

DISCIPLINE SPECIFIC CORE COURSE – 20 (DSC-EVS-20): ENVIRONMENTAL STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSC-EVS-20: ENVIRONMENTAL STATISTICS	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Gain insights into application of probability theory in solving environmental problems
- Explore environmental data using descriptive and inferential statistics
- Understand regression analysis for determining environmental relationships
- Equip with methods of analyzing time series data and identify trends in environment
- Practice spatial statistics to identify spatial patterns in environmental variables

Learning outcomes

After this course, students will be able to

- Apply probability theory to assess risks in environment
- Analyze and visualize environmental data using descriptive statistics and graphical methods
- Formulate and test hypotheses to understand problems in environmental science
- Apply regression analysis to decipher the relationships between different sets of environmental variables
- Analyze time series data and spatial statistics to identify trends and spatial relationships among different variables

Unit 1: Basics of Environmental Statistics and Probability (7 hours)

Definition, scope, and applications of environmental statistics; Types of environmental data, sampling and data collection; Data exploration and basic visualization (boxplots, histograms); Introduction to probability theory, conditional probability, and independence; Overview of random variables and probability distributions in environmental applications.

Unit 2: Descriptive Statistics and Data Relationships (7 lectures)

Measures of central tendency (mean, median, mode) and dispersion (range, standard deviation, variance); Skewness, kurtosis, and graphical summaries; Correlation and covariance; Introduction to Spearman's rank correlation; Conceptual introduction to principal components (without calculation).

Unit 3: Hypothesis Testing and Regression Analysis (8 hours)

Formulating null and alternative hypotheses; Type I and II errors; Parametric tests: t-test (one-sample and two-sample), Chi-square test (goodness of fit, independence), and one-way ANOVA; Introduction to simple linear regression and its applications in environmental management.

Unit 4: Time Series, Non-Parametric Methods, and Spatial Basics (8 hours)

Basics of time series data: trend, seasonality, decomposition (qualitative understanding); Introduction to forecasting applications in environment; Non-parametric tests: Mann-Whitney U, Wilcoxon signed-rank, Kruskal-Wallis (concepts and application); Introduction to spatial data types and environmental relevance (without deep geostatistics or spatial modeling).

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Visualize an environmental data set using descriptive statistics and graphical methods
2. Estimate risk for a given environmental hazard using probability distributions
3. Use one-sample t-test and test a hypothesis about a population parameter and interpret the results.
4. Test a hypothesis about the difference between multiple population means using ANOVA
5. Analyze environmental data using a linear regression model and interpret the coefficients and goodness of fit
6. Analyze the given time series data set using trend analysis or analyze a spatial data set using spatial regression models
7. Use cluster analysis to group environmental samples based on their similarities.

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Cressie, N. A. C., & Wike, C. K. (2011). Statistics for spatio-temporal data. JohnWiley & Sons.
- Gotelli, N. J., & Ellison, A. M. (2004). A primer of ecological statistics. SinauerAssociates.
- Hoshmand, R., 2017. Statistical methods for environmental and agriculturalsciences. CRC press.
- Millard, S.P., 2013. EnvStats: an R package for environmental statistics. SpringerScience & Business Media.
- Qian, S.S., 2016. Environmental and ecological statistics with R. Chapman and Hall/CRC.

Suggestive readings

- Brown, J. A., & Lovett, G. M. (2018). Spatial models for environmental andecological data. CRC Press.
- Clark, J.S. and Gelfand, A.E. eds., 2006. Hierarchical modelling for the environmentalsciences: statistical methods and applications. OUP Oxford.
- Helsel, D. R. (2012). Statistics for censored environmental data using Minitab and R.John Wiley & Sons.
- Hoshmand, R., 2017. Statistical methods for environmental and agriculturalsciences. CRC press.
- Fletcher, R. and Fortin, M., 2018. Spatial ecology and conservation modeling (p.523). Cham: Springer International Publishing.

Note: Examination scheme and mode shall be as prescribed by the ExaminationBranch, University of Delhi, from time to time.