



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

(Deemed to be University)

DEPARTMENT OF MATHEMATICS

SCHOOL OF APPLIED SCIENCES

SPRING SEMESTER-2023-24

Course Handout

1. **Course Code:** MA3012
2. **Course title:** INFERENCE STATISTICS
3. **L-T-P :** Structure: 3-1-0
4. **Course Coordinator:** Dr. Debdulal Panda
5. **Prerequisites or co-requisites:** MA2005/MA2007/MA2009
6. **Use of ICT tools by teachers :**
7. **Course Objective(s):**

The course aims to equip the students with tools of advanced statistical analysis for data science, and application in varied domains where large amounts of data are involved. The tools and techniques include statistical analysis on sampled data, different types of hypothesis testing, correlation and regression.

8. Course (learning) outcomes:

At the end of the course, the students will be able to:

CO1: Represent and visualize data in different ways.

CO2: Demonstrate strong conceptual knowledge of probability and different distributions.

CO3: Perform statistical analysis based on sampled data.

CO4: Perform hypothesis testing on sampled data.

CO5: Identify correlation between different variables characterizing the samples.

CO6: Perform different regression analysis.

9. Course Contents:

UNIT 1: 14 hrs[CO1&CO2]

Descriptive statistics: Population, sample and processes, Pictorial and tabular methods in Descriptive statistics.

Probability, Sample spaces, Events, Properties of Probability, Conditional Probability, Independent events. Random variables, Probability distribution of discrete random variable, Binomial distribution, Poisson distribution. Probability distribution of continuous random variable, Probability density functions, Cumulative distribution functions, Expected values, Normal distribution, Exponential and Gamma distributions, Chi-squared, T and F distributions. Two dimensional random variables, Joint and marginal distributions in discrete and continuous cases, Independent random variables. Expected values.

UNIT 2: 10hrs[CO3]

Sampling & Its Distribution: The Central limit theorem. Point Estimation: Method of maximum likelihood estimation. Interval Estimation: Confidence interval for one normal population.

UNIT 3: 12 hrs[CO4]

Hypothesis Testing: Statistical hypothesis, Null and alternative hypothesis, Critical region, Two types of errors, Level of significance, Power of test

Tests based on normal, Chi-square, T and F distribution, Chi-square test of goodness of fit, Critical function, Most powerful tests, Neyman-Pearson's lemma, Uniformly most powerful test, Likelihood ratio test, Problems based on these topics.



UNIT 4: 12hrs[CO5 & CO6]

Correlation: Meaning of correlation, Scatter diagram, Karl Pearson's coefficient of correlation, Probable error of rank correlation, Rank correlation, Spearman's Rank Correlation Coefficient.

Regression Analysis: Linear regression, Regression coefficients, Properties of regression coefficients, Angle between two lines of regression, Standard error of estimate of residual variance, Correlation coefficient between observed and estimated values, Curvilinear regression. **ANOVA:** Analysis of variance, One way classification, Two way classification with one observation per cell.

10. Text books

T1. Probability and Statistics for Engineers and Sciences by J. L. Devore, CENGAGE Learning., 8th edition.

11. Reference books

R1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition

R2. Fundamental of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons.

R3. Statistical Inference, George Casella and Roger L. Berger.

12. Lesson plan and active learning activities

Lect. No.	Learning Topics to be covered	Article No./ Text Book	Course Objective(CO)
Basic Probability			
01	Population, sample and processes, Pictorial and tabular methods in Descriptive statistics	1.1, 1.2(T1)	CO1
02	Sample spaces, Events, Properties of probability(2.1, T1)	2.1(T1)	CO2
03	Addition rules of probability (2.2, T1)	2.2(T1)	CO2
04	Tutorial (Problem Solving)		CO2
05	Conditional Probability, Bays' Theorem	2.4(T1)	CO2
06	Problems solving		CO2
07	Independent events	2.5(T1)	CO2
08	Tutorial (Problem Solving)		CO2
09	Random variables, Probability distribution of discrete random variable	3.1(T1)	CO2



10	Probability distribution of discrete random variable, Tutorial (Problem solving)	3.2(T1)	CO2
11	Expected values, Variance	3.3(T1)	CO2
12	Binomial distribution, Poisson distribution	3.4, 3.6(T1)	CO2
13	Tutorial (Problem solving)		CO2
14	Probability distribution of continuous random variables. Expected Values, Variance.	4.1, 4.2(T1)	CO2
15	Normal Distribution, Exponential and Gamma distribution	4.3, 4.4(T1)	CO2
16	Two dimensional random variables, Joint and marginal distributions in discrete and continuous cases, Independent random variables. Expected values.	5.1, 5.2(T1)	CO2
17	Quiz Test-1		CO1&CO2
	Assignment-1		CO1& CO2
18	Statistic, Random samples, Sample mean, Sample variance.	5.3(T1)	CO3
19	The distribution of the sample mean: Standard Error of the mean, Normal population distribution, The central limit theorem .	5.4 (T1)	CO3
20	Point estimation: Maximum likelihood Method	6.1 &6.2(T1)	CO3
21	Estimation of the mean and variance of a normal population	6.2(T1)	CO3
22	Interval estimation: Confidence level, Confidence limits, Confidence interval	7.1 &7.2(T1)	CO3
23	Confidence interval for the mean of the normal distribution with known variance	7.3(T1)	CO3
24	Confidence interval for the mean of the normal distribution with unknown variance	7.4(T1)	CO3
25	Confidence interval for the variance of the normal distribution	7.4(T1)	CO3
26	Tutorial(Problem Solving)		CO3
27	Tutorial(Problem Solving)		CO3
28	Quiz Test-2		CO3
	Assignment – 2		CO3
29	Testing of Hypotheses: Statistical hypotheses, Null and alternative hypotheses, Critical region, Level of significance.	8.1(T1)	CO4



30	One-sided and two-sided alternatives, Errors in tests, Power of a test	8.1(T1)	CO4
31	Test for the mean of the normal distribution with known variance(Tests based on normal distribution)	8.2(T1)	CO4
32	Test for the mean of the normal distribution with unknown variance(Tests based on t-distribution) and for variance(Tests based on Chi-square distribution)	8.2(T1)	CO4
33	Comparison of the Means of Two Normal Distributions	9.1(T1)	CO4
34	Comparison of the Variance of Two Normal Distributions	9.5(T1)	CO4
35	Tutorial (Problem solving)		CO4
36	Chi-square test of goodness of fit	25.7(R1)	CO4
37	Tutorial (Problem solving)		CO4
38	Critical function, Most powerful tests, Neyman-Pearson's lemma, Uniformly most powerful test	16.4.1,2,16.5(R2)	CO4
39	Likelihood ratio test	16.6(R2)	CO4
	Assignment – 3		CO4
40	Correlation: Meaning of correlation, Scatter diagram, Karl Pearson's coefficient of correlation	10.1,10.2, 10.3(R2)	CO5
41	Probable error of rank correlation, Rank correlation	10.5,10.6(R2)	CO5
42	Spearman's Rank Correlation Coefficient	10.6.3(R2)	CO5
43	Linear regression, Regression coefficients, Properties of regression coefficients,	10.7.1, 10.7.2, 10.7.3, 10.7.4(R2)	CO5
44	Angle between two lines of regression	10.7.5(R2)	CO5
45	Standard error of estimate of residual variance, Correlation coefficient between observed and estimated values	10.7.6,10.7.7(R2)	CO5
46	Curvilinear regression	10.7.7(R2)	CO5
47	Analysis of variance, One way classification	14.6(R2)	CO6
48	Two way classification with one observation per cell.	14.7(R2)	CO6
	Assignment – 4		CO5&CO6

**13. Assessment components:**

Sl. No.	Assessment Component	Duration	Weightage / Marks	Nature of the Component
1	Mid Semester Examination	90 min	20	Closed Book
2	End Semester Examination	3 Hours	50	Closed Book
3	Problem Solving(Assignment)	4 weeks	20	Open Book
4	Quiz Test-1	30 min	05	Closed Book
5	Quiz Test-2	30 min	05	Open Book

14. Assessment plan for active learning activities:

Sl. No	Active learning Assessment Component	Duration	Weightage / Marks	Nature of the Component
1	Assignment-1	1-week	5	Open Book
2	Quiz Test-1	30min	5	Closed Book
3	Quiz Test-2	30min	5	Closed Book
4	Assignment-2	1-week	5	Open Book
5	Assignment-3	1-week	5	Closed Book
6	Assignment-4	1 week	5	Open Book

15. Attendance:

Every student is expected to be regular (in attendance) in all lecture classes, tutorials, tests, quizzes, seminars etc. and in fulfilling all tasks assigned to him / her. Attendance will be recorded and 75% attendance is compulsory.

15. Makeup:

- No make-up examination will be scheduled for the mid semester examination. However, official permission to take a make-up examination will be given under exceptional circumstances such as admission in a hospital due to illness / injury, calamity in the family at the time of examination.
- A student who misses a mid-semester examination because of extenuating circumstances such as admission in a hospital due to illness / injury, calamity in the family may apply in writing via an application form with supporting document(s) and medical certificate to the Dean of the School for a make-up examination.
- Applications should be made within five working days after the missed examination.

16. Discussion of Mid Semester performance:

Performance of the mid semester examination will be discussed in the class room

17. Pre-end semester total marks: *Please see the SAP portal link:***18. Course Management System:**

SAP Portal is a software system designed to facilitate teachers in the management (instructional content, assessment and documentation) of the courses for their students. Both teachers and students can monitor the system. Though usually considered as a tool and often used to complement the face-to-face classroom.

19. Chamber consultation hour for doubts clarification: Wednesday 4.00PM-6.00PM

20. Notices: All notices regarding the course will be displayed only on the School of Computer Science and Engineering notice board.

(Dr. Debdulal Panda)
Course Coordinator