OPERATIONS RESEARCH AND INFORMATION ENGINEERING (GRADUATE FIELD)

Program Website (http://www.orie.cornell.edu/)

Field Description

Ph.D. (Operations Research)

Doctoral students majoring in operations research concentrate in one of three areas:

Applied probability and statistics stresses the techniques and associated underlying theory of probability and statistics, particularly as applied to problems in science, finance, and engineering. The techniques emphasized are those associated with applied stochastic processes (for example, mathematical finance, queuing theory, traffic theory, and inventory theory) and statistics (including statistical decision theory, reliability theory, analysis of life data, and the statistical aspects of the design, analysis, and interpretation of experiments and of ranking and selection theory).

Manufacturing systems engineering is concerned with the analysis and design of complex manufacturing and distribution systems. Problems studied include the establishment of inventory-control policies in multistage production and distribution systems; design of manufacturing plants with optimal amounts of equipment and optimal materials-handling systems; planning and scheduling of production in large-scale, multi-item, multilocation systems; and economic analysis of engineering processes. Students use modern analytic and computer techniques in the design and analysis of such systems. Students are expected to understand the manufacturing processes associated with some type of industry. Research, which may involve development of new mathematical methodology, is often conducted directly with a cooperating company, for example, in automotive or semiconductor manufacturing.

Mathematical programming concentrates on optimization, including linear, nonlinear, integer, and combinatorial programming; network flows; problems of scheduling and sequencing; and discrete and computational geometry. Research ranges from the development and applications of computational algorithms (exact and approximate) to the associated studies of duality theory, convex and variational analysis, polyhedra, combinatorics, and graph theory.

Doctoral students also select two minor subjects for the Ph.D. degree, one of which must be outside the field. A minor may be in operations research or in a subject offered in another field, such as computer science, econometrics and economic statistics, environmental systems engineering, managerial economics, mathematics, or planning theory and systems analysis.

In addition to the examinations required by the Graduate School, the field requires a qualifying examination for Ph.D. degree candidates, normally taken in the third term of graduate study at Cornell.

For more information on the Ph.D. program, see the ORIE website (https://www.orie.cornell.edu/orie/programs/phd-program/).

M.Eng. (Operations Research and Information Engineering)

As a two- or three-semester professional degree program, the ORIE M.Eng. has become highly valued in the marketplace and continues to be an attractive option for well-prepared undergraduates in Operations Research, Industrial Engineering, Mathematics, Finance, and many other quantitative disciplines.

The main objectives of every MEng program at Cornell are to advance the breadth and depth of our students' technical knowledge and to provide students with opportunities to synthesize and apply this knowledge in a real-world environment. In ORIE, the technical tools of primary importance are mathematical modeling and the application of quantitative techniques instilled within the fields of optimization, probability, stochastic processes, statistics, and simulation. The areas of application for these tools are virtually limitless, but ORIE students generally apply their knowledge to the design, operation, and improvement of business systems.

The capstone component of the ORIE M.Eng. program is the team-based engineering design project, which all students complete with the guidance of a Cornell faculty advisor. The MEng project is fundamentally and purposefully different from traditional coursework and the process of completing an individual Masters' thesis. It is intended to prepare students for the professional arena by engaging them in client-sponsored project work with real data, deadlines, and deliverables. Regardless of their respective concentrations, students are expected to play major roles in all aspects of their projects, including formulating and analyzing the problem, managing the client relationship, monitoring the project timeline and milestones, and delivering the final results.

Six concentrations and one minor are currently associated with the MEng degree program in ORIE. Each is designed to meet certain educational objectives:

- Applied Operations Research Concentration (AOR)
- Data Analytics Concentration (DA)
- Financial Engineering Concentration (FE)
- Information Technology Concentration (IT)
- Manufacturing and Industrial Engineering Concentration (MIE)
- Strategic Operations Concentration (SO)
- Systems Engineering Minor

All of these concentrations and minors share a common set of base requirements, including a minimum number of course credit hours, core and distribution courses, and participation in an approved engineering design project. The specific courses that are required in order for a student to complete a particular concentration or minor may vary depending on his or her background.

Regardless of concentration, the ORIE M.Eng. program is designed to begin in the fall semester. For a variety of reasons, including the sequencing of offered courses and the timeline for project activities, completing the ORIE M.Eng. program in the traditional fall-spring or fall-spring-fall semester sequence is strongly encouraged. Although students are occasionally admitted to the ORIE M.Eng. program in the spring semester, spring admission is typically limited to applicants who are already at Cornell and have been able to participate in project start-up activities that take place during the fall semester.

Learn more about our Ithaca campus-based M.Eng. program (https://www.orie.cornell.edu/orie/programs/meng-degree-ithaca/) or the Cornell

Tech M.Eng. program (https://www.orie.cornell.edu/orie/programs/meng-degree-cornell-tech/) located in New York City.

Data and Statistics

Doctoral Program Statistics (https://gradschool.cornell.edu/about/program-metrics-assessments-and-outcomes/doctoral-program-statistics/?SelectGradField=35)

Field Manual

Manual (https://www.orie.cornell.edu/orie/programs/phd-program/degree-requirements/)

Subject and Degrees

Operations Research

- Operations Research (Ph.D.) (Ithaca) (https://catalog.cornell.edu/programs/operations-research-phd/)

Operations Research and Information Engineering

- Operations Research and Information Engineering (M.Eng.) (Cornell Tech (NYC)) (https://catalog.cornell.edu/programs/operations-research--information-engineering-nyor-meng/)
- Operations Research and Information Engineering (M.Eng.) (Ithaca) (https://gradschool.cornell.edu/academics/fields-of-study/subject/operations-research-and-information-engineering/operations-research-and-information-engineering-meng-ithaca/)

Concentrations by Subject

Operations Research

- applied probability and statistics
- manufacturing systems engineering
- mathematical programming

Operations Research and Information Engineering

- applied operations research
- data analytics
- financial engineering
- information technology
- manufacturing and industrial engineering
- strategic operations

Faculty

Jayadev Acharya (http://www.ece.cornell.edu/faculty-directory/jayadev-acharya/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: Information Theory, Machine Learning, Algorithmic Statistics.

Arielle Elissa Anderer (http://www.johnson.cornell.edu/faculty-research/faculty/aea68/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: Adaptive learning algorithms, healthcare operations, multi-armed bandits problems machine learning

Victoria Z. Averbukh (http://www.orie.cornell.edu/faculty-directory/victoria-averbukh/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: financial engineering
- **Research Interests**: financial engineering

Siddhartha Banerjee (http://www.engineering.cornell.edu/faculty-directory/sid-banerjee/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: Stochastic Modeling, Design of Scalable Algorithms, Matching Markets and Social Computing, Control of Information-Flows, Learning and Recommendation

Sumanta Basu (http://www.stat.cornell.edu/people/faculty/sumanta-basu/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: high-dimensional statistics, time series, graphical models, ensemble learning, nonlinear methods, genomics, and financial econometrics

David S. Bindel (http://www.cs.cornell.edu/~bindel/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: numerical methods applied to data science problems; Monte Carlo methods in transport; spectral methods in network science; scalable Gaussian processes and Bayesian optimization; simulation-based optimization of physical systems

Eilyan Bitar (http://bitar.engineering.cornell.edu/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming
- **Research Interests**: Modern power systems, control, optimization, and market mechanism design

James G. Booth (http://cals.cornell.edu/james-g-booth/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: statistics; biostatistics

Kathryn E. Caggiano (http://www.orie.cornell.edu/faculty-directory/kathryn-elizabeth-caggiano/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; data analytics; financial engineering; information technology; strategic operations
- **Research Interests**: operations research; information engineering

Jim Dai (http://www.orie.cornell.edu/faculty-directory/jim-dai/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; *Operations Research*: applied probability and statistics
- **Research Interests**: dynamic queueing control via Brownian or fluid approximations

Brenda Lynn Dietrich (http://www.orie.cornell.edu/faculty-directory/brenda-lynn-dietrich/)

- **Campus**: Ithaca - (Divisional Member)
- **Concentrations**: *Operations Research*: manufacturing systems engineering
- **Research Interests**: manufacturing schedule, services resource management, transportation logistics, integer programming, combinatorial duality

Moon Duchin (http://publicpolicy.cornell.edu/people/moon-duchin/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: Data science for civil rights, elections, computing and law, geometry and redistricting. Science, technology, and society, science policy, census data, privacy, computational social choice. Random walks and Markov chains, partition problems, networks, algorithmic fairness. Geometric group theory, counting and growth, nilpotent groups, dynamics of group actions. Geometric topology, hyperbolicity, metric geometry, Teichmüller theory.

Raaz Dwivedi (http://www.orie.cornell.edu/faculty-directory/raaz-dwivedi/)

- **Campus:** Cornell Tech (NYC)
- **Concentrations:** *Operations Research:* applied probability and statistics
- **Research Interests:** My research involves a multi-disciplinary approach to data science and brings together ideas from computer science, electrical engineering, and statistics in collaboration with domain experts. I develop statistical machine learning approaches for data-driven personalized decision-making with research across causal inference, reinforcement learning, and distribution compression, and work on several applications in healthcare and engineering systems.

Omar El Housni (http://tech.cornell.edu/people/omar-el-housni/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; strategic operations; *Operations Research*: mathematical programming
- **Research Interests:** Strategic Operations, Applied Operations Research

Peter Frazier (http://www.orie.cornell.edu/faculty-directory/peter-frazier/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; financial engineering; *Operations Research*: applied probability and statistics; manufacturing systems engineering
- **Research Interests**: statistical learning; stochastic optimization; ranking and selection; Bayesian statistics; sequential analysis

Kyra Gan (http://tech.cornell.edu/people/kyra-gan/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research*: applied probability and statistics; manufacturing systems engineering; mathematical programming
- **Research Interests**: applied probability and statistics, manufacturing systems engineering, mathematical programming.

Nikhil Garg (http://tech.cornell.edu/people/nikhil-garg/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: Application of algorithms, data science, and mechanism design

David Alan Goldberg (http://www.orie.cornell.edu/faculty-directory/david-alan-goldberg/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: Applied Probability and Stochastic Processes; Inventory Models, Queueing Theory; Distributionally Robust Optimization; Combinatorial Optimization; Multi-arm Bandit Problems

Ziv Goldfeld (http://www.ece.cornell.edu/faculty-directory/ziv-goldfeld/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: Optimal transport theory, information theory, mathematical statistics, and applied probability. He develops theoretical foundations and tools for designing inference/learning algorithms that are provably reliable, efficient, robust, scalable, and private.

Paul Leon Gölz (http://paulgoelz.de/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; manufacturing systems engineering; mathematical programming
- **Research Interests**: I am broadly interested in processes for group decision-making that serve the public good, including: Democratic Innovations: Citizens' assemblies (sortition), liquid democracy, apportionment, deliberation, participatory budgeting. Resource Allocation Problems: Refugee matching, fair division, kidney exchange. My work draws on a broad set of tools from theoretical computer science, optimization, and artificial intelligence.

Shane G. Henderson (http://www.orie.cornell.edu/faculty-directory/shane-g-henderson/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; *Operations Research*: applied probability and statistics; manufacturing systems engineering
- **Research Interests**: discrete-event simulation; simulation and optimization; applications in radiation oncology; emergency service planning

Robert Alan Jarrow (http://www.johnson.cornell.edu/faculty-and-research/faculty/raj15/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: mathematical finance; derivative securities; investment theory

Nathan Kallus (http://www.orie.cornell.edu/faculty-directory/nathan-kallus/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: robust optimization, stochastic optimization, machine learning

Robert D. Kleinberg (http://infosci.cornell.edu/content/kleinberg-0/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; mathematical programming
- **Research Interests**: mathematical programming; applied probability and statistics; algorithmic game theory; theoretical machine learning; discrete random structures and processes

Jon M Kleinberg (http://infosci.cornell.edu/content/kleinberg/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming
- **Research Interests**: algorithms that exploit the combinatorial structure of networks and information

Mark E. Lewis (http://www.orie.cornell.edu/faculty-directory/mark-e-lewis/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; *Operations Research*: applied probability and statistics
- **Research Interests**: Markov decision processes; queueing control; inventory control; stochastic processes; applied probability

Adrian Lewis (http://www.orie.cornell.edu/faculty-directory/adrian-s-lewis/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: financial engineering; *Operations Research*: mathematical programming
- **Research Interests**: variational analysis; non-smooth optimization; eigenvalue optimization

Andrea Lodi (http://tech.cornell.edu/people/andrea-lodi/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research*: mathematical programming
- **Research Interests**: Discrete Optimization, Integer Programming

David Matteson (http://www.stat.cornell.edu/~matteson/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: statistics

Jacob Paul Mays (http://www.cee.cornell.edu/faculty-directory/jacob-mays/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming
- **Research Interests**: Optimization, Energy Systems, Market Design

Andreea Minca (http://www.orie.cornell.edu/faculty-directory/andreea-c-minca/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; financial engineering; *Operations Research*: applied probability and statistics
- **Research Interests**: mathematical finance

Pierre Patie (http://www.orie.cornell.edu/faculty-directory/pierre-patie/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; financial engineering; *Operations Research*: applied probability and statistics
- **Research Interests**: Exit times for Markov processes, including Levy processes, self-similar and related Markov processes; Spectral theory of Feller semigroups; Financial and insurance mathematics

Jamol J. Pender (http://www.orie.cornell.edu/faculty-directory/jamol-j-pender/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; *Operations Research*: applied probability and statistics
- **Research Interests:** Non-stationary Queues, non-stationary Markov processes, orthogonal polynomials

Meng Qi (http://sha.cornell.edu/faculty-research/faculty/mq56/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; manufacturing systems engineering; mathematical programming
- **Research Interests**: Data-driven decision-making with uncertainty; Supply chain management; Machine learning; Stochastic optimization; robust optimization

James Renegar (http://www.orie.cornell.edu/faculty-directory/james-renegar/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; financial engineering; *Operations Research*: mathematical programming
- **Research Interests:** mathematical programming; interior point methods

David Ruppert (http://www.orie.cornell.edu/faculty-directory/david-ruppert/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; financial engineering; *Operations Research*: applied probability and statistics
- **Research Interests**: splines; semiparametric estimation; measurement error; environmental statistics; biomedical statistics

Samitha Samaranayake (http://cee.cornell.edu/samitha/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming

Gennady Samorodnitsky (http://www.orie.cornell.edu/faculty-directory/gennady-samorodnitsky/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; *Operations Research and Information Engineering*: financial engineering
- **Research Interests**: long-range dependence; applied probability; heavy tails; teletraffic modeling; financial modeling

Ziv Scully (http://www.orie.cornell.edu/faculty-directory/ziv-scully/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics; manufacturing systems engineering; mathematical programming
- **Research Interests**: My research spans four main themes: multiserver systems (§1), uncertainty (§2), overheads and constraints (§3), tail metrics (§4). As respective examples, my research provides the first queueing theoretic analyses of multiserver SRPT, the Gittins policy, scheduling under the constraints of network switch hardware, and a new scheduling policy that strictly improves upon FCFS's tail latency. Underlying these "firsts" are new frontiers in queueing theory (§5) that my collaborators and I have opened. In the future, I plan to study systems like machine learning training clusters and extend my theoretical insights to domains like reinforcement learning (§6).

Soroosh Shafieezadeh Abadeh (http://www.orie.cornell.edu/faculty-directory/soroosh-shafiee/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research:* applied probability and statistics; manufacturing systems engineering; mathematical programming
- **Research Interests**: optimization under uncertainty, with the aim of bridging the gap between optimization and statistical aspects in data-driven decision-making problems. CAM focus: Stochastic Methods, Optimization and Discrete Mathematics, and Algorithms and Complexity.

David B Shmoys (http://infosci.cornell.edu/content/shmoys/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; Operations Research: mathematical programming
- **Research Interests**: approximation algorithms; combinatorial optimization; stochastic optimization; logistics

Karthik Sridharan (http://www.cs.cornell.edu/~sridharan/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: machine learning, online learning, statistical learning theory, stochastic optimization

Eva Tardos (http://infosci.cornell.edu/content/tardos/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming
- **Research Interests**: combinatorial optimization; algorithmic game theory

Huseyin Topaloglu (http://www.orie.cornell.edu/faculty-directory/huseyin-topaloglu/)

- **Campus**: Cornell Tech (NYC)
- **Concentrations**: *Operations Research and Information Engineering*: applied operations research; manufacturing and industrial engineering; *Operations Research*: manufacturing systems engineering; mathematical programming
- **Research Interests**: dynamic fleet management; stochastic programming; approximage dynamic programming

Alexander B. Vladimirsky (http://math.cornell.edu/alexander-vladimirsky/)

- **Campus:** Ithaca
- **Concentrations:** *Operations Research:* applied probability and statistics; mathematical programming
- **Research Interests:** robustness and optimality in decision making under uncertainty; optimal control; differential and mean field games; applications in robotics, biology, traffic engineering, and resource management

Martin Timothy Wells (http://www.stat.cornell.edu/~wells/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: applied probability and statistics
- **Research Interests**: Bayesian statistics; combinatorics; decision theory; empirical finance

David Paul Williamson (http://infosci.cornell.edu/content/williamson/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming

- **Research Interests**: approximation algorithms; combinatorial optimization; information networks

Manxi Wu (http://www.orie.cornell.edu/faculty-directory/manxi-wu/)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: mathematical programming

Fengqi You (http://www.atkinson.cornell.edu/about/people/fellows/view.php?NetID=fy86)

- **Campus**: Ithaca
- **Concentrations**: *Operations Research*: manufacturing systems engineering
- **Research Interests**: process design, prices optimization, energy, systems engineering, sustainability engineering

Christina Lee Yu (http://www.orie.cornell.edu/faculty-directory/christina-lee-yu/)

- **Campus**: Ithaca
- **Concentrati**ons: *Operations Research*: applied probability and statistics
- **Research Interests**: machine learning

Ruihao Zhu (http://rzhu.github.io/)

- **Campus:** Ithaca
- **Concentrations:** *Operations Research:* applied probability and statistics; manufacturing systems engineering
- **Research Interests:** My research seeks to develop novel tools for data science, optimization, and sequential decision-making to address fundamental and practical challenges in revenue management, supply chain, fairness, and service operations