

Course Description and Syllabus
Scientific Method in Geology (GEOL 4/5/72035)
Kent State University
Fall 2008

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Lecture: Tu/Th 12:30 – 1:45 pm, McGilvrey 234

Office Hours: Tuesdays and Thursdays 2-4pm and by appointment

Course Rationale and Objectives: While the earliest roots of geology and Earth science are based on qualitative descriptions, many sub-fields within modern geology and Earth science require quantitative analysis of large, complex, or multi-dimensional datasets. This course will provide students with the skills and confidence needed to quantitatively analyze scientific data. This will be accomplished by helping students "load up their data analysis toolboxes" by studying and applying a diverse array of analysis methods in real world contexts. Real world examples considered during the semester will be taken from a broad swath of geology and Earth and environmental science. Students are encouraged to share their specific areas of scientific interest with the instructor.

Pre-requisites: Basic computer skills, algebra, trigonometry and one semester of calculus and/or linear algebra will be helpful. Experience with computer software such as Excel will be helpful but is not required.

Text: Required for all students:

Statistics and Data Analysis in Geology, Third Edition by John C. Davis.
Published by Wiley, 2002, ISBN: 978-0-471-17275-8

Course web site: <http://www.personal.kent.edu/~dwitter/scimeth/f2008/>

Many helpful resources are available on the course web site, including a detailed class schedule and links to resources and additional information for assignments. Students are advised to familiarize themselves with the web site early in the semester and then to make use of these resources throughout the semester. Please see the instructor if you need help accessing the web site. Note that as with all internet resources, access to or availability of the web site cannot be guaranteed. Exams will not be rescheduled if the website is unavailable. Please use the resources available on the web site in advance of exams.

Consultation with the Instructor: The instructor welcomes questions from students either in person, by email or by phone. Please include your first and last name on any electronic correspondence. To ensure your own privacy, do not include your social security number on any electronic correspondence. Because the instructor uses email anti-spam filters, please include an informative subject line in any email correspondence. Students are encouraged to send email from their KSU email account.

Grading Policy

Students are expected to attend class, do all assignments and reading, take the exams, and participate in in-class discussions and activities.

For undergraduates (registered for GEOL 42035), grades are based on:

Midterm 1	20%
Midterm 2	20%
Homework Assignments	30%
Class Participation	10%
<u>Final Exam</u>	<u>20%</u>
Total	100%

For graduate students (registered for GEOL 52035 or GEOL 72035), grades are based on:

Midterm 1	15%
Midterm 2	15%
Homework Assignments	25%
Class Participation	10%
Final Project	15%
<u>Final Exam</u>	<u>20%</u>
Total	100%

Exams: Midterms will allow students to demonstrate their mastery of material in the first third of the class (midterm 1) and in the second third of the class (midterm 2). The final exam will be comprehensive. All of these exams will be held in class. Please see the class schedule for exact dates and times. Each exam will cover: (a) the principles of the analysis methods discussed in class, (b) application of methods to scientific data, and (c) interpretation of results from the analysis methods discussed in class. Midterms are passed back and discussed in class to help students prepare for the final. Exam scores may be curved, at the discretion of the instructor, but each student has the potential to succeed in this course.

Homework Assignments: Homework will provide students with the opportunity to apply what they have learned during lecture. Due dates will be announced in class and posted to the class schedule on the class website. Unless a prior arrangement has been made with the instructor, all assignments are expected to be turned in on the day they are due at the beginning of class. Assignments that are turned in late will be penalized 1 letter grade per day late and must be turned in directly to the instructor. Unless otherwise specified, students may work in groups to complete homework assignments; each student must however write up their own answers to homework questions.

Final Exam: The final exam is a required element of the course and is scheduled for Tuesday Dec. 9 from 12:45 - 3:00 pm. A make-up final exam is available only to students who have a scheduling conflict with the final exam for another KSU course or who have more than three final exams scheduled for the same day. Please see the instructor early in the semester if either of these situations applies to you.

Final Project (required of graduate students only): Each graduate student will complete a final project that involves analysis and interpretation of a dataset from their area of research interest. Datasets may include data that is being used for the student's thesis or dissertation or data that is complementary to the student's work on their thesis or dissertation. The final project includes three deadlines (1=initial project description, 2=preliminary write-up, 3=final write-up) to give students multiple opportunities to learn from feedback from the instructor. Specific dates for these deadlines will be posted to the class schedule on the course webpage and announced in class. Students are encouraged to meet with instructor early in the term to discuss plans for their final project.

Make-ups: Students who anticipate missing an exam due to official University travel, athletics, or active military service must contact the instructor in advance to arrange for a makeup exam. Students who miss an exam due to illness or other personal circumstance are expect to contact the instructor by phone (330-672-7002) or email (dwitter@kent.edu) within 24 hours of the scheduled start time of the exam.

Electronic Devices: The use of unapproved electronic devices during exams is prohibited (including, but not limited to, cell phones, laptops, iPods, MP3 players and PDAs). Any student found using an unapproved electronic device during an exam will receive a failing grade for the course and will be reported to the University Administration.



Scientific Method in Geology – Fall 2008

Important Dates (Mark Your Calendar!)

Homework Due Dates	See class website
Graduate Student Projects Initial Description Preliminary Write-Up Final Write-UP	Tuesday September 30 Tuesday November 11 Thursday December 4
Midterm Exams	Thursday September 25 Tuesday November 4
Final Exam	Tuesday December 9, 12:45 pm – 3:00 pm McGilvrey 234



**Class Schedule – Scientific Method in Geology
Fall 2008**

Week	Dates	Lecture Topic	Reading Assignment (Tentative)
1	Aug 26	Introduction to the Course: Loading Up Your Data Analysis Toolbox	Davis, pgs 7-9
	Aug 28	Elementary Statistics I Populations, Samples and Random Variables Histograms and Frequency Distributions Summary Statistics and Associated Assumptions	Davis, pgs 25-39
2	Sep 2	Software Tutorial - Introduction to Excel (Computer Lab Activity)	
	Sep 4	Elementary Statistics II Joint Variation of Two Variables Comparing Populations	Davis, pgs 40-46, 55-58
3	Sep 9	Central Limits Theorem Visualizing Elementary Statistics (Computer Lab Activity)	Davis, pgs 58-59
	Sep 11	Hypothesis Testing I Formulating the Hypothesis Type I and Type II Errors P Values, Significance Levels and Confidence Limits	Davis, pgs 60-68
4	Sep 16	Hypothesis Testing II The t-Distribution (Comparing Sample Means) The F-Distribution (Comparing Sample Variances) The Chi-Squared Goodness of Fit Test (Comparing Distributions)	Davis, pgs 68-78, 92-96
	Sep 18	Introduction to Analysis of Variance (ANOVA)	Davis, pgs 78-83
5	Sep 23	The ANOVA Table Two-Way ANOVA	Davis, pgs 84-87
	Sep 25	Midterm I	
6	Sep 30	Error Analysis and Propagation of Errors Sampling Strategies Graduate Student Projects: Initial Project Descriptions Due	Class notes
	Oct 2	Transformations Non-Parametric Methods Wilcoxon Sign-Rank-Sum Test Spearman's Rank Correlation Mann-Whitney Test Kruskal-Wallis Test	Davis, pgs 97-107
7	Oct 7	Analysis of Sequences of Data and Transitions Among States Markov Chains	Davis, pgs 168-178
	Oct 9	Introduction to Least-Squares Methods Calculating Parameters for Simple Linear Regression	Davis, 191-195
8	Oct 14	Linear Regression – Evaluating Goodness of Fit	Davis, pgs 191-204
	Oct 16	Linear Regression	Davis, pgs 191-204,

		The ANOVA Table for Regression Characterizing Uncertainty in the Regression Model	66-68
9	Oct 21	Analysis of Residuals Alternate Regression Models – Curvilinear Regression	Davis, pgs 207-214, 221-223, 227-228
	Oct 23	Selecting the “Best” Regression Model Weighted Regression Characterizing Scales in a Dataset Autocorrelation Analysis Cross-Correlation Analysis	Davis, pgs 224-228, 243-254
10	Oct 28	Cross-Correlation Analysis Harmonic Analysis	Davis, pgs 248-254, 266-275
	Oct 30	Harmonic Analysis Spectral Analysis	Davis, pgs 266-275
11	Nov 4	Midterm II	
	Nov 6	Analysis of Directional Data	Davis, pgs 316-330
12	Nov 11	Analysis of Spherical Data Contouring Spatial Data Graduate Student Projects: Preliminary Write-Ups Due	Davis, pgs 330-334, 341-342, 370-397
	Nov 13	Data-Adaptive Methods and Multivariate Analysis I What are “Data-Adaptive” Methods? Review of Matrix Algebra	Davis, pgs 123-140
13	Nov 18	Data-Adaptive Methods and Multivariate Analysis II Multiple Linear Regression	Davis, pgs 461-470
	Nov 20	Data-Adaptive Methods and Multivariate Analysis III Discriminant Functions	Davis, pgs 471-479
14	Nov 25	Data-Adaptive Methods and Multivariate Analysis IV Review of Eigenvalues and Eigenvectors Introduction to Eigenvector-Based Data Analysis	Davis, pgs 141-153, 500-502
	Nov 27	Thanksgiving Holiday	
15	Dec 2	Data-Adaptive Methods and Multivariate Analysis V Principal Component Analysis (PCA) Overview	Davis, pgs 500-502, 509-526
	Dec 4	Data-Adaptive Methods and Multivariate Analysis VII Applications of PCA Graduate Student Projects: Final Write-Ups Due	Davis, 526-547
	Tues. Dec. 9	Final Exam (12:45-3:00 pm)	

* Readings and class topics are subject to change. Please see the class schedule on the course website, <http://www.personal.kent.edu/~dwitter/scimeth/f2008/> for the most recent information.

University Policies

The following University policies apply to all students in this course:

1. **Registration Requirement:** The official registration deadline for this course is September 7, 2008. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashFast) prior to the deadline indicated. Registration errors must be corrected prior to the deadline.
2. **Course Drop and Course Withdraw:** For Fall 2008, the last day to withdraw from the class without receiving a grade of "W" is September 7, 2008. The last day to withdraw from the class with a grade of "W" is November 2, 2008.
3. **Student Accessibility:** In accordance with University policy, if you have a documented disability and require accommodations to obtain equal access in this course, please contact the instructor at the beginning of the term or when given an assignment for which accommodation is required. Students with disabilities must verify their eligibility through the Office of Student Accessibility Services (SAS), located on the ground floor of the DeWeese Health Center (2-3391)
4. **Final Exams:** Please check the final exam schedule for the classes in which you are enrolled. In the event that you have a conflict with another scheduled exam, the instructor will make suitable arrangements. Students who have conflicts or more than three examinations on the same day should consult with instructor and the Dean of his or her college at the earliest possible time for assistance in making alternative arrangements.
5. **Cheating/plagiarism:** Cheating and plagiarism will not be tolerated. Kent State University has strict policies and procedures (see section 3342-3-07 of the University Policy Register) for dealing with student cheating and plagiarism. Please become familiar with these policies and procedures, as they will be followed and enforced to the maximum extent by the instructor of this course.

Statement on Academic Dishonesty Excerpted from the University's Administrative policy and procedures regarding student cheating and plagiarism. Policy #3342-3-07

(A) Policy statement. It is the policy of the university that:

- (1) Students enrolled in the university, at all its campuses, are to perform their academic work according to standards set by faculty members, departments, schools and colleges of the university; and
- (2) Cheating and plagiarism constitute fraudulent misrepresentation for which no credit can be given and for which appropriate sanctions are warranted and will be applied.

(B) Intent and scope of the policy.

- (1) In providing this policy, the university affirms that acts of cheating and plagiarism by students constitute a subversion of the goals of the institution, have no place in the university and are serious offenses to academic goals and objectives, as well as to the rights of fellow students.
- (2) It is the intent of this policy to provide appropriate sanctions, to provide fair and realistic procedures for imposing those sanctions, to provide safeguards for any student suspected of cheating or plagiarism, and to coordinate the policy with procedures of the code of student conduct, rule 3342-4-15 of the Administrative Code and of this register.
- (3) This policy applies to all students of the university, graduate and undergraduate, full or part-time,

whose conduct is of such a nature prohibited by the policy. Other offenses of a nonacademic nature are covered by the code of student conduct, rule 3342-4-15 of the Administrative Code and of this register.

(C) Definitions. As used in this rule:

- (1) **"Cheat"** means intentionally to misrepresent the source, nature, or other conditions of academic work so as to accrue undeserved credit, or to cooperate with someone else in such misrepresentation. Such misrepresentations may, but need not necessarily, involve the work of others. As defined, cheating includes, but is not limited to:
 - (a) Obtaining or retaining partial or whole copies of examination, tests or quizzes before these are distributed for student use;
 - (b) Using notes, textbooks or other information in examinations, tests and quizzes, except as expressly permitted;
 - (c) Obtaining confidential information about examinations, tests or quizzes other than that released by the instructor;
 - (d) Securing, giving or exchanging information during examinations;
 - (e) Presenting data or other material gathered by another person or group as one's own;
 - (f) Falsifying experimental data or information;
 - (g) Having another person take one's place for any academic performance without the specific knowledge and permission of the instructor;
 - (h) Cooperating with another to do one or more of the above; and
 - (i) Using a substantial portion of a piece of work previously submitted for another course or program to meet the requirements of the present course or program without notifying the instructor to whom the work is presented.
 - (j) Presenting falsified information in order to postpone or avoid examinations, tests, quizzes, or other academic work.
- (2) **"Plagiarize"** means to take and present as one's own a material portion of the ideas or words of another or to present as one's own an idea or work derived from an existing source without full and proper credit to the source of the ideas, words, or works. As defined, plagiarize includes, but is not limited to:
 - (a) The copying of words, sentences and paragraphs directly from the work of another without proper credit;
 - (b) The copying of illustrations, figures, photographs, drawings, models, or other visual and nonverbal materials, including recordings, of another without proper credit; and
 - (c) The presentation of work prepared by another in final or draft form as one's own without citing the source, such as the use of purchased research papers.