WEN610: Environmental Sampling and Data Analysis

Program & Course Code	**Water & Environmental Engineering Program** **WEN 610**
Course Title	Environmental sampling and data analysis
Credit Hours	3
Instructor	Dr Taha B.M.J. Ouarda
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Office Hours	TBA
Bulletin Course Description	This course is intended to present advanced notions in environmental sampling theory and statistical techniques for the analysis of sampled data, to water and environmental scientists to. The course covers such topics as statistical sampling techniques, field sampling design, sample size identification, estimation of the characteristics of the population, identification of hot spots, estimation of spatial patterns, statistical tests, and prediction with data series. A number of real-world case studies are also presented.
Pre-requisites	WEN501 or equivalent with Instructor consent. WEN521or equivalent with instructor consent.
Co-requisites	None
Course Objectives (Learning Outcomes of the Course)	After completing the course the student should be able to: •Select the appropriate statistical sampling method for the problem in hand and plan a sampling campaign. •Identify the sample size that allows meeting the estimation needs, and analyze the sampled data. •Identify whether highly contaminated local areas (hot spots) are present and locate them properly. •Define confidence interval bounds for any statistical sampling scheme. •Use a number of statistical methods for the analysis of the sampled data and make inference concerning the population. •Develop mathematical equations for the sample size and characteristics of the population with any new mathematical sampling technique. •Carry out a full frequency analysis with sampled data. •Address a number of more advanced mathematical issues such as non-stationarity in data, spatial modeling and resampling techniques.
Relationship of course objectives to IDDP Program outcomes	1. Demonstrate appropriate depth and breadth of knowledge that is at the frontier of their disciplines 2. Use skills of interdisciplinary scholarship and research to integrate multiple perspectives 3. Work effectively in a multidisciplinary collaborative environment using highly developed cognitive and creative expert skills and intellectual independence. 4. Communicate effectively, in written and oral forms, their research results and/or critique highly complex and diverse matters to diverse audiences. 5. Use self-development for personal and professional improvement in their field and contribute to its future advancement.

Week	Course Topics and Contents
1	Sampling objectives and principles.
2	Preparation of field work / Statistical sampling techniques.
3	Locating Hot Spots.
4	Simple random sampling.
5	Ratio estimation and sample size.
6	Spatially and auto-correlated data.
7	Stratified random sampling.
8	***Mid-Term Break***
9	Further aspects of Stratified random sampling.
10	Systematic sampling /Two-Stage sampling/ Double sampling.
11	Statistical tests, drawing conclusions from data
12	Prediction with sampled data.
13	Trends, shifts and seasonality.
14	Resampling techniques, spatial patterns in data.
15	Design problem presentations
16	*Final Examination.*

Out-of-class assignments	
Homework	Homework assignments
Design Problem	• Design problems (teams of two students) and presentations.

Course Grading	
Homeworks	30%
Design Problem	30%
Final Exam	40%
Total	**100 %**

Class/Laboratory schedule and Methodology	
Class	The class meets 15 weeks, 2 lectures per week, 75 minutes each (35 hours total).
Laboratory	Computer laboratory might be used for software applications (homeworks and design problem).
Teaching and learning methodologies	A combination of white board use, hand-outs, PowerPoint slide presentations, and interactive class discussions will be used. Open discussions are favored as they encourage students to participate and exchange, and enhance the overall learning process. A site visit may be arranged during the course.

Course Materials	
Textbook(s)	- Handouts. - Gilbert, R.O. (1987) Statistical Methods for Environmental Pollution Monitoring. John Wiley & Sons, New York. (ISBN 0-471-28878-0). - Cochran, W.G. (1977) Sampling Techniques. John Wiley & Sons, Toronto. (ISBN 0-471-16240-X).
Recommended	Selected materials from the following items:

Readings	- Brockwell, P. J., Davis, R. A. (2005) Introduction to Time Series and Forecasting. Springer Texts in Statistics. - Manly, B.F.J. (2009) Statistics for environmental science and management. Applied Environmental Statistics Series, Chapman & Hall/CRC Press. - Kitanidis, P.K. (1997) Introduction to geostatistics. Cambridge University Press. - Salas, J. D., Delleur, J. W., Yevjevich, V. and Lane, W. L., 1980, Applied Modeling of Hydrologic Time Series, Water Resources Publications, Littleton, Colorado.
Instructional material and resources	Copies of all necessary material will be provided to the students. Copies of additional recommended reading textbooks will be ordered at the library.