

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	ESO301	Applied Statistics for Environmental Engineering	3	0	0	9
Course Objective						
This course has been designed to make the students conversant with the fundamental concepts of probability and statistics, specifically focusing on the environmental sciences. To become aware of the wide range of applications of statistics in environmental management & decision-making and develop technical skills to use statistical tools and software in environmental data analysis.						
Learning Outcomes						
Upon successful completion of this course, students will:						
- Understand the basic concepts of probability and statistics required for data analysis in the field of environmental sciences. - Given any research/practical problem related to data analysis, have a comprehensive idea to proceed with such problems using different techniques like hypothesis testing, trend analysis, causal analysis and time series analysis to name a few.						
Unit No	Topics to be Covered		Lecture Hours	Learning Outcome		
1	<i>Introduction to environmental statistics:</i> basic concepts of probability and statistics, univariate and bivariate random variables, forms of the probability distribution function, statistical properties of data, probability distributions, and illustrative examples in R Language.		7	Learn the basic concepts of probability and statistics required for data analysis.		
2	<i>Collecting environmental data - Sampling and Monitoring:</i> finite population sampling, non-parametric test, goodness of fit, trend estimation, uncertainty analysis, inaccessible and sensitive data, sampling in the wild. Case study on data fitting, trend estimation and uncertainty analysis using data from the field of environmental science, illustrative examples using R Language.		9	Gain an understanding of sampling data and hypothesis testing for efficient application in the field of environmental science.		
3	<i>Examining environmental effects – stimulus-response relationship:</i> simple linear regression, multiple linear regression, correlation and regression, correlation and causality, multivariate analysis, causal graphs. Case study on model fitting for simulation/prediction and causal analysis using data from the field of environmental science, illustrative examples using R Language.		12	Learn the basics of modelling using environmental data through different techniques like regression and causal analysis.		
4	<i>Multidimensional environment - spatial and temporal processes:</i> space and time effect, time series, basic issues, descriptive methods, time-domain models, frequency domain models, spatial point process models, general spatial process, spatial models. Case studies on the statistical assessment of the state of global warming, climatological change in climatic and hydrologic variables, prediction of weather data like temperature and rainfall, assessing the source of water pollution and assessment of air quality, illustrative examples using R Language.		14	Learn the application of statistical methods in environmental sciences and the effective use of different techniques.		

Text Books:

1. Maity, R. (2022). *Statistical methods in hydrology and hydroclimatology*, 2nd Edition, Springer, Springer Nature Singapore Pte Ltd., e-Book ISBN: 978-981-16-5517-3, Hard Cover ISBN: 978-981-16-5516-6.
2. Barnett, V. (2005). *Environmental statistics: methods and applications*. John Wiley & Sons.
3. Kottegoda N.T. and Rosso R. (2008) *Applied Statistics for Civil and Environmental Engineers*, McGraw-Hill, International Edition.
4. Chambers, J. M., Chambers, J. (2008). *Software for Data Analysis: Programming with R*. Germany: Springer New York.

Reference Books:

5. Gilbert, R. O. (1987). *Statistical methods for environmental pollution monitoring*. John Wiley & Sons.
6. Scott, M., & Chandler, R. (2011). *Statistical methods for trend detection and analysis in the environmental sciences*. John Wiley & Sons.
7. Al-Karkhi, A. F., & Alqaraghuli, W. A. (2019). *Applied statistics for environmental science with R*. Elsevier.
8. Johnson, R. A., Miller, I., & Freund, J. E. (2000). *Probability and statistics for engineers*, 9th Edition, Pearson Education Limited 2018, ISBN 13: 978-1-292-17601-7.
9. Helsel D.R. and Hirsch R.M. (1997) *Statistical Methods in Water Resources*, Elsevier Science Ltd., UK.