



School of Civil and Environmental Engineering (SCEE)
National University of Sciences & Technology



Course Title: Geo-Spatial Statistical Analysis

Course Code: CCSD-801

Course Objectives: This course is intended to provide core of data analytics, its sources, models and assessments criterion for dealing qualitative/quantitative univariable and multivariable information. There are a large number of problems involving spatial data, time series, panel data and extremes, but the focus will be on problems of applied nature, especially of developing countries. Lectures will cover multiple areas of data analytics, geo-spatial data analysis, lattice (areal) data, point patterns, linear and non-linear methods of analysis.

Course Outcomes:

On completion of this course, student should be able to:

- Understand different data sources and their types along with knowledge of adequate dealing strategies.
- Use existing methods to investigate spatial autocorrelation in example datasets provided as exercises.
- Analyze the trends and tendencies of data distribution and choice of suitable predictive models and their assessments.

Detailed Contents:

- **Introduction:** Data sources and their types, Pre-processing, Data visualization, Descriptive analysis and the need of inferential models
- **Preliminary Analytics:** Dealing univariate, bivariate and multivariate data, Correlation and its types, Linear model and its extension, Multiple linear regression model, issues of multicollinearity, heteroscedasticity and autocorrelation with their dealing strategies
- **Probability Distributions:** probability density function, spatio-temporal distribution, review of non-spatial methods, trend analysis, goodness-of-fit measures
- **Geostatistical Analysis:** semi-variogram, variograms and covariance functions, fitting variogram functions, kriging, spatial regression and smoothing methods
- **Areal Data Analysis:** neighborhoods, testing for spatial association, spatial processes, spatial autocorrelation, autoregressive models, estimation/inference, grids and image analysis, maps for spatial analysis
- **Time series analysis:** ARMA and ARIMA models, Panel data analysis
- **Special Topics:** Bayesian methods for spatial analysis, Bayesian mapping, Spatio-temporal modeling, Estimation methods including maximum likelihood, L-moments, Probability weighted moments, Maximum product of spacing

Text/Ref Books:

- N. A. C. Cressie Statistics for Spatial Data (1993), John Wiley & Sons.
- L.A. Waller and C.A. Gotway Applied Spatial Statistics for Public Health Data (2004), John Wiley & Sons.
- O. Schabenberger and C. A Gotway. Statistical Methods for Spatial Data Analysis (2005), Chapman & Hall.
- S. Banerjee, B. Carlin, and A. Gelfand. Bayesian and Hierarchical Modeling of Spatial Data: Hierarchical Modeling and Analysis for Spatial Data (2004), Chapman and Hall.
- Probability and Statistics. 3rd ed. Boston, MA: Addison-Wesley., 2002. by

DeGroot, Morris H., and Mark J. Schervish.

- Chapters covered: 1-10, Sections covered: 1.2-1.10, 2.1-2.3, 3.1-3.10, 4.1-4.8, 5.2, 5.4, 5.6, 5.7, 5.9, 5.10, 6.2-6.5, 7.2-7.5, 8.2, 8.5, 8.6, 9.1-9.4, 9.6.
- An Introduction to Probability Theory and Its Applications. 3rd ed, by Feller, William. New York, NY: Wiley, 1968
- Av Jay L. Devore, Probability and Statistics for Engineering and Sciences
- Box, G.E.P., Hunter, J.S and Hunter, W.G, Statistics for experimenters - design, innovation and discovery, 2nd edition, Wiley. ISBN: 978-0471718130.
- Draper, N.R. and Smith, H. Applied regression analysis, Wiley.
- Montgomery, D.C. and Runger, G.C, Applied statistics and probability for engineers.
- W. N. Venables and B. D. Ripley Modern Applied Statistics with S. Fourth Edition (2002), Springer.
- T.Ormsby, E. Napoleon, R. Burke, C. Groessl, L. Bowden Gettingto Know ArcGIS Desktop Second Edition (2010), Redlands: ESRI Press.
- Venables, W. N., Smith, D.M. and the R Team (2001) An Introduction to R
- Hosking JRM and Wallis JR (1997). Regional frequency analysis: An approach based on L-moments. Cambridge University Press.