain (iii) Is the Markov chain irreducible? **6**

b) Two flashcards are selected at random from a box which contains five cards numbered 1,1, 2 ,2 and 3. Find the joint distributions of X and Y where X denotes the sum of two numbers and Y denote the maximum of two numbers drawn. Also determine the $Cov(X, Y)$. **7**

c) Suppose that the new razor blades were introduced in the market by three companies at the same time. When they were introduced, each company has an equal share of the market, but during the year the following changes took place. Company A retained 90% of its customers and lost 3% to company B and 7% to company C. Company B retained 70% of its customers and lost 10% to company A and 20% to company C. Company C retained 80% of its customers and lost 10% to company A and 10% to company B. **7**

(i) Write the transition matrix for the model.
(ii) In the long run, what share does each company have?
(iii) In the successive third year, find the probability of company B's share.

UNIT - III

4 a) Explain the basic principles of design of experiments. **4**

b) An agricultural scientist is interested in an experiment to ascertain the effect of applying chemical fertilizers on the land production in different acres of land. It has divided into four fertilizers treatments farms: A, B, C and D. There are three blocks, each containing four acres of land of comparable sizes. As a result of the experiment, the following is the production data from the lands. **8**

Lands	Fertilizers			
	A	B	C	D
I	10	12	14	13
II	16	20	24	25
III	18	21	26	28

Identify the design and hence analyze the data.

c) An experiment was conducted on the yield of potatoes in a randomized block design with four replications. Analyze the following 2^2 factorial design. **8**

Block	Treatment Combinations			
(1)	(1) 23	K 25	P 22	KP 38
(2)	P 40	(1) 26	K 36	KP 38
(3)	(1) 29	K 20	KP 30	P 20
(4)	KP 34	K 31	P 24	(1) 28

UNIT - IV

5 a) A physical therapist examines the strength of a particular muscle in a certain group of individuals. He observes for a sample of 64 subjects who participated in the experiment the mean to be 8.76 and the standard deviation to be 1.84. Construct with 99% confidence the mean maximal strength of a particular muscle. **6**

b) At a certain date in a large city, 16 out of a random sample of 500 men were found to be drinkers. After the heavy increase in tax on intoxicants, another random sample of 100 men in the same city included 3 drinkers. Was the observed decrease in the proportion of drinkers significant? **7**

c) The standard deviation of the height of Honours students of a college is 4 cm. Two samples are taken. The standard deviation of the height of 100 B.Com Honours students is 3.5cm and 50 B.A. Honours students is 4.5cm. Test the significance of the difference of standard deviations of the samples. **7**

UNIT - V

6 a) Ten cut shoots of broad bean plants were treated for 18 hrs with a solution of chloramphenicol and were examined for the concentration of the chemical. They were 50,53,58,57,63,62,55,65,46,60 milligrams per gram of fresh weight. From past experience it is known that the standard deviation of concentration is 4.5 mg for the bean plants. Do the data suggest that the mean concentration is less than 54*mg* for the bean plants? **6**

b) The following figures relate to production in kg. of three varieties A, B and C of wheat sown in 12 plots. **7**

A	14	16	18	-	-
B	14	13	15	22	-
C	18	16	19	19	2

Test if there is any significant difference in the production of three varieties of wheat. (One-way ANOVA)

c) In a cross between rust-resistant and rust-susceptible varieties of oats, the F_3 families were compared for rust reaction in the seedling stage and in the field under ordinary epidemic conditions. The data are as follows: **7**

Field Reaction	Seedling Reaction		
	Resisting	Segregating	Susceptible
Resisting	142	51	7
Segregating	13	404	5
Susceptible	5	17	176

Test whether the rust reaction is independent in two stages.

OR

7 a) From an experiment on milk yield (in lbs.) of cows fed with two diets – field wilted alfalfa (diet 1) and dewatered alfalfa (diet 2), the following data are obtained. **6**

Diets	Sample Sizes	Standard Deviation (s)
Field wilted alfalfa	13	4.8541
Dewatered alfalfa	12	4.2847

Test whether the population variances are same at $\alpha = 10\%$.

b) Following data give weight gains of 8 pairs of experimental animals matched with respect to various growth factors. One of each pair, selected by chance, was given vitamin B_{12} supplement and the other was not given the supplement. Test whether B_{12} supplement is beneficial. **7**

Pair	1	2	3	4	5	6	7	8
With B_{12}	1.6	1.68	1.75	1.64	1.75	1.79	1.78	1.77
Without B_{12}	1.56	1.52	1.52	1.49	1.59	1.56	1.6	1.56

c) An experiment is conducted to investigate the effect of drying temperature of wheat grain on the baking quality of bread. Three temperature levels were used and the response variable measured was the volume of the loaf of bread produced. The data are as follows: **7**

Temperature	Volume				
A	1245	1235	1285	1245	1235
B	1235	1240	1200	1220	1210
C	1225	1200	1170	1155	1095

Use Kruskal- Wallis One-way Analysis of Variance at 1% level of significance.

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