

# APPLIED & COMPUTATIONAL MATH (ACM)

## ACM 587 TOPICS COURSE

1-4, 1/0

In-depth examination of rapidly and significantly changing disciplinary issues, topics, or practices; offered occasionally.

## ACM 600 MATHEMATICAL MODELING AND APPLICATIONS I

1, 1/0

Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics (PACM) Program. Processes of mathematical modeling, use of dimensional analysis, scaling, and elementary perturbation methods; constrained and unconstrained optimization, sensitivity analysis, derivation and analysis of system of discrete dynamical models.

## ACM 601 MATHEMATICAL MODELING AND APPLICATIONS II

1, 1/0

Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics (PACM) Program. Mathematical modeling and applications of differential equations, simulation of dynamical systems, and partial differential equations.

## ACM 602 MATHEMATICAL MODELING AND APPLICATIONS III

1, 1/0

Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics (PACM) Program. Applications of series and integral transforms, and the study and simulations of probability models.

## ACM 604 TOPICS IN STATISTICAL INFERENCE

1, 1/0

Prerequisites: Instructor permission. Topics include continuous distributions, sampling distributions, point and interval estimation, and tests of hypotheses. Offered occasionally.

## ACM 610 CONTINUOUS FOUNDATIONS OF APPLIED MATHEMATICS FROM A PROBLEM SOLVING PERSPECTIVE

1, 1/0

Prerequisite: Admission to program or instructor permission. Problem solving and applications of continuous mathematics, including real analysis, single and multivariable calculus, differential equations, optimization, and Fourier analysis. Emphasis on team building and group management through problem-solving activities.

## ACM 611 DISCRETE FOUNDATIONS OF APPLIED MATHEMATICS FROM A PROBLEM SOLVING PERSPECTIVE

1, 1/0

Prerequisite: Admission to program or instructor permission. Problem solving and applications of discrete mathematics, including combinatorics, graph theory, logic, linear algebra, number theory, and set theory. Emphasis on team building and group management through problem-solving activities.

## ACM 612 COMPUTATIONAL FOUNDATIONS OF APPLIED MATHEMATICS FROM A PROBLEM SOLVING PERSPECTIVE

1, 1/0

Prerequisite: Admission to program or instructor permission. Introduction to algorithm design to implement mathematical models, procedural, and functional programming, programming paradigms, higher-level languages; statistical and visualization software, typesetting software for science and mathematics.

## ACM 613 SPREADSHEETS AND DATABASES FOR MATH

1, 1/0

Prerequisites: Instructor permission. Applications of spreadsheet and database software programming to solve real life problems in computational mathematics. Analysis of data to produce reports and presentations for diverse audiences.

## ACM 614 STATISTICAL AND DATA ANALYSIS SOFTWARE FOR MATH AND SCIENCE PROFESSIONALS

1, 1/0

Prerequisite: Instructor permission. Survey of statistical and data programming software and applications to real life problems in computational mathematics. Analysis of data to produce reports and presentations for diverse audiences with a focus on understanding the syntax and use of statistical programming languages.

## ACM 620 OPTIMIZATION OF DISCRETE MODELS

1, 1/0

Prerequisite: Admission to the program or instructor permission. Mathematical analysis and solution of real-world problems that optimize linear objective functions subject to systems of linear inequalities; the two-phase revised simplex method; applications in diverse areas such as business management, industry, economics, finance, and game theory.

### ACM 621 EMPIRICAL MODEL BUILDING

1, 1/0

Prerequisite: Admission to program or instructor permission. Exploratory data analysis, polynomial interpolation, curve fitting, least squares, cubic splines, minimax polynomial, Taylor and Chebyshev series, applications to fitting experimental data.

### ACM 622 MODELING CHANGE WITH DYNAMICAL SYSTEMS

1, 1/0

Prerequisite: Admission to program or instructor permission. Difference equations, systems of differential equations, Euler and Runge-Kutta methods, error analyses, logistic models; applications to ecology, finance, conflicts, natural and social sciences.

### ACM 630 NUMERICAL LINEAR ALGEBRA

1, 1/0

Prerequisite: Admission to program or instructor permission. Numerical algorithms for linear algebra problems, matrix operations, matrix decompositions, solving systems of linear equations, selected problems from applied settings.

### ACM 631 EIGENVALUE PROBLEMS

1, 1/0

Prerequisite: Admission to program or instructor permission. Numerical algorithms for eigenvalue problems, matrix factorization, matrices, vectors, eigenvalues, eigenvectors, eigenspaces, eigenvalue algorithms, selected problems from applied settings.

### ACM 632 NUMERICAL CALCULUS

1, 1/0

Prerequisite: Admission to program or instructor permission. Numerical methods and algorithms for finding roots of non-linear equations, numerical integrals, Fourier series and Laplace transform; selected problems from applied settings.

### ACM 640 LINEAR REGRESSION AND CORRELATION

1, 1/0

Prerequisite: Admission to program or instructor permission. Simple linear regression and correlation, multiple linear regression, multicollinearity, multiple and partial correlations, confounding and interaction, sequential methods of model selection.

### ACM 641 DESIGN AND ANALYSIS OF EXPERIMENTS

1, 1/0

Prerequisite: Admission to program or instructor permission. Design of experiments (one, two and three factors), multiple comparisons, randomized complete block designs, Latin square design.

### ACM 642 NONPARAMETRIC STATISTICS

1, 1/0

Prerequisite: Admission to program or instructor permission. Introduction to nonparametric tests such as sign-test, signed rank test, rank sum test, two-way analysis of variance by ranks, tests of randomness, rank correlation coefficient.

### ACM 650 RANDOM WALKS AND BROWNIAN MOTION

1, 1/0

Prerequisite: Admission to program or instructor permission. Symmetric random walks, ballot theorem, returns to origin and arcsine laws, gambler's ruin, Brownian motion, conditional distributions, hitting times and maxima.

### ACM 651 MARKOV CHAINS

1, 1/0

Prerequisite: Admission to program or instructor permission. Transition matrices, classification of states, limiting probabilities, applications.

### ACM 652 CONTINUOUS-TIME STOCHASTIC PROCESSES

1, 1/0

Prerequisite: Admission to program or instructor permission. Exponential distribution, Poisson, Yule, pure birth, birth and death processes, applications.

### ACM 653 MARKOV CHAIN MODELS IN CREDIT RISK MANAGEMENT

1, 1/0

Prerequisites: Graduate standing. Practical introduction to mortgage lending and the practice of measuring and managing consumer credit risk. Introduction to Markov chain theory and transition roll rate modeling through extensive case study of the collapse of the U.S. mortgage industry in 2007 - 2008 and the origins of the Great Recession. Risk reporting and segmenting; probability of default; loss given default; house price dynamics; loss forecasting with consideration of micro and macro-factors. Use of statistical software package SAS to analyze loan-level datasets. Suggested preparation: previous coursework or experience in calculus, linear algebra, linear regression, and introduction to programming.

### ACM 654 MATHEMATICS OF FINANCE I: MODELING, ANALYSIS AND NUMERICAL METHODS

1, 1/0

Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics Master program. In-depth study of probability, differential equations and numerical analysis and their connections to finance and economics; put-call parity equation; risk-neutral probability; binomial tree analysis.

### ACM 655 MATHEMATICS OF FINANCE II: MODELING, ANALYSIS AND NUMERICAL METHODS

1, 1/0

Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics Master program. Additional study of probability, differential equations and numerical analysis and their connections to finance and economics; Black-Scholes equation, risk-neutral probability, Brownian motion, hedging, continuous and discrete stochastic models.

### ACM 660 LOGISTIC REGRESSION

1, 1/0

Prerequisite: ACM 640 or instructor permission. Comparison of linear and logistic regression, multiple logistic regression, regression diagnostics, indicator variables, multicollinearity, confounding and interaction, model selection, maximum likelihood techniques, polychotomous logistic regression.

### ACM 661 SURVIVAL ANALYSIS

1, 1/0

Prerequisite: ACM 640 or instructor permission. Survival and hazard functions, life tables, Kaplan-Meier survival analysis, Cox regression proportional hazards model and Cox regression with time-dependent variables; comparison with logistic regression approaches.

ACM 662 TIME SERIES ANALYSIS AND FORECASTING

1, 1/0

Prerequisite: ACM 640 or instructor permission. Time and frequency domain techniques including autocorrelation, spectral analysis, autoregressive moving average and integrated moving average models, Box-Jenkins methodology, fitting, forecasting and seasonal adjustments.

ACM 690 INTERNSHIP IN APPLIED AND COMPUTATIONAL MATHEMATICS

1-3, 1/0

Prerequisite: Written approval of faculty adviser and department chair. Research or investigation of a particular problem, planned and carried out under the guidance of a qualified member of the graduate faculty, submitted in acceptable form according to directions given by the Mathematics Department.

ACM 721 THESIS/PROJECT CONTINUATION

0, 0/0

ACM 722 THESIS/PROJECT EXTENDED

0, 0/0