MODULE INFORMATION SHEET

Name of Module Unit	**Geostatistics**
Name in polish language	Geostatystyka
Module type	compulsory
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Dep. of Informatics and Environment Quality Research
Responsible person	Prof. dr hab. inż. Jarosław Zawadzki

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
2	30E	15	-	-	-	4

Learning outcomes (knowledge, skills, competences)

The students will obtain the general and detailed knowledge on geostatistics, i.e, how to describe, analyze, and interpret uncertainty caused by a limited spatial sampling of a property under study. They will gain the skills to a variety of geostatistical tools for describing spatial continuity that is an essential feature of many phenomena in environmental engineering and environmental protection research. Namely, students will be familiar with geostatistical concepts, such as semivariogram, covariance function, correlogram, cross-semivariance, etc. They will know the modeling of variograms using the authorized functions, important type of spatial estimation methods, which are generally known as kriging, as well as cokriging methods, that are the most important tool of spatial estimation using secondary information. The knowledge on geostatistical simulation methods will be given to students. They will also gain basic skills to use geostatistical packages.

Prerequisites

Calculus I, II, III, Information Technology, Physics I, II
Statistics in Environmental Sciences

Rules for integrated grade definition

Integrated grade is calculated from the formula: 0.5E + 0.3T+0.2HA, where E is final exam grade, T is tests grade, HA denotes for home works and active participation.

Recommended readings

1. Isaaks, E. H. and Srivastava, R. M., An Introduction to Applied Geostatistics, Oxford University Press, New York, NY, 1989.
2. T. Hengl A practical guide to Geoststistical Mapping of Environmental Variables, JRC Scientific and Technical Reports, EUR 22904 EN-2007.
3. I.Clarc, Practical geostatistics : http://w3eos.whoi.edu/12.747/resources/pract_geostat/pg1979_latex.pdf.
4. Pannatier Y., Variowin, Software for Spatial Data Analysis in 2D, Springer-Verlag, 1996.
5. "Central information server for Spatial Statistics and Geostatistics on the Internet"): www.ai-geostats.org - http://curie.ei.jrc.it/ai-geostats.htm.

Contents of lectures (syllabus)

	Topics	**Time** (hrs.)	**Scope** (S / Ex)
1	The characteristic features of environmental data. The importance, beginning, development and current status of geostatistics.	1	S
2	The random function. Regionalised variable concept.	1	S
3	Hypothesis of stationarity. Strict stationarity. Second-order stationarity. Intrinsic hyphothesis. Ergodicity.	2	S
4	Spatial continuity. h-scatterplot, variogram cloud and experimental variogram. The typical shape of variogram: nugget effect, sill, range of correlation.	2	S
5	Anothers measures of spatial continuity: the covariance function, correlogram, madogram, standardised variogram, relative variograms etc.	2	S
6	Assessing reliable empirical variograms. Examples of typical and non-typical variograms.Search strategies.	2	S
7	Need of modelling variograms. Positive definiteness. Different authorised variogram models. Nested structures. Variogram model parameters assessment. Indicative goodness of fit.	3	S
8	The influence of drift on variogram. The behaviour of variograms near the origin and at long distances. Geometric and zonal anisotropy. .	3	S
9	Ordinary kriging. The random function model, unbiasedness. Minimising of the error variance.	2	S
10	The ordinary kriging system and its main properties. Intuitive description of kriging.	2	S
11	Exemplary, another types of kriging e.g. blok kriging, kriging with the trend model, lognormal kriging indicator kriging.	3	S
12	Cross-validation, jack-knife.	1	S
13	Cross h-scatterplots. Crossvariogram, crosscorrelogram etc. The cokriging system and its properties. Corregionalisation.	3	Ex
14	Introduction to geostatistical simulations. Need of simulations. Sequential gaussian simulation. Simulated annealing.	3	Ex
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

Prof. dr hab. inż. Jarosław Zawadzki

Assessment method

Final exam

Contents of tutorials

	Topics	**Time** (hrs.)	**Scope** (S / Ex)
1	Basic information on geostatistical packages. Demonstration of some free ones.	3	S
2	Example of variograms calculations, variograms modelling, and ordinary kriging calculations.	2	S
3	Examples of geostatistical analyses for environmental problems e.g. geochemical, geophysical, mining.	3	S
4	Introduction to environmental sampling designs: classical and geostatistical ones. The role of kriging variance in environmental sampling.	2	Ex
5	Solving chosen geostatistical problem– a student project.	5	S
	Total	**15**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for tutorials

Prof. dr hab. inż. Jarosław Zawadzki

Assessment method for tutorials

Active participation, performance of the project.