Instructor: Malgorzata Peszynska, Professor of Mathematics

Catalog Description: Discrete and continuous mathematical models and methods for analysis, including linear analysis, equilibrium and minimum principles, calculus of variations, principal component analysis and orthogonal expansions, asymptotic and Fourier analysis, least squares, constrained and unconstrained optimization, inverse problems, and Monte Carlo techniques. Particular models and methods covered may vary annually.

Credits: 3
Terms offered: S
Meets: Three lectures weekly

Prerequisites: MTH 256, MTH 341, and junior status or above.

Course Content: This class covers various discrete and continuous models along with the necessary mathematical methods. The methods include linear analysis, equilibrium and minimum principles, calculus of variations, principal component analysis (singular value decomposition) and orthogonal expansions, asymptotic and Fourier analysis, least squares, and constrained and unconstrained optimization. As time permits, a gentle introduction to inverse problems and Monte Carlo techniques will be included. The models will be explored in depth in guided projects and computer lab activities, none of which require prior computing expertise.

The applications, models, and projects may vary from year to year. In the initial course offering, models and analysis of the following systems will be developed.

- image reconstruction and deblurring
- web search engines and recommender systems
- data clustering
- linear programming and transportation problem
- applications of Fourier analysis to equilibrium problems and touch-tone dialing and bar-code reading
- Kalman filter and GPS
- asymptotic analysis

Learning Resources: The required course textbook is “Introduction to Applied Mathematics” by G. Strang, Wellesley, 1986. This will be supplemented by class notes and handouts.

Evaluation of Student Learning: (Approximate percentages given.)

- Homework scores 30%
- Lab and project reports 30%
• Exam I  20%
• Exam II  20%

Note: No late HW will be accepted but the lowest HW score will be dropped.

Attendance in class is not taken but students are responsible for the material covered in class. Attendance in lab meetings is required but a pre-arranged absence in one lab meeting can be allowed if necessary. A daily schedule will be posted as a guide to the class activities.

Course Learning Outcomes:

A successful student who has completed MTH 420 will be able to:

1) Follow the fundamental ideas of mathematical modeling for various current applications which translate a given problem to one that can be solved using algebra and differential equations.

2) Solve discrete and continuous quadratic minimization problems and the associated positive definite linear models arising from physically motivated equilibrium problems and calculus of variations.

3) Apply the basics of Fourier analysis to selected examples.

4) Use the principles of principal component analysis and least squares for solving, in particular, large underdetermined and overdetermined linear systems.

A successful student who has completed MTH 520 will be able to:

1) Apply the fundamental ideas of mathematical modeling for various current applications which translate a given problem to one that can be solved using algebra and differential equations.

2) Formulate and solve discrete and continuous quadratic minimization problems and the associated positive definite linear models arising from physically motivated equilibrium problems and calculus of variations.

3) Apply the basics of Fourier analysis and understand its limitations

4) Use the principles of principal component analysis and least squares for solving, in particular, large underdetermined and overdetermined linear systems. Select the most appropriate method for a given application.

Students with Disabilities: Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Course drop/add information is at http://oregonstate.edu/registrar/.

Student Conduct: All students are expected to obey to OSU’s Student Conduct Code; see http://oregonstate.edu/studentconduct/ See also http://oregonstate.edu/studentconduct/offenses for information on the consequences of Academic or Scholarly Dishonesty