Geography 222 - Quantitative Methods in Earth Sciences
3 Credits, Fall Semester 2010

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Catalogue Description. GGY 222. Quantitative Methods in Earth Sciences (3) Use and interpretation of statistical techniques in geographic and geologic research. The course emphasizes problem identification, data collection and interpretation through assignments covering specific kinds of statistical methods.

Lecture. MWF 11:00-11:50, DeLoach Hall 114. This course includes lectures, PowerPoint demonstrations, and example problems. We will move as quickly as possible through the course topics, adjusting the pace as necessary. Therefore, your attendance is essential to keep track of assignments, to be informed about schedule changes, and to identify problem areas before the exams. Students are responsible for keeping current with course topics and due dates as announced in class and updated to the course web site. If you miss a class, please arrange to get the notes from a fellow student.

Prerequisites and Purpose. This course is intended as an introduction to statistical methods for geographers and others in the earth and environmental sciences. No prior course work in statistics is necessary. A basic understanding of algebra is assumed. This course meets the quantitative skills requirement in Geography and Environmental Studies.

Textbook and Course Web Site. J.C. McGrew and C.B. Monroe, 2009. *An Introduction to Statistical Problem Solving in Geography* (2nd ed.), Waveland Press, Long Grove, IL. The textbook includes explanations of course topics, practical examples to follow, and statistical tables and formulas. Problem sets, lecture notes, and helpful tables will be posted regularly to the course web site.

Exams. Each exam will involve definitions, short answers, and problem solving. The necessary statistical equations and tables will be provided, and students should bring a calculator to the exams. The 2nd exam is not cumulative - it will only cover material presented since the 1st exam.

Problem Sets. Roughly 6-8 homework assignments will be given during the semester. The problem sets will give students a chance to practice the statistical methods discussed in class, to develop some basic statistical computing skills, and to interpret the results of statistical analysis. Students are encouraged to work in groups, but each student must hand in his/her own finished assignment. The assignments will be graded on correct answers and methods, so hand in all your work with each assignment, including your calculations and explanations of your reasoning.

Data Projects. Two extended problem sets will be given asking students to collect and analyze their own data sets. The midterm data project deals with spatial statistics and nearest neighbor analysis, while the final data project will cover sampling, estimation, and hypothesis testing. These are essentially take-home exams that give students a chance to practice hands-on sampling, analysis, and interpretation. Data for these projects may be derived from coursework or textbooks in your classes, atlases and other reference books, or web sites and online databases.

Grading. Your course grade will be based on 2 exams and between 6-8 problem sets.
50 % Homework Problem Sets (plus one extra credit problem set)
30% Exams (midterm in late September, final in early November)
20 % Data Projects (midterm due in early October, final due during final week)

Calculators and Computers. Students should purchase a calculator with statistical functions for use on problem sets and during exams. Look for a statistical calculator with keys such as Σ, μ, σ, n, or STAT. A good, cheap model is the TI-36 from Texas Instruments, available in stores for about $25. We will discuss the use of statistical calculators in class, but students are ultimately responsible for learning to use their own calculator. We will also use Microsoft Excel to perform statistical analysis for several problem sets during the semester.

Academic Honor Code: Academic dishonesty, including cheating and plagiarism, are not tolerated in this class. Students must conform to the Academic Honor Code at all times. Please familiarize yourself with the Code as outlined in the UNCW Student handbook and at *http://www.uncw.edu/stuaff/odos/honorcode/*.

Students With Disabilities: Students requiring special accommodations to complete GGY 222 should contact the Office of Disability Services in Westside Hall (962-7555), or at *http://www.uncw.edu/stuaff/disability/*.

Course Topics:

Topics to be covered on the first mid-term exam:
- Ch. 1-2: Introduction (basic vocabulary, notation, measurement levels, graphical methods)
- Ch. 3: Descriptive Statistics (measures of centrality, spread, and shape)
- Ch. 4: Descriptive Spatial Statistics (measures of location, distance, and dispersion)

Topics to be covered on the second mid-term exam:
- Ch. 5: Probability (postulates and theorems, random variables, probability distributions)
- Ch. 6: Sampling (random samples, sampling distributions, spatial sampling)
- Ch. 7: Estimation (confidence intervals for estimates of population mean or proportion)

Topics to be covered on problem sets after the second mid-term:
- Ch. 8: Basic Hypothesis Testing (one-sample tests for difference of means or proportions)
- Ch. 9-10: Multiple-Sample Hypothesis Testing (2-sample tests, ANOVA methods)
- Ch. 13: Correlation (covariance, measures of correlation, spatial correlation)

Learning Outcomes. After completing GGY 222 you should be able to:

- Calculate and interpret statistical measures of centrality, dispersion, and shape that describe distributions of numerical and spatial data.
- Collect a representative sample from a population, and use the sample statistics to estimate population parameters by applying the Central Limit Theorem.
- Calculate probabilities associated with discrete and continuous random variables.
- Calculate and interpret statistical measures of correlation between two variables.
- Interpret and explain the changes in a geographic variable over time or space using quantitative statistical measures.
- Interpret and explain the sources of uncertainty associated with confidence interval estimates derived from surveys or sampling.
- Use the p-value method of hypothesis testing to support or refute a mathematical argument based on sample data.
- Display frequency and probability data (histograms, probability distributions) using the appropriate graphical methods.
- Portray statistical information on maps to indicate the center, spread, and outliers of a spatial population.
- Explain the results of statistical analyses in both precise technical language and concise common language.
- Recognize the differences between discrete and continuous variables, and between nominal, ordinal, ratio, and interval scales of measurement.
- Determine the impact of sample size and length of record on accuracy of analysis.
- Identify the differences between various probability distributions (uniform, binomial, normal, logarithmic, etc.) and the types of natural variables they represent.
- Collect unbiased, representative samples from field observations or from information available in atlases, reference books, or online databases.
- Utilize probability tables and calculators available in textbooks or online sources.
- Evaluate the limitations of geographic/geologic data arising from measurement scale, sample size, spatial distribution, or length of record.
- Recognize the primary sources of information for demographic, geospatial, climatological, hydrological, geological, and biological data.
- Apply geo-statistical techniques to analyze a spatial distribution derived from field observation or information available in a reference book or online database, and interpret the results in terms of the processes responsible for generating the pattern.
- Apply the p-value method of hypothesis testing to sample data generated from field observations or information available in a reference book or online database, and interpret the statistical significance of the results.
- Formulate fact-based opinions about the preferred length of record and spatial coverage for various earth science databases, and explanations of why these records are lacking.
- Properly cite the source of information used in class assignments.