

Geo-statistics

1.1. Course Number: GE 312

1.2. Contact Hours: 3-0-0 Credits: 9

1.3. Semester Offered: 3rd Year-Odd

1.4. Prerequisite: An overview of Statistical Methods would be useful.

1.5. Syllabus Committee Members: Dr. Satish Sinha and Dr. Piyush Sarkar

2. **Objective:** This course is proposed to introduce of the basic principles of geo-statistics and its practical applications in the geosciences will be presented. The main topics include Kriging, and spatial analysis.

3. **Course Content:** Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topics	Lectures
1	Basic Theory	Statistics Review and Notations, Geostatistics theory and prediction, Geostatistics versus Simple Interpolation	6
2	Review of Probability Theory	Nomenclature and Notation, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Gaussian Distribution	8
3	Spatial Analysis	Conventional Analysis: Data processing, contour map, symbol map, indicator map, moving window. Spatial continuity analysis: Variogram, h-scatterplot, variogram vs univariate statistics, Higher dimensions and Statistical anisotropy, pure nugget variogram, standard deviation. Varigram Modeling.	10
4	Estimation	The problem of estimation, geostatistical estimation and non-geostatistical estimation	10
5	Advanced topics	Cross validation, simple kriging, indicator kriging, block kriging, Geostatistical simulation	6
Total			40

4. Readings:

4.1. Textbook:

- Schabenberger, O. and Gotway, C. Statistical Methods for Spatial Data Analysis Chapman &Hall/CRC.
- Peter J. Diggle, Paulo J. Ribeiro, Jr., Model-based geostatistics, Springer.

- Cressie, N. (1993). Statistics for Spatial Data (Revised Ed.). John Wiley & Sons, Inc.
- Chiles, J. P. and Delfiner, P., Geostatistics: Modeling Spatial Uncertainty. Wiley.
- Stein, M. L., Interpolation of Spatial Data: Some Theory for Kriging. Springer.
- Banerjee, S, Carlin, B., and Gelfand, A. E., Hierarchical modeling and analysis for spatial data. Chapman & Hall
- Wackernagel, H., Multivariate Geostatistics (2nd ed.) Springer.

4.2. Reference Books:

- Kitanidis, P.K., Introduction to geostatistics: applications in hydrology.
- Goovaerts, Pierre, Geostatistics for Natural Resource Evaluation.
- Olea, R. A., Geostatistics for Engineers and Earth Scientists.
- Christakos, G., Modern Spatiotemporal Geostatistics.
- Webster, R. and Webster, M., Geostatistics for Environmental Scientists.

5. Outcome of the course:

On successful completion of this course, students will be applying the concepts of spatial variability to geoscience variables. Knowledge of variograms for simple one- and two-dimensional data sets. Evaluate simple calculations of estimation variances. Formulate and solve kriging equations.