FACULTY OF COMPUTER APPLICATIONS
Master of Computer Applications

Sem. : 1
Subject Code : 05MC0109
Subject : Probability and Statistics

Course Objectives:

- To introduce fundamental concepts of data analysis and statistical thinking
- To develop understanding of probability models and uncertainty
- To enable students to perform statistical inference and hypothesis testing
- To build foundational knowledge of regression and statistical modelling
- To prepare students for advanced analytical and machine learning subjects

Prerequisites:

Basic knowledge of mathematics at undergraduate level, including elementary algebra and functions. No prior knowledge of statistics is assumed.

Unit No	Topics Covered	No of Lectures Required
1	**Descriptive Statistics & Data Analysis:** Introduction to data, types of data, measurement scales, data collection methods, descriptive statistics, measures of central tendency (mean, median, mode), measures of dispersion (range, variance, standard deviation), shape of distribution (skewness and kurtosis – conceptual understanding), data visualization (histogram, frequency polygon, ogive, boxplot).	8
2	**Probability & Random Variables:** Sample space, events, axioms of probability, conditional probability, independence, Bayes' theorem and its applications, discrete and continuous random variables, probability mass function (PMF), probability density function (PDF), cumulative distribution function (CDF), mathematical expectation, variance, standard deviation, standard probability distributions (binomial, Poisson, normal).	9

3	**Sampling & Statistical Inference:** Population and sample, random sampling methods, sampling distributions, central limit theorem, point estimation, confidence intervals, hypothesis testing (null and alternative hypothesis, Type I and Type II errors, level of significance, p-value), statistical tests (Z-test, t-test, chi-square test for goodness of fit and independence), likelihood function, basic concept of maximum likelihood estimation (MLE).	9
4	**Correlation, Regression & ANOVA:** Scatter plot, Pearson correlation coefficient, simple linear regression model, least squares method, interpretation of coefficients, multiple linear regression (concept, model representation, assumptions), coefficient of determination (R^2), residual analysis, analysis of variance (ANOVA), variance decomposition (SST, SSR, SSE), ANOVA table, F-test, role of ANOVA in regression.	10
5	**Bayesian Methods and Statistical Learning Applications:** Prior, likelihood, posterior distribution, Bayesian inference, naïve Bayes classifier, bias-variance tradeoff, overfitting and underfitting, confusion matrix, accuracy, precision, recall.	9

Course Outcomes:

After completion of the course, students will be able to:

- **CO1:** Apply descriptive statistical measures for data analysis and interpretation
- **CO2:** Use probability concepts and distributions to model uncertain situations
- **CO3:** Perform statistical inference and hypothesis testing for decision-making
- **CO4:** Analyze relationships between variables using correlation and regression techniques
- **CO5:** Apply statistical reasoning in computational and machine learning contexts

Text Book:

1. Montgomery, D. C., & Runger, G. C., *Applied Statistics and Probability for Engineers*, Wiley India, Latest Edition.

Reference Books:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R., *An Introduction to Statistical Learning*, Springer.

2. Casella, G., & Berger, R. L., *Statistical Inference*, 2nd Edition, Duxbury Press.
3. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K., *Probability and Statistics for Engineers and Scientists*, Pearson.

Web References:

1. https://www.geeksforgeeks.org/statistics/
2. https://www.statlect.com

App References:

1. Khan Academy
2. Coursera
3. Kaggle

Syllabus Coverage from Text / Reference Book:

Unit #	Unit Title	Text Book 1 (Montgomery)	Reference Book (ISLR)
1	Descriptive Statistics & Data Analysis	Ch.1: 1.1, 1.2, 1.3 Ch.2: 2.1, 2.2, 2.3, 2.4	—
2	Probability & Random Variables	Ch.2: 2.5, 2.6 Ch.3: 3.1–3.5 Ch.4: 4.1–4.3	—
3	Sampling & Statistical Inference	Ch.6: 6.1–6.3 Ch.7: 7.1–7.2 Ch.8: 8.1–8.3 Ch.9: 9.1–9.3	—
4	Correlation, Regression & ANOVA	Ch.11: 11.1–11.4 Ch.12: 12.1–12.3 Ch.13: 13.1–13.2	Ch.3: Linear Regression Ch.5: Resampling Methods
5	Bayesian Methods and Statistical Learning Applications	Ch.2: 2.6 (Bayes) Ch.3–4 (Probability base)	Ch.2: Statistical Learning Ch.4: Classification Ch.5: Resampling Methods

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