

OPERATIONS MANAGEMENT

Degree Types: PhD

The Operations Management doctoral program trains students to apply theoretical, data-driven or empirical analysis to advance our understanding of how work and processes are, or should be, organized and managed.

Thoughtful design and execution of operations is critical to the success of any enterprise. The Operations Management doctoral program equips students to evaluate both strategic issues of designing operations as well as tactical issues of executing processes. The faculty embraces a wide variety of research methods so students are capable of applying the tools that are most appropriate for the problem at hand.

The program aims to produce scholars who can be successful in both business and engineering schools. This is accomplished through both coursework and working closely with faculty on research projects.

The program is intentionally small so that students can work using an apprenticeship model with at least one, and often several, of our faculty, whom are *all* active in research.

Additional resources:

- Department website (<https://www.kellogg.northwestern.edu/faculty/academics/operations/>)
- Program handbook(s)

Degree Offered

- Operations Management PhD (<https://catalogs.northwestern.edu/tgs/operations-management/operations-management-phd/>)

Learning objective(s)/Students should be able to...

- Learning objectives are provided within the program guidelines.

Operation Management Courses

OPNS 510-0 Stochastic Calculus and Control (1 Unit)

Ito Calculus, HJB equations, SDEs and their applications to performance evaluation, dynamic control of manufacturing and service operations, and telecommunications systems, heavy traffic approximations.

OPNS 516-0 Stochastic Foundations (1-4 Units)

The first part of the course covers basic concepts in probability; the second part renewal and regenerative processes including Markov chains; and the last part Martingales and Brownian motion. Throughout, theoretic results are applied to the analysis of queues. Students are expected to have some background in probability (e.g., IEMS 202-0) and stochastic processes; no measure theory background is required.

OPNS 516-1 Stochastic Processes I (1 Unit)

The course prepares the student with an understanding of Stochastic Processes. This course covers the following topics: Poisson Processes, discrete-time Markov chains, and continuous time Markov chains. It applies these concepts to queuing systems. Students are expected to have some background in probability.

OPNS 521-0 Foundations of Operations Management (1 Unit)

This course will introduce PhD students to the basic models used in academic research of operations management. As such, we will survey a broad array of "research content" (basic models and approaches in the

literature) as well as discuss the "process of conducting research" (how to write a paper and deliver a talk).

OPNS 522-0 Queueing Networks: Models, Algorithms and Emerging Applications (1 Unit)

This course aims to expose students to advanced methods in stochastic analysis and develop a toolbox of probabilistic analytical techniques. To focus the discussion, the course will be centered around queueing networks, which serve as building blocks in many modeling applications. Topics covered include fundamental queueing models, fluid and diffusion processes, limit theorems and approximations, and stochastic control. To discuss the algorithmic/computational elements of stochastic control, we will touch on approximate dynamic programming and explore how it is used in the control of queueing networks.

OPNS 523-0 Estimation of Dynamic Programs (1 Unit)

This seminar will cover methods for estimating empirical dynamic discrete choice models. We will put the econometric theory to practice with weekly computer lab sessions and several rigorous programming assignments. We will study applications from the operations management area, including inventory control, supply chain coordination, service operations, and facility positioning.

OPNS 524-0 Empirical Methods in Operations Management (1 Unit)

This course examines: (1) how to critically read empirical studies, (2) how to ask questions that are interesting and worthwhile studying empirically, (3) what each method of causal inference (e.g. instrumental variables, panel data methods, regression discontinuity, etc.) does and why, when, and how to use each method, and (4) how an empirical researcher goes from an idea to a finished paper.

OPNS 525-0 Emerging Areas in Operations Managements (1 Unit)

This course studies novel, emerging topics and methods used in academic research of operations management. Content will depend on the expertise and interests of the instructor. Past content included statistical (machine) learning and sequential decision-making, such as bandit learning, balancing exploration/exploitation, and reinforcement learning, including methods for value function approximation and algorithms for efficient exploration.

OPNS 590-0 Research (3 Units)

Independent investigation of selected problems pertaining to thesis or dissertation. May be repeated for credit.

OPNS 599-0 Independent Study - PhD (1 Unit)