

**GEO 325K and 383D Fall 2011**  
**Computational Methods in Geological Sciences**

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**Class Meets:** Monday 11AM-1PM and either Wednesday 11AM-1PM or Friday 11AM-1PM

Meeting Rooms: JGB 3.116 and 2.312 (Computer lab). Most of the time we will meet for 2 hours on Monday in 3.116. Students may select their lab day to be either Wednesday or Friday in 2.312. However, this schedule may vary from time to time. You will have access to the computer lab at other times when classes are not meeting there to complete homework. Students who are not majors in Geological Sciences will be issued access cards for the computer lab. These cards will also provide access to the computer lab on the 6<sup>th</sup> floor, North end of the building

**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: (Professor)** Mondays and Wednesdays 9-11 GEO 4.220C and other times by appointment.

TA Office Hours to be announced

**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. An example is: *Essential MATLAB for engineers and scientists* (3rd ed., Elsevier, 2007) by Hahn is in the UT Library as an ebook that can be read on the internet, via the UT license.

**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).

**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.

**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 5 chapters of the course notes. (1) Data processing concepts; analog and digital signals, frequency content, analog to digital conversion, dynamic range and precision, statistics, review of complex numbers and sinusoids, the decibel scale, and review of matrices and vectors. (2) 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. (3) Time domain linear digital filters, moving average and autoregressive filters, the impulse response, discrete convolution and correlation, convolution theorems, filter transfer functions, inverse filters, filtering examples and applications. (4) Random variable concepts, probability density functions and common pdf's, the correlation coefficient, multiple random variables, stacking to reduce noise, estimates and confidence intervals, Monte Carlo experiments. (5) Least squares and maximum likelihood principles, least squares in matrix notation, underdetermined problems, weighted least squares, applications. We use Matlab throughout and the first 2 weeks are devoted to learning, re-learning or reviewing Matlab.