Applied Mathematics and Statistics
ACM/CMS 159.
Prerequisites: ACM157

Models in applied mathematics often have input parameters that are uncertain; observed data can be used to learn about these parameters and thereby to improve predictive capability. The purpose of the course is to describe the mathematical and algorithmic principles of this area. The topic lies at the intersection of fields including inverse problems, differential equations, machine learning and uncertainty quantification. Applications will be drawn from the physical, biological and data sciences.

Bayesian Inversion. Sampling: Importance sampling and MCMC. Optimization: Maximum a posteriori (MAP) estimators, variational methods, approximation in Kullback-Liebler divergence. Theory: well-posed inverse problems; Bayesian posterior consistency; Bernstein Von Mises Theorem.

Sequential Problems. Sampling: Kalman filter, particle filters. Optimization: 3DVAR and ensemble Kalman filter. Theory: well-posed filtering problems; large time behavior; small noise asymptotics.