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Course Code: MAT244
Semester: II

STATISTICAL MODELLING

Course Objectives:

An in-depth introduction to statistical inference with linear statistical models and basic time series analysis. Topics include estimation, testing of hypothesis analysis of variance and nonparametric inferences. R programming language to perform data analyses and generate reproducible reports.

UNIT - I   **15 Periods**

Linear Statistical Models: Simple linear regression & correlation - multiple regression & multiple correlation.

Basics of Time Series Analysis & Forecasting: Stationary - ARIMA Models - Identification - Estimation and Forecasting

UNIT - II   **15 Periods**

Estimation: Point estimation - criteria for good estimates (un-biasedness, consistency) - Methods of estimation including maximum likelihood estimation.

Sufficient Statistic: Concept & examples - complete sufficiency - their application in estimation.

Test of hypothesis: Concept & formulation - Type I and Type II errors - Neyman Pearson lemma - Procedures of testing

UNIT - III   **15 Periods**

Analysis of variance: one way - two way with as well as without interaction.

Non-parametric Inference: Comparison with parametric inference - Use of order statistics. Sign test - Wilcoxon signed rank test - Mann-Whitney test - Run test - Kolmogorov-Smirnov test - Spearman's and Kendall's test - Tolerance region

R statistical programming language: Introduction to R - Functions - Control flow and Loops - Working with Vectors and Matrices - Reading in Data - Writing Data - Working with Data - Manipulating Data - Simulation - Linear model - Data Frame - Graphics in R

REFERENCES

1. I. R. Miller, J.E. Freund and R. Johnson. *Probability and Statistics for Engineers*, PHI, Ninth Edition, 2017
2. Gun, A. M., M. K. Gupta, and B. Dasgupta. *Fundamentals of Statistics*, Volume 1 & Volume II, World Press, 2013
3. Chatfield, Chris. *The analysis of time series: An Introduction*, Chapman and Hall/CRC, Sixth Edition, 2003.
4. Montgomery, Douglas C., Elizabeth A. Peck, and G. Geoffrey Vining. *Introduction to Linear Regression Analysis,* John Wiley & Sons, 2012.
5. Mood, Alexander McFarlane. *Introduction to the Theory of Statistics*, McGraw Hill, 1950.
6. Draper, Norman R., and Harry Smith. *Applied regression analysis*. *Vol. 326*, John Wiley & Sons, 2014.
7. Grolemund, Garrett. *Hands-On Programming with R: Write Your Own Functions and Simulations*, O'Reilly Media, Inc, 2014.
8. Lander, Jared P. *R for Everyone: Advanced Analytics and Graphics*, Pearson Education, 2014.
9. www.rbi.org.in

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	Understand correlation and Regression analysis and their properties and also the concepts of time series analysis
Unit II	Learn the concepts of testing of hypothesis and estimation theory
Unit III	Know the ideas of ANOVA and different nonparametric tests
Unit IV	Learn the basics of R statistical programming

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Use linear statistical models to make predictions and explain relationships of the data
- Estimate the required parameters from the sample statistics and   Interpret modelling results in the context of real-world problems
- Make important decisions from few samples which are taken out of unmanageably huge populations
- Use the open source programming language R for the analysis of data arising from both observational studies and designed experiments.