GEO 325K and 383D Fall 2012
Computational Methods in Geological Sciences

Professor: Clark R. Wilson JGB 4.220C crwilson@jsg.utexas.edu
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Class Meets: Monday 11AM-1PM and Wednesday11AM-1PM
          Meeting Rooms: JGB 3.116 (usually 11-12) and 2.312 (usually 12-1). You will have access to the computer lab at other times when classes are not meeting there. Students who are not majors in Geological Sciences will be issued access cards for the computer lab, where Matlab is available. A UT-wide Matlab license is in the works, so any UT computer should provide access by mid-September. Access cards will also provide entry to the computer lab on the 6th floor. Students who have their own copy of Matlab will not need access outside of scheduled class time.

Text and Web Site: Blackboard is used to post homework, schedules and other files. The course notes are available at the Texas Union Copy Center Welch Hall (under GEO 325K/383D cost ~$20.). Notes include a Matlab primer, also posted on the blackboard site

Office Hours: Mondays and Wednesdays 9-11 GEO 4.220C and other times by appointment.
          TA Office Hours F 11-1 in JBG 2.312 (computer lab) and other times TBD
University of Texas Policies: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259

Other references: Matlab (student edition) is available for purchase in the campus computer store, and can be installed on your own computer. Wikipedia has many useful discussions of topics covered in the course. A number of texts are available to teach Matlab and applications, and the Matlab help files are extensive.

Course Work and Grades: Grades (plus minus grades are assigned): Examinations (2 in-class and a final exam): 50%; ~8 Weekly Quizzes 20%; Homework 30% (There will be ~8 homework assignments, many using Matlab. This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life.

Prerequisites: Experience with a scientific programming language (Matlab is best) and completion of mathematics courses required of your degree plan (normally calculus plus Math 427K and 427L or equivalent). For Geophysics Majors GEO 325J (Matlab and Fortran Programming) is a prerequisite. There are no set prerequisites for graduate students (GEO 383D)

Course Topics: The course covers topics essential to geophysical data processing, many related to time series analysis. Lectures and homework follow the course notes. An approximate schedule (Excel file) is posted on the Blackboard site. Topics include the first 7 chapters of the course notes. (1) Data processing concepts; analog and digital signals, frequency content, analog to digital conversion (2) Mathematical tools: dynamic range and precision, statistics, review of complex numbers and sinusoids, the decibel scale, and review of matrices and vectors. (3) Linear systems and linear digital filters. (4)The Discrete Fourier Transform (DFT), Fourier series and complex notation, transition from the Fourier series to the DFT, DFT conventions and interpretations, DFT power spectrum and filtering applications. (5) Time and frequency domain data processing, convolution theorems, filter transfer functions, filtering examples and applications. (6) Random variable concepts, probability density functions and common pdf's, correlation coefficient, multiple random variables, stacking to reduce noise, estimates and confidence intervals, Monte Carlo experiments. (7) Least squares and maximum likelihood principles, least squares in matrix notation, weighted least squares, applications. We use Matlab throughout and the first 2 weeks are devoted to learning or reviewing Matlab.