likelihood estimation, conditional probability density functions.
Prerequisite: graduate standing or permission of department.

MAT 5510 Functional Analysis. Banach and Hilbert spaces, linear functionals, Hahn-Banach theorem, dual spaces, linear operators, closed graph theorem, Riesz theory for compact operators, spectral theory, function and Banach algebras**.** *Prerequisite: graduate standing or permission of department.*

MAT 5401 Dynamical Systems. Qualitative theory of differential equations, bifurcation theory, and Hamiltonian systems; differential dynamics, including hyperbolic theory and quasiperiodic dynamics; low-dimensional dynamics; introduction to ergodic theory. *Prerequisite: graduate standing or permission of department.*

MAT 5100 Mathematical Modeling. Ordinary and partial differential equations of physical and biological problems; simplification, dimensional analysis, scaling, regular and singular perturbation theory, variational formulation of physical problems, continuum mechanics, fluid flows.
Prerequisite: graduate standing or permission of department.

MAT 5640 Mathematics of Finance. Fundamental topics will be covered: risk, arbitrage, mathematical models for asset price movements (based on trees, PDEs, and martingales); pricing of financial derivatives, and hedging; introduction to stochastic calculus, and to the Black-Scholes model.
Prerequisite: graduate standing or permission of department.

MAT 5511 Stochastic Calculus. Stochastic processes, including Brownian processes and Poisson processes, stochastic integration and differentiation, solving stochastic differential equations, martingale calculus, martingale measures, Black-Scholes model of a financial market.
Prerequisite: graduate standing or permission of department.

MAT 5400 Scientific Computing

MAT 5600 Topics in Mathematics of Finance. Possible topics may include: portfolio theory, risk management, game theory, applications to financial economics and econometrics.
Prerequisite: graduate standing or permission of department.

MAT 5402 Topics in Scientific Computing. This is an advanced graduate course on scientific computing. The aim of the course is to present some advanced techniques of scientific computing with applications to many areas of science. For example: integration of ODEs and PDEs for physics and engineering; singular value decomposition for dimension reduction and compression; Monte Carlo methods for statistics, probability, and finance; optimization for operations research.
Prerequisite: graduate standing or permission of department.

MAT 5930. Topics in Mathematical Physics (3 credits).

MAT 5931 Graduate Student Seminar (0-1 credits). Students attend seminar lectures to get exposure and knowledge in various areas of modern mathematics.
Prerequisite: graduate standing or permission of department.

MAT 5940 Internship/Practical Training (3-6 credits). The internship/practical training provides graduate students with opportunities to gain practical, career-related experience in a variety of supervised field settings. This involves participation in a project that requires applications of mathematics, numerical methods, or statistics, which is conducted outside the university in a governmental, commercial, or academic setting. Open only to graduate students with permission of the Director of Graduate Studies. Students must submit a brief written description of their work to the DGS before starting the internship and submit a written summary of their work when it is completed.

MAT 5900 Readings in Mathematics (3-6 credits). Topics to be arranged, depending on the interests and backgrounds of the students. Given only by arrangement with the instructor.
Prerequisite: graduate standing or permission of department.

MAT 8970 Thesis Research (1-9 credits). Preparation of MA or PhD Thesis under the supervision of adviser; credits will vary for masters and doctoral students.
Prerequisite: graduate standing or perm