INDUSTRIAL ENGINEERING & MANAGEMENT SCIENCES (IEMS)

IEMS 303-0 Statistics (1 Unit)
Introduction to the foundations of statistics and statistical computing for data analysis and their applications. Descriptive statistics and statistical inference for estimation, testing, and prediction. May not receive credit for both IEMS 303-0 and any of IEMS 201-0, STAT 210-0, BMD_ENG 220-0, or CHEM_ENG 312-0. May not be taken for credit with or after STAT 320-1.
Prerequisites: IEMS 202-0 or equivalent; COMP_SCI 110-0 or COMP_SCI 111-0 or equivalent.

IEMS 304-0 Statistical Learning for Data Analysis (1 Unit)
Predictive modeling of data using modern regression and classification methods. Multiple linear regression; logistic regression; pitfalls and diagnostics; nonparametric and nonlinear regression and classification such as trees, nearest neighbors, neural networks, and ensemble methods.
Prerequisites: IEMS 303-0 and COMP_SCI 111-0 or equivalents.

IEMS 307-0 Quality Improvement by Experimental Design (1 Unit)
Methods for designing and analyzing industrial experiments. Blocking; randomization; multiple regression; factorial and fractional factorial experiments; response surface methodology; Taguchi’s robust design; split plot experimentation. Homework, labs, and project.
Prerequisite: IEMS 201-0, IEMS 303-0, or equivalent.

IEMS 308-0 Data Science and Analytics (1 Unit)
Focuses on select problems in data science, in particular clustering, association rules, web analytics, text mining, and dimensionality reduction. Lectures will be completed with exercises and projects in open source framework R. Prior knowledge of classification techniques and R is required.
Prerequisites: IEMS 304-0; COMP_SCI 217-0.

IEMS 310-0 Operations Research (1 Unit)
Survey of operations research techniques. Linear programming, decision theory, stochastic processes, game theory. May not be taken for credit with or after IEMS 313-0.
Prerequisites: IEMS 201-0 or IEMS 202-0; GEN_ENG 205-1 or MATH 240-0.

IEMS 313-0 Foundations of Optimization (1 Unit)
Formulation and solution of applicable optimization models, including linear, integer, nonlinear, and network problems. Efficient algorithmic methods and use of computer modeling languages and systems. Homework, exams, and project.
Prerequisites: COMP_SCI 111-0; GEN_ENG 205-1; MATH 228-1; sophomore standing.

IEMS 315-0 Stochastic Models (1 Unit)
Fundamental concepts of probability theory; modeling and analysis of systems having random dynamics, particularly queueing systems.
Prerequisites: IEMS 202-0 and concurrent enrollment in IEMS 303-0; GEN_ENG 205-1.

IEMS 317-0 Discrete Event Systems Simulation (1 Unit)
Computer simulation of discrete-change systems subject to uncertainty. Choice of input distributions; development of models; design and analysis of simulation experiments. Mini-projects, exams, and computer labs.
Prerequisites: IEMS 303-0; IEMS 310-0 or IEMS 315-0.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Unit(s)</th>
<th>Description</th>
<th>Prerequisites</th>
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<tr>
<td>IEMS 313-0</td>
<td>Introduction to stochastic discrete-event simulation for graduate students, covering simulation modeling and programming; probability foundations of stochastic simulation; proper design and analysis of the simulation experiment; and simulation for research.</td>
<td>1 Unit</td>
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<td>IEMS 202-0 and IEMS 303-0 or equivalent; previous programming experience in some language.</td>
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<td>IEMS 441-0</td>
<td>Social Network Analysis</td>
<td>1 Unit</td>
<td>This seminar is intended to overview theoretical, computational, and analytic issues associated with network perspectives on communicating and organizing. The course will review scholarship on the science of networks in communication, computer science, engineering, organizational science, and social sciences in order to take an in-depth look at theories, methods, and tools to examine the structure and dynamics of networks.</td>
<td>IEMS 440-0 Social Network Analysis (1 Unit)</td>
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<td>IEMS 443-0</td>
<td>Health Policy Modeling</td>
<td>1 Unit</td>
<td>PhD level course on the application of mathematical, statistical, economic, and systems models to problems in health policy. A particular focus will be on predictive modeling techniques, multi-objective and stochastic decision making. Contemporary topics will be included as appropriate.</td>
<td>IEMS 440-0 Social Network Analysis (1 Unit)</td>
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<td>IEMS 450-1</td>
<td>Mathematical Optimization I</td>
<td>1 Unit</td>
<td>Constrained and unconstrained nonlinear optimization: Optimality conditions; linesearch and trust-region methods; Newton and quasi-Newton methods; active-set methods; augmented Lagrangian, sequential quadratic programming and interior point methods; convergence theory for numerical algorithm.</td>
<td>IEMS 450-0 Mathematical Optimization I (1 Unit)</td>
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<td>IEMS 450-2</td>
<td>Mathematical Optimization II</td>
<td>1 Unit</td>
<td>Efficient methods and min-max results for combinatorial optimization problems including minimum spanning trees, shortest paths, maximum flows, minimum cost flows, matching; polyhedral combinatorics; complexity theory.</td>
<td>IEMS 440-0 Social Network Analysis (1 Unit)</td>
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<td>IEMS 451-0</td>
<td>Stochastic Optimization</td>
<td>1 Unit</td>
<td>Optimization under uncertainty, including modeling and applications; exact optimization methods; deterministic approximation and bounding techniques; and Monte Carlo sampling-based approximations.</td>
<td>IEMS 450-0 Mathematical Optimization II (1 Unit)</td>
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<tr>
<td>IEMS 452-0</td>
<td>Combinatorial Optimization</td>
<td>1 Unit</td>
<td>Efficient methods and min-max results for combinatorial optimization problems including minimum spanning trees, shortest paths, maximum flows, minimum cost flows, matching; polyhedral combinatorics; complexity theory.</td>
<td>IEMS 450-0 Mathematical Optimization II (1 Unit)</td>
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<td>IEMS 453-0</td>
<td>Robust Optimization</td>
<td>1 Unit</td>
<td>Optimization with uncertain variables or parameters to find solutions that are both optimal and immune to uncertainties. Covers computational tools and applications including supply chains, revenue management, energy, portfolio theory, options pricing, risk management, healthcare, statistics and engineering design.</td>
<td>IEMS 450-0 Mathematical Optimization II (1 Unit)</td>
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<tr>
<td>IEMS 454-0</td>
<td>Large Scale Optimization</td>
<td>1 Unit</td>
<td>Algorithms for large-scale optimization. Ellipsoid method and complexity of linear programming; equivalence of separation and optimization;</td>
<td>IEMS 450-0 Mathematical Optimization II (1 Unit)</td>
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path-following interior point methods, including self-dual methods; decomposition algorithms, including column generation and row generation for linear, nonlinear, and integer programming; selected applications.
Prerequisite: IEMS 450-1.

IEMS 455-0 Machine Learning (1 Unit)
A survey of large-scale machine learning with emphasis on neural networks and kernel methods, including model formulation, large-scale applications and training (optimization). Case studies include text classification, image and speech recognition, and recommender systems. Construction of deep neural networks for large data sets.
Prerequisites: IEMS 202-0, IEMS 303-0 and IEMS 313-0 (or equivalent) and computer programming.

IEMS 457-0 Integer Programming (1 Unit)
Methods for NP-hard discrete optimization problems including general methods like branch and bound and cutting planes, as well as special purpose branch-and-cut methods and heuristics.
Prerequisite: IEMS 450-1 or equivalent.

IEMS 459-0 Convex Optimization (1 Unit)
The course develops expert knowledge in the theory and algorithms for convex optimization. Emphasis is on understanding fundamental properties of convex sets and functions, and on the role of duality. Covers practical algorithms.
Prerequisites: IEMS 202-0, IEMS 303-0 (or equivalent), and IEMS 450-1 or IEMS 450-2 (or equivalent).

IEMS 460-1 Stochastic Processes I (1 Unit)
Prerequisite: Permission of instructor.

IEMS 460-2 Stochastic Processes II (1 Unit)
Bernoulli processes, Poisson processes, Markov chains, renewal theory, regenerative process, and queuing models. Theory and applications.
Prerequisite: Permission of instructor.

IEMS 462-1 Predictive Analytics I (1 Unit)
Parametric regression and classification models for analyzing medium to large data sets.

IEMS 463-0 Statistical Analysis (1 Unit)
Principles of experimental design and their application to the analysis of standard designs including one-way layout, block designs, factorial/fractional factorial experiments, random/mixed effect models, nested/split-plot designs.

IEMS 464-0 Advanced Queueing Theory (1 Unit)
Queueing networks, the single-server queue, heavy-traffic approximations for the G/G/1 queue. Advanced level.
Prerequisite: IEMS 460-1 or equivalent.

IEMS 465-0 Simulation Experiment Design & Analysis (1 Unit)
Selected current topics in modern stochastic simulation research, including variance reduction, simulation optimization, model risk, and simulation analytics.
Prerequisites: IEMS 435-0, IEMS 401-0 and IEMS 460-1, or equivalent.

IEMS 468-0 Stochastic Control (1 Unit)
Optimal control of Markov chains, dynamic programming, finite horizon and discounted models, and applications in operations research.
Prerequisite: IEMS 460-1.

IEMS 469-0 Dynamic Programming (1 Unit)
Theoretical and computational aspects of solving stochastic sequential decision problems. Material supported by many real-world applications.

IEMS 473-1 Financial Engineering I (1 Unit)

IEMS 473-2 Financial Engineering II (1 Unit)
Prerequisite: IEMS 373-0.

IEMS 481-0 Logistics (1 Unit)
This course will provide an introduction to modeling and solution methods for facility location, transportation and inventory management decisions. By the end of the quarter, you should learn to model and formulate a variety of logistics problems; to develop and assess solution methods for these problems; and to use these tools to analyze strategic, tactical, and operational supply-chain decisions.
Prerequisites: IEMS 450-1; students should be familiar with some high-level programming language.

IEMS 482-0 Operations (1 Unit)
First Quarter: Introduction to production/logistics including: multi-objective, stochastic and dynamic facility location problems, multi-echelon and multi-item inventory models and heuristic, approximate and exact vehicle routing algorithms. Second Quarter: Introduction to production/distribution facility design and control, capacity management, push and pull production systems: MRP, JIT, ConWIP; introduction to deterministic and stochastic production scheduling: job shop, flow shop. Prerequisites: IEMS 450-1 and at least concurrent enrollment in IEMS 460-1.

IEMS 484-0 Inventory and Distribution Systems (1 Unit)
Multistage inventory and production models, multiproduct systems, distribution systems, and random yield models.
Prerequisites: IEMS 481-0 and IEMS 482-0.

IEMS 488-0 Economics and Decision Analysis (1 Unit)
Investment project evaluation: time value of money, treatment of risk, asset evaluation; decision trees, utility theory and risk attitude, multiobjectives. Public sector decision analysis, including cost/benefit analysis, and cost/effectiveness analysis.
Prerequisite: Calculus.

IEMS 490-0 Selected Topics in IE (1 Unit)

IEMS 499-0 Projects (1-3 Units)
SEE DEPT FOR SECTION AND PERMISSION NUMBERS - Special projects under faculty direction. Permission of instructor and department required. May be repeated for credit.

IEMS 519-0 Responsible Conduct of Research Training (0 Unit)

IEMS 590-0 Research (1-3 Units)
Independent investigation of selected problems pertaining to thesis or dissertation. May be repeated for credit. SEE DEPT FOR SECTION AND PERMISSION NUMBERS.