BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC **SEMESTER : II**
BRANCH: CQEDS **SESSION : SP/2024**

SUBJECT: ED113 STATISTICAL METHODS II

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. The required portion of the Chi-square table is given at the end of the question paper.

			CO	BL
Q.1	A dentist schedules all his patients for 30-minute appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following table shows the summary of the various categories of work, their probabilities and the time actually needed to complete the work.	[10]	1	4

Category	Time required (minutes)	probability of category
Filling	45	0.3
Crown	60	0.15
Cleaning	15	0.2
Extraction	45	0.15
Check-up	15	0.2

Simulate the dentist's clinic for four hours and determine the (a) average waiting time for the patients and (b) average idle time of the doctor.
Assume that the patients arrive at their scheduled time starting from 8 AM.
Use the following random numbers for simulation: 47,72,38,79,71,81,40,40

Q.2	In random sampling from normal population $N(\mu, \sigma^2)$, find the maximum likelihood estimators for (i) $\mu, when\ \sigma^2\ is\ known$ (ii) $\sigma^2, when\ \mu\ is\ known$	[10]	2	4

Q.3	A bird watcher sitting in a park has spotted a number of birds belonging to 6 categories. The exact classification is given below:	[10]	3	4

Category	1	2	3	4	5	6
Frequency	6	7	13	17	6	5

Test at 5% level of significance whether or not the data is compatible with the assumption that this particular park is visited by birds belonging to these six categories in the proportion 1 : 1 : 2 : 3 : 1 : 1.

Q.4	If $X_1, X_2, \ldots, X_n\ are\ iid\ N(\mu, \sigma^2)$ variate, then show that $\bar{x}$ (sample mean) is a more efficient estimator than sample median $\tilde{x}$.	[10]	4	3

Q.5(a)	A random sample $X_1, X_2, \ldots, X_5$ of size 5 is drawn from a Normal population with unknown mean μ. Consider the following: (i) t1=$\frac{(X_1+X_2+X_3+X_4+X_5)}{5}$ (ii) t2=$\frac{(X_1+X_2)}{2}+X_3$ (iii) t3=$\frac{(2X_1+X_2+\lambda X_3)}{3}$ Where λ is such that t3 is an unbiased estimator of μ. Find λ. Are t1 and t2 unbiased? Which estimator is best among t1, t2 and t3.	[5]	4	3

PTO

Q.5(b) A binary logit regression model is run to find the probability of securing 1st division in the examination based on hours of study by a student. Here the dependent variable (DV) is Y=1 if a student secures 1st division and Y=0, otherwise. Based on the following regression output, answer the given questions: [1+2+2] 5 3

Logistic Regression coefficient			
DV: Y=1 if a student secures 1st division, Y=0 otherwise			
	β-values	S.E. (standard error of estimate)	p-value
hours of study (X)	0.1666022	0.0211265	0.000
Constant	-5.003779	0.8649213	0.000

(i) Is hours of study a significant predictor of the probability of securing 1st division?
(ii) By how much amount the odds of securing 1st division will be impacted for one unit increase in the hours of study?
(iii) Calculate the marginal effect of hours of study (at X=10 hours) on the probability of securing 1st division.

Chi-square Distribution Table

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81

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