

EAS 309 Computer-Aided Analysis For Geosciences

Professor Braile

Two lectures and one lab per week, 3 credits

Two exams and 12 lab assignments

Goals: Develop an understanding of some fundamental statistical and numerical methods that are useful in Geosciences; explore applications of these methods using Matlab computer codes.

Textbook: Amos Gilat (*Matlab -- An Introduction with Applications*, 2nd edition, John Wiley publishers, Hoboken, NJ, 343 pp., 2005).

Lecture Notes:

- I. Getting Started with Matlab
- II. The Normal or Gaussian Distribution
- III. Statistics of randomly-spaced events (applicable to earthquakes, volcano eruptions, tornadoes, hurricanes, etc.)
- IV. Explore the Chi-Square Test with Random Data
- V. Matrices and matrix operations
- VI. The Method of Least Squares and the Least Squares Straight Line Fit Through Observations
Addendum to Section VI. Least Squares Matlab codes and output
- VII. Least Squares II – Matrix Algebra, Higher Order Equations
- VIII. Least Squares Straight Line Fit to Non-linear Equations by Transformation
- IX. Least Squares and ANOVA
- X. Interpolation (1-D and 2-D)
- XI. Time Series Analysis -- Sampling Theory and Aliasing
- XII. Time Series Analysis -- Convolution and Correlation
- XIII. The Fourier Transform -- Theory and Numerical Calculation
- XIV. The Fourier Transform -- Numerical Calculations, Gibbs Phenomenon, Smoothing, Truncation and Signal Processing

Lab Assignments:

- Lab 1: Getting Started with Matlab
- Lab 2: Using Statistics to Analyze a Series of Data Points and Making 2-D Plots
- Lab 3: Working with the Chi-Square Test
- Lab 4: Matrix Algebra
- Lab 5: Least Squares I -- The Least Squares Straight Line Fit and the Correlation Coefficient
- Lab 6: Least Squares II -- Least Squares for the Exponential Curve Fit and the Error (Confidence) Bounds on the Predicted Values of y
- Lab 7: Least Squares III -- ANOVA for a Least Squares Straight Line Fit and Quadratic Fit
- Lab 8: Least Squares IV -- Least Squares Polynomial Fit: Choosing the Best Order of the Polynomial
- Lab 9: 1-D and 2-D Interpolation
- Lab 10: Time Series Analysis – Sampling, Aliasing, Convolution and Correlation
- Lab 11: The Fourier Transform (Using the FFT)
- Lab 12: The Fourier Transform (The FFT of real data)