Industrial Engineering and Management Sciences
PhD Student Guide

Effective: Fall 2026 – Summer 2027

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Northwestern | McCORMICK SCHOOL OF ENGINEERING

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Introduction and Purpose

Dear PhD Students,

Welcome to the PhD program in Industrial Engineering and Management Sciences (IEMS) at Northwestern University. We are proud to be a consistently top-ranked graduate program, recognized for our rigorous academic standards, world-class faculty, innovative research, and impactful contributions to science and society.

Our program offers a strong foundation in optimization, statistical machine learning, and stochastic and risk analysis. You will also find a rich spectrum of applications—from healthcare, operations, and logistics to computational social science, artificial intelligence, and energy systems. This combination of theoretical depth and real-world relevance prepares our students to become leaders in academia, industry, and beyond.

We set high expectations and admit top students from around the world who are motivated to excel. At the same time, we value building a supportive and inclusive community. We offer a variety of social events and informal gatherings to foster connections among students, faculty, and staff—because we believe that meaningful engagement and collaboration are essential to a rewarding graduate experience.

This handbook outlines the rules, milestones, and expectations that will guide your journey toward your PhD. If you have questions or need support, please don't hesitate to reach out to your advisor, the Director of Graduate Studies, or me.

Wishing you a creative, productive, and fulfilling time in IEMS.

Warm regards,



Simge Küçükyavuz

Chair, David A. and Karen Richards Sachs Professor

Program Contacts

This section provides a general description of who has responsibility for curricular, admission, financial, and other matters in the program. The most up-to-date list of personnel can be found on the Industrial Engineering & Management Sciences website.

Director of Graduate Studies (DGS): Sean Sinclair (sean.sinclair@northwestern.edu). The DGS oversees the graduate program, advising students on academic matters and assisting with advisor selection and changes. The DGS also monitors academic progress and participates in decisions concerning academic probation and exclusion.

Department Chair: Simge Küçükyavuz (simge@northwestern.edu). The Department Chair is responsible for providing academic leadership, managing faculty affairs, overseeing curriculum and instruction, supporting student success along with the DGS, handling budgeting and resource allocation, coordinating departmental operations, and representing the department externally.

Graduate Program Coordinator: Charlotte Dezen (charlotte.dezen@northwestern.edu). This staff member aids with administrative aspects of the program, including procedures, paperwork for milestones, registration issues, and other day-to-day operations.

Financial Administrator / Assistant: Colleen Sweeney Walker, Financial Administrator (colleen.walker@northwestern.edu) and Jay Tucker, Financial Assistant (jay.tucker@northwestern.edu). These staff members oversee financial aspects such as stipends and tuition payments.

Learning Outcomes

Our mission is to provide an environment that promotes learning and stimulates intellectual and professional development. We aim at training PhD students to become independent researchers and leaders in their fields; leaders who understand the need for life-long learning. The focus is on providing opportunities for students to broaden their knowledge while deepening their skills for solving challenging problems that not only push the boundary of knowledge in their field but also benefit society. Students also gain writing and presentation skills that enable them to communicate their ideas to both experts and general audiences.

Students will learn how to:

- Identify and design a research problem,
- Use Operations Research (including statistical and machine learning) methodologies to analyze the problem,
- Assess the intellectual contribution and broader impact of their results,

- Lead a research project independently,
- Teach and communicate their knowledge effectively, and
- Enact ethical research methodologies and practice.

These objectives are achieved through a comprehensive PhD curriculum that includes both methodological and research-oriented coursework. In addition, students develop the skills necessary to become independent researchers through the candidacy examination, prospectus examination, dissertation defense, and close collaboration with their faculty advisors. Students also strengthen their teaching and communication skills by serving as teaching assistants and by collaborating closely with instructors and students in the classroom.

Program-Specific Academic Requirements & Policies

To receive the PhD in Industrial Engineering and Management Sciences, students must successfully complete all degree requirements as specified in the sections below, including the required coursework, candidacy, prospectus, and dissertation defense exams, teaching requirements of The Graduate School, and McCormick Responsible Conduct of Research (RCR) training. Please refer to the McCormick PhD Handbook for additional policies relating to PhD studies at Northwestern. Students must also complete all degree requirements within the IEMS Departmental timeline and submit all required forms prior to graduation. For details on the candidacy, prospectus, and dissertation defense exams, please see Program Specific Milestone Policies section.

Coursework Requirements

Core/Required Courses

To fulfill the course requirements, 15 one-credit courses must be taken for a letter grade (not taken P/NP) by the end of the fourth year.

Three Core Courses

- IEMS 401 Applied Mathematical Statistics
- IEMS 460-1 Stochastic Processes I
- IEMS 450-1 Mathematical Optimization I

Two Advanced Core Courses
Choose two of the following four advanced courses:

- IEMS 402 Statistical Learning
- IEMS 450-2 Mathematical Optimization II
- IEMS 460-2 Stochastic Processes II

- IEMS 435 Stochastic Simulation

Three Application Courses

- IEMS 488 Economics of Decision Analysis, and

Choose two additional courses from the following list:

- IEMS 441 Social Network Analysis
- IEMS 473 Financial Engineering
- IEMS 481 Logistics
- IEMS 482 Routing and Scheduling
- IEMS 485 Healthcare Engineering
- IEMS 486 Smart Grid
- IEMS 446 Computational Social Science
- IEMS 490 Humans, AI & Decision-Making
- IEMS 490 AI in Manufacturing: Data Analytics

Two Research Courses

- IEMS 499 Independent Study (taken in two quarters)

Due to the rigor and technical nature of the core and advanced core courses, students are strongly encouraged to take a proof-based mathematics course from the mathematics department. Appropriate courses include:

- MATH 300 Foundations of Higher Mathematics
- MATH 320 Real Analysis
- MATH 320-1 MENU: Real Analysis
- MATH 410 Graduate Analysis I

The appropriate course will be determined in consultation with the Director of Graduate Studies based on a placement assessment offered during Boot Camp prior to the start of the Fall quarter. The assessment evaluates each student's preparation and comfort with proof-based mathematical topics, including real analysis.

Elective Courses (Five Courses)

Students must complete five elective courses from the list of approved electives (see Appendix B). These courses can be chosen from different subject areas as shown below:

- Analytics

- Stochastic Analysis and Simulation
- Optimization
- Financial Engineering
- Logistics and Operations
- Healthcare Engineering
- Applied Statistics and Statistical Learning
- Management Science

Students must get approval from their advisors (or the Director of Graduate Studies) before registering for a course. See Elective Course Approval Form in Appendix A.

Students may petition the Director of Graduate Studies to add a course to the list of approved elective courses (see Appendix C). Petitions must be submitted before the student enrolls in the course. Upon receiving a petition, the IEMS Graduate Committee will review the request and determine whether to approve the course for inclusion on the list of approved electives or deny the petition.

Students enrolled in the PhD program prior to Summer Quarter 2025 are considered to operate under the earlier coursework requirements but retain the option to opt into the new system as desired. Please email the Graduate Program Coordinator if you wish to do so.

GPA Requirements

During their first year, students must maintain a Core GPA of 3.3 or higher in five courses: three core courses and two advanced core courses. If a student takes more than two advanced core courses during the first year, the two highest grades from those courses will be used to calculate the Core GPA. Failure to maintain a Core GPA of at least 3.3 by the end of Spring quarter of the first year will result in dismissal from the program.

Course Waiver Policy

Students may request a waiver of the course requirement for their PhD in IEMS if they can justify it with graduate-level coursework completed at another institution. Waiving a required course does not reduce the total number of courses required for the degree. If a core course is waived, a substitute course must be taken in its place. This substitution must be approved by the IEMS Graduate Committee. The substitute course must be in the same subject area. Interested students should submit the Required Course Waiver Request Form (Appendix D), along with supporting documentation of previous graduate-level coursework (such as transcripts, syllabi, course descriptions, and reading lists), to the Director of Graduate Studies immediately after entering the program.

Teaching Requirement

All PhD students in the IEMS PhD program are required to complete teaching assistant (TA) service equivalent to at least a 25% appointment for one academic quarter, after their first year and before the end of their fifth year. The requirement is normally fulfilled through service as a teaching assistant for an IEMS course. For details on IEMS expectations of teaching assistants, please review the IEMS department responsibilities and expectations for teaching assistants (Appendix E).

FERPA Online Training

The Family Educational Rights and Privacy Act (FERPA) defines student educational records and directory information, outlines students' rights, and governs who may access the information and under what circumstances. FERPA Training is required to be completed before working as a Teaching Assistant or Grader and can be completed here.

TA Assignment Process

Teaching assistant assignments are made each quarter based on the instructional needs of the department, considering the courses requiring TA support and, where applicable, faculty advisors' requests to have their PhD advisees serve as TAs for their courses. Every effort is made to align assignments with students' research interests; however, neither preferences nor alignment with research interests can be guaranteed. Past performance as a TA is also considered when making assignments, and students whose prior performance has not been satisfactory are not guaranteed a TA appointment. The IEMS PhD curriculum—with its three core and two advanced core course requirements—is designed to ensure that all students are well-versed in the major areas of operations research, so that *every student is prepared to serve as a TA for any undergraduate-level course in the department*.

Other Activities and Events

In addition to formal coursework, participation in other activities is an important part of graduate education.

Events/Activities

Seminars

The IEMS Department hosts ***a weekly research seminar***, and all PhD students are ***strongly encouraged*** to attend these seminars.

Brown-Bag Seminars

The ***brown-bag seminar series*** is designed primarily for first-year students in the IEMS PhD program. It provides an opportunity for students to meet IEMS faculty members and learn more about their research interests and current projects. This provides an opportunity to identify potential advisors and an orientation to the field of IEMS. Attendance is ***required*** for all first year IEMS PhD students, even in the case that the speaker is not a potential advisor for the student.

Professional Skills Development

INFORMS Student Chapter

Northwestern University has a student chapter of the nationally recognized INFORMS organization. The NU INFORMS Student Chapter is a student-run organization, serving Northwestern's IEMS students. The INFORMS Student Chapter provides opportunities for academic, professional, and personal development. The chapter organizes brown-bag seminars, career panels, and social events throughout the year and assists the Department in building a friendly environment.

See here for more information.

- **Graduate Student Research Mixer:** An opportunity for IEMS PhD students to present to their peers, in an informal setting, their current research to nurture collaboration between research groups.
- **Panels:** 3-4 panel events throughout the year that provide students with the opportunity to hear from IEMS Alumni, Industry Professionals, Academic Professors, and includes a Candidacy Panel for first years to ask general questions of IEMS second years and above about the Candidacy exam process.
- **Peer mentorship:** Incoming IEMS first-year students are partnered with a current IEMS student during their first quarter in the fall.
- **Chicago activities:** Organized tickets to Chicago Cubs games, Chicago Bulls games, and more.
- **Cultural Snack Hours:** Quarterly events where IEMS students can socialize and share snacks from around the world, recognizing different cultures across our diverse student body.
- **Game Nights:** Quarterly game nights organized for IEMS students to socialize over board games and pizza.

Internships

After passing their candidacy exam, students may work as interns with outside organizations. Interning students do not receive funding from IEMS but are supported by their internship instead. Internships are best done in the summer quarter. Students should consult with their advisors before making internship arrangements. Students can find internships on their own, get advice from their advisors or peers in the INFORMS chapter, or visit Engineering Career Development in McCormick or

Northwestern Career Advancement. Students must register for CRDV 510, the Crown Family Internship, when working as an intern.

Typical IEMS PhD Timeline

A typical timeline for completing the PhD program in IEMS is five years.

- **Year 1:** Students must complete a total of 12 courses during their first year. They also complete the Responsible Conduct of Research (RCR) training, and all international students must satisfy the University's English language proficiency requirement. At the end of the Spring Quarter, students take the candidacy examination. They are also expected to secure a faculty advisor by the end of their first Spring quarter. Based on their overall performance in the first year, the faculty evaluates each student and determines whether the student will continue in the PhD program.
- **Year 2:** Students complete the remaining coursework required for the PhD program and continue working with their faculty advisors on their dissertation research. During the second year, students form their Prospectus Examination Committee and begin preparing for the Prospectus Examination, which is typically taken during the second or third year.
- **Year 3:** Students complete any remaining course requirements and must successfully complete the Prospectus Examination by the end of their third year.
- **Years 4-5:** Students focus primarily on completing their dissertation research. The dissertation is typically completed and defended during the fourth or fifth year. The dissertation defense cannot occur any earlier than nine months after the successful completion of the Prospectus Examination unless otherwise approved by the DGS and the dissertation committee.

Program Specific Milestone Policies

YEAR 1

Completion of Core Courses

In their first year, all PhD students must take a total of 12 courses, consisting of 3 core courses, 2 advanced core courses, 2 research-based courses, and 5 other courses chosen from the lists of advanced core, application, or elective courses. Elective courses are relevant, graduate-level courses offered throughout the university. Students must choose electives from the approved list. Their advisor (or the Director of Graduate Studies) must approve the selection prior to the student registering for the course (see Appendices A and B).

The course work for the first year includes the following:

(i) Three Core Courses:

a. IEMS 401 Applied Mathematical Statistics
b. IEMS 450-1 Mathematical Optimization I
c. IEMS 460-1 Stochastic Processes I

(ii) **Two Advanced Core Courses:**

Two from the following four courses:

a. IEMS 402 Statistical Learning
b. IEMS 450-2 Mathematical Optimization II
c. IEMS 460-2 Stochastic Processes II
d. IEMS 435 Stochastic Simulation

- **Two Research Courses:**
  Students must complete two research-based courses, IEMS 499 Independent Study, in their first year. Only one IEMS 499 course may be taken per quarter. Students must first receive approval from the faculty member with whom they wish to take the course to register for these courses. At the end of each quarter, students must submit their reports to their advisors to receive a grade. Students must also send a copy of the report to the IEMS Graduate Program Coordinator and Director of Graduate Studies by the Thursday of exam week for the quarter in which they took IEMS 499.

(iii) **Five Other Courses:**

The remaining five courses may include a mathematical preparation course, as well as courses selected from the lists of advanced core courses, application courses, and approved elective courses (see Appendix B).

Advisor Selection

IEMS Policy requires that every student must have an advisor by the end of the first Spring quarter.

Beyond the end of the first year, every PhD student must have an advisor. If a student's advisor chooses to stop advising the student, the advisor should notify the Director of Graduate Studies (DGS). A PhD candidate should see the DGS for help if they have trouble finding an advisor, lose an advisor, or believe that their advisor is not doing enough to help the student achieve satisfactory academic progress. A PhD candidate who does not have an advisor will be placed on program probation for one quarter, during which they must secure an advisor. Once confirmed, the new advisor should notify the DGS of the new advising relationship. If the probation period elapses without having an advisor, a PhD candidate will be excluded (dismissed) from the program immediately.

Candidacy Exam and Continuation in the PhD Program

Candidacy consists of two components: (i) performance in core courses, and (ii) performance in the oral exam.

- **Performance in Core Courses:** During their first year, students must maintain a Core GPA of 3.3 or higher in five courses: three core courses and two advanced core courses. If a student takes more than two advanced core courses during the first year, the two highest grades from those courses will be used to calculate the Core GPA. Failure to maintain a Core GPA of at least 3.3 by the end of Spring quarter of the first year will result in dismissal from the program.

- **Performance in the Oral Exam:**
  The oral exam is offered in June of each year. Students must take the exam during the first offering after completing the five core and advanced core courses.

During the Spring quarter, each student is assigned a different research paper from a selection of papers provided by IEMS faculty. The student will then write a written report consisting of a critical review of the paper and a substantive extension. The extension is an essential component of the exam and should demonstrate the student's ability to formulate a new research question, identify the technical challenges, and propose an appropriate analytical or computational approach.

The oral exam is a two-hour exam administered individually by a committee of at least three IEMS faculty members selected by the department. Detailed guidelines regarding the written report, oral presentation, and evaluation criteria will be provided to students in advance of the exam by the Director of Graduate Studies. Note that an "IEMS faculty member" is defined as any graduate faculty member with at least 20% appointment in IEMS.

You achieve PhD candidacy upon passing the candidacy exam at the end of the first year.

Evaluation at the End of the First Year

After the oral exam, the IEMS faculty evaluates the overall performance of each student. This evaluation considers performance on both components of the candidacy exam, as well as the student's research potential evaluated through the two IEMS 499 course reports, among others. There are four possible outcomes of the evaluation after the candidacy exam:

- **Invitation to continue in the PhD program:** This is the normal outcome.

- **Invitation to continue in the PhD program, with conditions:** The student will be placed on probation and will be dismissed from the program unless specified conditions are met. The conditions are determined as warranted by the individual student's unique record. Possible conditions include earning adequate grades in additional courses, performing satisfactorily on another candidacy exam, finalizing an advising relationship with a faculty member, and completing English requirements.

- **Dismissal from the PhD program, eligible for MS degree:** The student is dismissed from the PhD program effective immediately. However, the performance on the candidacy exam was sufficient to grant an MS degree provided that the other requirements for the MS degree are satisfied (see page 18 for more information on MS Degree Conferral).

- **Dismissal from the PhD program, ineligible for MS degree:** The student is dismissed from the PhD program effective immediately and cannot receive the MS degree.

YEAR 2

Research Toward Dissertation

In their second year, students are expected to conduct research with their advisor that will lead toward a dissertation.

Prospectus Committee

Students are required to have a prospectus committee formed prior to their Prospectus exam but are encouraged to do so by the end of their second year. Students should seek guidance from all committee members and learn their expectations while research is in progress. A student's Prospectus committee is chaired or co-chaired by the student's advisor. Two or more additional committee members are chosen jointly by the student and the advisor. At least two committee members, including the chair or a co-chair, must be full or joint IEMS faculty. The committee must include at least one member whose primary affiliation is outside the IEMS department. Often, this member is also from outside the university.

YEAR 3

Prospectus by End of Spring Quarter

Students present a prospectus once they have finished an initial part of their dissertation research and can present their ideas about the next steps. This must happen by the end of the third year. Students who do not complete their Prospectus Examination by the end of their third year will be placed on academic probation by the IEMS department and given up to two additional quarters to complete the exam (unless otherwise specified by the student's advisor). Students who fail to complete the prospectus examination within this period will be dismissed from the PhD program.

The prospectus exam requires producing a research document, an oral presentation, and receiving approval by a prospectus committee selected jointly by the student and advisor. The research document must be submitted to all members of the prospectus committee at least two weeks before the prospectus exam. The exam should include at least one paper that the prospectus committee

determines is sufficiently complete (preferably already submitted for publication), as well as ideas for future research. The exam is open to all IEMS faculty and PhD students who wish to attend.

The student must complete **all** the following steps **at least two weeks before the prospectus exam**:

- Log into GSP and:
- Ensure that the Committee tab on GSP reflects all committee members for the Prospectus exam. The Graduate Program Coordinator will verify that the committee meets the relevant requirements; if not, the committee will need to be changed before the exam can take place.
- Fill out the Course Verification form, Prospectus IEMS form, and PhD Prospectus form, **in that order.**
- The purpose of the Course Verification form is to ensure that the student is on track to fulfill coursework requirements before graduation. Note that students may present the prospectus exam prior to finishing all coursework requirements. However, the student should have a plan to finish the courses by the end of their fourth year.
- Send the research document to all committee members.
- Notify all IEMS faculty and PhD students by email about the prospectus, including the title, abstract, committee members, time, date, and location of the exam. The exam is open to any of them who wish to attend.

Outcomes of Prospectus Exam: There are three possible outcomes when the prospectus exam takes place:

1. **Pass:** With the unanimous agreement of the committee members, the student has satisfied the prospectus exam requirement.
2. **Pass with conditions:** The committee members unanimously agree that the oral component of the prospectus exam was satisfactory. However, some or all of them require changes to the prospectus document before giving final approval. Once changes are made to the satisfaction of a committee member, they will notify the Graduate Program Coordinator that all requirements have been met. Once unanimous support has been achieved, the student has satisfied the prospectus exam requirement.
3. **Fail:** At least one committee member declines to endorse the passage of the exam on the grounds that the student's performance was unsatisfactory. The student must do another prospectus exam to satisfy the prospectus exam requirement.

The Graduate Program Coordinator will reach out to each of the committee members after the exam has been completed to assess the student's performance.

A student who did not pass the prospectus exam can schedule another prospectus exam, in consultation with the advisor. There is no penalty for failing a prospectus exam. There is only the requirement to pass the prospectus exam by the end of the third year. As mentioned above, if this is not done, the student will be placed on academic probation, which will result in eventual dismissal if the prospectus exam is not passed within the specified date. To leave time for changes to the

prospectus document or a second prospectus exam, the prospectus exam should be scheduled well before the end of the third year.

In case of failing the prospectus exam, if the student and advisor disagree with the judgment of a committee member, they can change the composition of the committee for the next prospectus exam. If the student disagrees with the advisor's judgment that the student failed the exam, and cannot resolve the situation through mutual discussion, the student should discuss the situation and a possible change of advisor with the DGS.

Electronic Participation and Approval: The prospectus exam must be in person, with all committee members physically present. If any committee member (particularly those who are not local to Evanston) cannot participate in person, the student must receive approval from the DGS to participate electronically.

YEAR 4 (and beyond)

Dissertation Defense

The dissertation is normally completed and defended during the fourth or fifth year. The dissertation defense must take place at least nine months after the prospectus exam, unless otherwise approved by the Director of Graduate Studies and the student's dissertation committee. The procedures and rules governing the dissertation defense are the same as those for the prospectus exam, where instead of the research document for the prospectus exam, there is the dissertation.

IEMS students who enter their sixth year without completing their degree will be required to meet with their advisor to develop a detailed plan and timeline for completing the dissertation. The plan must be submitted to the Director of Graduate Studies. Failure to meet the expectations and timeline specified in the plan may result in the student being placed on probation.

Steps to Complete Defense:

1. Log into GSP and submit the Application for Degree (AFD) form.
2. Work with your committee and Advisor to schedule a date for the defense.
3. Notify all IEMS faculty and PhD students by email about the defense two weeks prior to the exam, including the title, abstract, committee members, time, date, and location of the exam. The exam is open to any of them who wish to attend.

- Once the dissertation has been approved by the student's committee and all edits and revisions are complete, the student must submit an electronic version of the dissertation online via UMI/ProQuest. After uploading the dissertation, email the confirmation receipt to the Graduate Program Coordinator as proof this step is completed. See this page for information on formatting guidelines and copyright laws and regulations.

4. Log into GSP and submit the PhD Final Exam Form (PFE). The Graduate Program Coordinator can only approve the PFE once the dissertation has been completed, all faculty have approved the dissertation, and the thesis has been uploaded to ProQuest.

Annual Advisor Reviews (Year 2 and beyond)

In accordance with the McCormick PhD Handbook, satisfactory academic progress is assessed in two ways: completion of milestones by deadlines, and satisfactory research progress as evaluated by the student's advisor. The milestones of candidacy, prospectus, and defense exams were described above. The advisor's evaluation of research progress takes two forms: annual review and timely notification of unsatisfactory progress.

By the end of the week following finals each Spring Quarter, each student must complete an annual progress report in GSP. The advisor will review the report and provide written comments, and the Director of Graduate Studies will review both the report and the advisor's comments. Students whose research progress is determined to be unsatisfactory may be placed on academic probation for up to two quarters.

Students placed on probation must submit a written plan for improvement, developed in consultation with and signed by their advisor. The plan should identify the areas of concern, the steps the student will take to address them, and the timeline for demonstrating satisfactory progress. A student may be removed from probation by the Director of Graduate Studies, in consultation with the student's advisor, once satisfactory progress has been demonstrated. Failure to make satisfactory progress within the specified time may result in dismissal from the PhD program.

MS Degree Conferral

The requirements for the Master of Science in IEMS are: (i) Twelve credits of graduate coursework taken for a letter grade (not P/NP), including the five core and advanced courses; (ii) A GPA of at least 3.0; and (iii) Satisfactory performance on the candidacy exam. Any IEMS PhD student who satisfies these requirements is eligible to receive the MS degree, whether the student continues in the PhD program or leaves. If a student's overall performance is not sufficient to continue in the PhD program at the time of the candidacy exam, then the candidacy exam performance will be evaluated according to the standard criteria for awarding a master's degree.

An IEMS PhD student who has satisfied these requirements and wants to be awarded the MS degree must log into Graduate Student Progress (GSP) and fill out the Master's in Primary PhD form. Following

approval of this form, applicants will subsequently submit the Application for Degree and Master's Degree Completion forms via GSP. All three forms must be submitted to be awarded the degree.

You can find the Master's in Primary PhD form within GSP under the TGS Forms tab. This form is specifically used to request a master's degree along the way to the PhD in the same program. Completing this form is a necessary step before submitting other required forms for degree conferral, such as the Application for Degree and Master's Degree Completion forms, also submitted via GSP.

Program Resources/Support

Department Chair
Professor Simge Küçükyavuz

Director of Graduate Studies
Professor Sean Sinclair

Staff

Business Administrator
Chris Hardin
Budget Oversight; Staff Management; Planning and Analysis

Financial Administrator
Colleen Sweeney Walker
Payroll; Purchasing

Graduate Program Coordinator
Charlotte Dezen
Admissions and Recruitment; Graduate Student Support

Program Assistant
Nathan Keiller
Event Planning; Seminar Coordinator; Assistant to the Chair

Financial Assistant
Jay Tucker
Stipends; Tuition Payments

Graduate Faculty

Bruce Ankenman
Daniel Apley
Moses Chan
Minshuo Chen
Noshir Contractor
Julia Gaudio
Izzy Grosof
Seyed Iravani
Diego Klabjan
Simge Küçükyavuz
David Morton
Jorge Nocedal
Chang-Han Rhee
Naichen Shi
Sean Sinclair
Karen Smilowitz
Dashun Wang
Zhaoran Wang
Michael Watson
Ermin Wei

Sanjay Mehrotra
Janice Mejia
Mark Werwath
Jill Wilson
Zikai Xiong

Appendices

Appendix A
Elective Course Approval Form
(This form must be completed and submitted before the Prospectus exam)

Student Name: _____ ***Student ID:*** _____
Advisor(s) Name(s): _____ __

Entrance to PhD Program: Fall 20____ ***DATE:*** _____ /_____ /_____

During their first three years, PhD students must complete five elective courses from the list of approved electives (see Appendix B). These courses can be chosen from one or more of the following areas: Analytics, Stochastic Analysis and Simulation, Optimization, Financial Engineering, Logistics and Operations, Healthcare Engineering, Applied Statistics and Statistical Learning, and Management Science. Students must consult with their advisors and receive their approval before registering for a course. Students and their advisors must complete this form.

Title of Major (Optional)

Students must select five elective courses that align with their research. These courses may constitute a student's PhD major. Although optional, advisors and students are encouraged to choose a title for the major. The title may be one of the above areas (e.g., "Optimization"), a combination of these areas (e.g., "Operations Models of Healthcare Engineering"), or a title reflecting the theme of the five courses. Having a titled major on a student's resume provides a clearer picture of their education and expertise.

Major Title: _____

Five Courses of the Major:
List the courses you took or are planning to take to fulfill the elective (major) requirement. For each course, explain how it relates to your dissertation goals.

Full Course 1 Title:_____***Instructor:*** _____ _ ***Year (quarter) Taken:***_____ ***Grade:***___ __

Reason for taking the course:
.....

.....
.....

Full Course 2 Title:_____***Instructor:*** _____ _ ***Year (quarter) Taken:***_____ ***Grade:***___ ___

Reason for taking the course:
.....

.....
.....

Full Course 3 Title:_____***Instructor:*** _____ _ ***Year (quarter) Taken:***_____ ***Grade:***___ ___

Reason for taking the course:
.....

.....
.....

Full Course 4 Title:_____Instructor: _____ _ Year (quarter) Taken:_____ Grade:___ ___

Reason for taking the course:
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.....

Full Course 5 Title:_____Instructor: _____ _ Year (quarter) Taken:_____ Grade:____ __

Reason for taking the course:
.....

.....
.....

Student Signature:_____ Date:_____

Approval of the Advisor (Advisor must complete below):

I acknowledge that the student consulted with me before enrolling in these courses. These courses are beneficial to the student's dissertation and research. Thus, I approve these courses to satisfy the elective (major) requirement.

Advisor Signature: _____ Date:_____

Do not mark below – DGS use only

Date Presented to Director of Graduate Studies (DGS): _____

___ ___I approve the designed area as listed

_____ I approve the designed area with the following modifications (See below)

Modifications: _____
_____
_____
_____

Graduate Director Signature:_____ Date: _____

Do not mark below – Office use only

Date Processed:_____ Graduate Program Coordinator Signature_____

Appendix B
List of Approved Elective Courses

Five courses in the following areas can be chosen to fulfill the Major in the IEMS PhD course requirements

- *Analytics*
- *Stochastic Analysis and Simulation*
- *Optimization*
- *Financial Engineering*
- *Logistics and Operations*
- *Healthcare Engineering*
- *Applied Statistics and Statistical Learning*
- *Management Science*

Some courses may not appear here, even if they were approved to count towards an area in the past, if they have not been taught in recent years. They may appear in gray if future offerings are in doubt.

Analytics

Major should not include more than two courses from this area:

IEMS Department:

- *IEMS 455 Machine Learning*
- *IEMS 404-1 Predictive Analytics I*
- *IEMS 404-2 Predictive Analytics II*

Machine Learning and Data Science Program

- *MLDS 420 Predictive Analytics*
- *MLDS 421 Data Mining*
- *MLDS 490-23 Health Analytics and Decision Making*
- *MLDS 490-21 Predictive Models for Credit Risk Management*
- *MLDS 490-20 Text Analytics*
- *MLDS 490 Reinforcement Learning for Artificial Intelligence*

Electrical Engineering Department

- *ELEC_ENG 435 Neural Networks*

Computer Science Department

- *COMP_SCI 496: Advanced Topics in Deep Learning*

Applied Statistics & Statistical Learning

IEMS Department

- *IEMS 404-1 Predictive Analytics I*

- *IEMS 404-2 Predictive Analytics II*
- *IEMS 463 Statistical Analysis of Designed Experiments*
- *IEMS 465 Simulation Experiment Design and Analysis*
- *IEMS 490 Statistical Learning*
- *IEMS 490 Uncertainty Quantification*
- *IEMS 490 AI in Manufacturing: Data Analytics*
- *IEMS 490 Deep Generative AI*

Department of Economics

- *ECON 480-1,2,3 Introduction to Econometrics*
- *ECON 481-1,2,3 Econometrics*
- *ECON 482 Applied Econometrics: Time-Series Methods*
- *ECON 483 Applied Econometrics: Cross-Section Methods*

Electrical Engineering Department

- *ELEC_ENG 433 Statistical Pattern Recognition*

Computer Science Department

- *COMP_SCI 574 Probabilistic Graphical Models*

Kellogg Finance Department

- *FINC 520 Time Series Analysis*

Kellogg Managerial Economics and Strategy Department

- *MECS 577 Introduction to Applied Econometrics 2*
- *MECS 578 Introduction to Applied Econometrics 3*

Statistics Departments

- *STAT 325 Survey Sampling*
- *STAT 348 Applied Multivariate Analysis*
- *STAT 350 Regression Analysis*
- *STAT 351 Design and Analysis of Experiments*
- *STAT 352 Nonparametric Statistical Methods*
- *STAT 355 Analysis of Qualitative Data*
- *STAT 356 Hierarchical Linear Models*
- *STAT 359 (Topics) Data Mining*
- *STAT 420-1,2,3 Statistical Theory & Methodology*
- *STAT 448 Multivariate Statistical Methods*
- *STAT 450-1 Advanced Statistical Theory I*
- *STAT 453 Survival Analysis*
- *STAT 454 Time-Series Analysis*
- *STAT 455 Advanced Analysis of Qualitative Data*
- *STAT 457 Applied Bayesian Inference*

- *STAT 461 (Topics) Theory of Statistical Data Mining*
- *STAT 461 (Topics) Advanced Survey Sampling*
- *STAT 465 Statistical Methods for Bioinformatics and Computational Biology*

University of Chicago Statistics Department

- **University of Chicago: STAT 31150 Inverse Problems and Data Assimilation*

Financial Engineering

IEMS Department

- *IEMS 461 Advanced Stochastic Models*
- *IEMS 473 Financial Engineering*
- *IEMS 475 Simulation in Financial Engineering*

Electrical Engineering Department

- *ELEC_ENG 495 Game Theory and Networked Systems*

Kellogg Finance Department

- *FINC 585 Introduction to Financial Theory / 485-1 Asset Pricing I*
- *FINC 587 Dynamic Asset Pricing Theory / 485-2 Asset Pricing II*
- *FINC 588 Econometrics of Financial Markets*

Healthcare Engineering

IEMS Department

- *IEMS 443 Health Policy Modeling*
- *IEMS 444 Health Management Science*
- *IEMS 445 Decision and Risk Analysis*
- *IEMS 490 (Selected Topics) Humanitarian and Non-profit Logistics*
- *IEMS 441 Social Network Analysis*

Civil and Environmental Engineering Department

- *CEE 377-0: Choice Modeling in Engineering*

Machine Learning and Data Science Program

- *MLDS 490 (Selected Topics) Healthcare Analytics*

Statistics Department

- *STAT 453 Survival Analysis*
- *STAT 465 Statistical Methods for Bioinformatics and Computational Biology*

Masters in Public Health Department (Feinberg)

- *PUB HLTH 444 Advanced Decision Analysis*

Optimization

IEMS Department

- *IEMS 451 Stochastic Optimization*
- *IEMS 452 Combinatorial Optimization*
- *IEMS 453 Robust Optimization*
- *IEMS 454 Large-Scale Optimization*
- *IEMS 455 Machine Learning*
- *IEMS 457 Integer Programming*
- *IEMS 459 Convex Optimization*
- *IEMS 469 Advanced Algorithms for Machine Learning*
- *IEMS 490 (Selected Topics) Data-Driven Decisions Under Uncertainty*
- *IEMS 490 (Selected Topics) Machine Learning*
- *IEMS 490 (Selected Topics) Robust Optimization*
- *IEMS 490 (Selected Topics) Stochastic Optimization*
- *IEMS 490 (Selected Topics) Conic*

Computer Science Department

- *COMP_SCI 457 Advanced Algorithms*

Electrical Engineering Department

- *ELEC_ENG 495 Distributed Optimization*

Kellogg Managerial Economics and Strategy Department

- *MECS 560-1 Foundations of Managerial Economics I: Static Decision Models*
- *MECS 560-2 Dynamic Optimization*

Management Science

IEMS Department

- *IEMS 411 Field Research in Organizations*
- *IEMS 430 Systems Analysis*
- *IEMS 432 Systems Engineering*
- *IEMS 433 Theory and Practice of Evaluation*
- *IEMS 434 Systems Methodology*
- *IEMS 436 Engineering Project Management*
- *IEMS 441 Social Network Analysis*

- *IEMS 446 Computational Social Science*
- *IEMS 446 Game Theory and Networked Systems*

- *IEMS 490 Humans, AI & Decision-Making*

Civil and Environmental Engineering Department

- *CEE 482 Evaluation and Decision-Making for Infrastructure Systems*

Department of Economics

- *ECON 414-3 Economics of Information*

Kellogg Management and Organization Department

- *MORS 524-1 The Individual and the Organization*
- *MORS 524-2 Social Processes in Organizations*
- *MORS 525-1 Behavior in Organizational Systems*
- *MORS 525-2 Organizations in their Environments*
- *MORS 526-1 Micro-Organizational Research Methods*
- *MORS 526-2 Macro-Organizational Research Methods*
- *MORS 522 Economics, Social Psychology and their Experiments*

Media Science and Technology (Weinberg)

- *MTS 525 (Selected Topics) Peer Production: Collective Action & Organization*

Electrical Engineering Department

- *ELEC_ENG 495 Game Theory and Networked Systems*
- *EECS 472 Designing and Constructing Models with Multi-Agent Languages*

Logistics and Operations

IEMS Department

- *IEMS 482 Routing and Scheduling*
- *IEMS 489 Transportation Network Design and Operation*
- *IEMS 490 (Selected Topics) Humanitarian and Non-profit Logistics*
- *IEMS 490 (Selected Topics) Service Systems*

Civil and Environmental Engineering Department

- *CEE 471-1,2 Transportation Systems Analysis*
- *CEE 479 Transportation Systems Planning and Management*
- *CEE 480-1,2 Travel Demand Analysis and Forecasting*
- *CEE 482 Evaluation and Decision-Making for Infrastructure Systems*

Kellogg Operations Department

- *OPNS 521 Foundations of Operations Management*
- *OPNS 524 Empirical Models of Operations*

Electrical Engineering Department

- *ELEC_ENG 495 Game Theory and Networked Systems*

Stochastic Analysis & Simulation

IEMS Department

- *IEMS 451 Stochastic Optimization*
- *IEMS 461 Advanced Stochastic Models*
- *IEMS 464 Advanced Queueing Theory*
- *IEMS 465 Simulation Experiment Design and Analysis*
- *IEMS 468 Stochastic Control*
- *IEMS 469 Advanced Algorithms for Machine Learning*
- *IEMS 460-2 Stochastic Processes II*

Computer Science Department

- *COMP_SCI 496 Special Topics in CS: Expansion Phenomenon in Computer Science*

Department of Mathematics

- *MATH 450-1,2 Probability*
- *MATH 450-3 Stochastic Analysis III*
- *MATH 455-1,2 Stochastic Analysis*

Kellogg Operations Department

- *OPNS 522 Queueing Networks: Performance Analysis*

University of Chicago

- **University of Chicago Management Science and Operations Management: Queueing Models for Service Operations Management (40911) (Half Credit Course)*

Appendix C
Petition to Add a Course to the List of Approved Electives

Instructions: *To petition for a course to be added to the list of approved elective courses, students must follow these steps:*

- *Contact their advisor(s) to obtain approval that the course is a graduate (PhD-level) course.*
- *Then, complete and submit the form below to the Director of Graduate Studies at least three weeks before the course begins.*

Course Number and Name: .....
Department offering the course: .....
Quarter/Year being offered: .....

Student *(this part must be completed by the student):*
Title of your Major (optional): .....

Explain how this course relates to your dissertation (research): .....
.....
.....

Advisor *(This part must be completed by the advisor):*
Does this course have significant content at the level of a graduate (PhD) course? Please explain.
.....
.....
.....

What are the contents that are beneficial to the student's dissertation, research progress, and the theme of student's Major?
.....
.....
.....
.....
.....
Which of the following research areas does this course relate to (Analytics; Stochastic Analysis and Simulation; Optimization; Financial Engineering; Logistics and Operations; Healthcare Engineering; Applied Statistics and Statistical Learning; Management Science). If the course is related to two or more areas, please specify.
.....

Student's Name and Signature: ..... *Date:* .....

Advisor's Name and Signature: ..... *Date:* .....

Appendix D
Required Course Waiver Request Form

Instructions: Use this form to request a waiver of the requirement that a course be taken for the M.S. or Ph.D. in IEMS, justified by graduate-level coursework previously done at another institution. Submit this form along with documentation of your previous graduate-level coursework, such as transcript, syllabi, course descriptions, and reading lists.

Policies:

- *A waiver of a required course does not reduce the total number of courses required for the degree.*
- *If a core course is waived, you must take another course as a substitute for the waived core course. The substitution is subject to the approval of the Director of Graduate Studies. The substitute course must be in the same subject area and at least as valuable in assessing first year student achievement.*

IEMS course requirement to waive: _____
Substitute course (if applicable): _____

Previous graduate-level coursework:

University	*Department*	*Course #*	*Course Name*	*Grade*

I request a waiver of the requirement to take the IEMS course listed above. If it is a core course, I understand that I am required to complete the approved substitute course during my first year.

Student Name: _____

Student Signature: _____ *Date:* _____

I approve the waiver request and, if applicable, course substitution.

Director of Graduate Studies Signature: _____ *Date:* _____

Appendix E
IEMS Expectations for Teaching Assistantships

In November 2013, The Graduate School endorsed guidelines for expectations regarding teaching assistantships: https://www.tgs.northwestern.edu/funding/assistantships/graduate-and-teaching/

This document outlines the IEMS Department's policy on teaching assistantships within the department. It reiterates some of the TGS guidelines, modifies or clarifies them, and adds further guidelines.

Instructors and TAs should work together as a team to support student learning in their course. If one of them fails to meet the expectations set forth in this document, they should have a civil and candid discussion about how to do so. If they cannot reach an agreement or if problems persist, the IEMS Director of Graduate Studies should be notified (if the TA is an IEMS Ph.D. student).

The department encourages TAs to participate in departmental and university programs that enhance pedagogical knowledge and proficiency. This includes departmental TA training and resources that support students' work as TAs and their development as teachers at the Searle Center for Advancing Learning & Teaching (University-wide) https://searle.northwestern.edu/

Responsibilities of Teaching Assistants

Responsibilities and duties will be set forth in students' teaching assistantship appointment letter. Additionally, teaching assistants will be asked to meet regularly with the course instructor to request feedback and seek opportunities to continually develop pedagogical proficiencies.

Being Well-Informed

Course Material

Become proficient in the course content and methodologies, using appropriate pedagogical methods. Familiarize yourself with all the material students are expected to learn, including case studies (if applicable), so you can answer their questions. If you are not already familiar with the course content, you may be required to attend lectures. Review all assignments before distributing them to students so that you are prepared to answer their questions.

Procedures

Become familiar with university and college or school policies, requirements, and deadlines pertaining to topics such as academic integrity, safety protocols, and maintaining a diverse and respectful classroom environment, as well as the registrar's procedures and deadlines. The academic integrity procedures applicable to undergraduate engineering courses can be found at: https://www.mccormick.northwestern.edu/students/academic-integrity.html
If you suspect a violation of academic integrity, alert the instructor immediately.

Helping Students

Office Hours

Hold regular, scheduled office hours. In consultation with the instructor, choose the times of your office hours and publicize them to the class. The TA room (C236) is the usual location, but larger rooms can be reserved if needed because many students may attend office hours at once. If you need to cancel office hours, notify the instructor and students promptly and discuss scheduling makeup office hours.

Other Contact

Students may request meetings with you outside of office hours or ask questions via email. Try to accommodate these requests as long as they do not result in an excessive workload or interfere with your other academic commitments. Encourage students to use office hours to ask questions, bearing in mind that some students may be unable to attend. TAs are expected to respond to student emails within one business day.

Tutoring

No TA may be paid to tutor any undergraduate student in the work of a class taught by that same TA.

Feedback and Evaluation

At the end of each quarter, TA performance is evaluated in two ways: (i) CTEC and (ii) instructor evaluation.

Course and Teacher Evaluation Council (CTEC)

Students evaluate the TA's performance in their class through the Course and Teacher Evaluation Council (CTEC). Some of the CTEC evaluation questions are:

- *Was the TA able to answer your questions?*
- *Was the TA well prepared for each session?*
- *Did the TA communicate ideas clearly?*
- *Did the TA show a strong interest in teaching the course?*
- *Open-ended question: What are the primary strengths and weaknesses of the TA?*

Instructor Evaluation

Instructors are asked to evaluate their TA's performance by completing a survey from the IEMS department. Some of the survey questions are:

- *Did the TA respond promptly to emails and other communications?*
- *Were the supplemental materials the TA produced of high quality and accuracy?*
- *Did the TA communicate with you in a respectful and professional manner?*
- *Did the TA work quickly and efficiently to complete assigned tasks?*
- *Would you recommend this TA to other instructors? Why or why not?*

Feedback and Corresponding Actions

At the end of each quarter, the IEMS department evaluates the performance of all TAs and identifies three groups:

- ***Satisfactory Performance:*** *These include TAs who performed their duties well. The students with the best performance will be nominated to receive the Best TA Award from the IEMS Department. Also, when teaching opportunities become available, TAs in this group will be given priority to teaching the course.*
- ***Below Average Performance:*** *This includes TAs who did not perform at the expected level in some of their duties. The Director of Graduate Studies will meet with these students to provide feedback on their performance.*
- ***Poor Performance:*** *This includes TAs who had serious issues performing their duties. These students will receive a warning in an official letter from the IEMS department. Students in this group are asked to: (i) Meet with the DGS to receive feedback about their poor performance. (ii) Develop a plan explaining how they will improve their TA duties and submit it to the DGS. These students will have one more chance to be a TA and must demonstrate significant improvement in their performance. Failure to do so may result in the suspension of the student's financial support through the TA position.*

Appendix F

IEMS PhD Student Conference Attendance Approval

*If you are an IEMS PhD student and wish to travel to an IEMS recognized conference during your PhD career in the department you are allowed to utilize your **IEMS PhD Travel Fund**. These funds are to be used after your TGS grants have been exhausted or used in lieu of your TGS travel grant if you are not presenting at a conference. All funding is given out at the department's discretion.*

To begin, complete this form in its entirety and return to the Graduate Coordinator.

Conference Name:
Conference Location:
Conference Date:
Why are you going to the conference?

Breakdown of Funds:

Airfare	*$*
Hotel	*$*
Conference Registration Fee	*$*
Estimate of Food Costs	*$*
Ground Transportation (Taxi, Uber, Rail, etc.)	*$*
Other	*$*
Total:	*$*
Student Name:	*Student Signature:*
Student ID:	*Request Date:*
Advisor Name:	*Advisor Signature:*

Graduate Coordinator Signature:	*Date Submitted to Graduate Coordinator:*
Financial Administrator Signature:	*Date Approved:*
	Approved Amount:

Appendix G
*Course Verification Form**

PhD students who entered the program in Fall 2024 or prior to Fall 2024 may use either this Course Verification Form or the form attached in Appendix H

This must be completed and signed at the time of your prospectus exam to verify you are successfully progressing towards degree completion. Any courses that have not been completed must be finished by the end of the fourth year of enrollment in the program.

Student Name:		Starting Date:	

Please return this form to the Graduate Program Coordinator at the time of your prospectus exam.

Category	Course	Title	Quarter Taken	Professor	Grade	Anticipated Enrollment Quarter (if not yet taken)
Core	*IEMS 401*	*Applied Mathematical Statistics*				
	IEMS 402	*Statistical Learning*				
	IEMS 450-1	*Mathematical Optimization I*				
	IEMS 450-2	*Mathematical Optimization II*				
	IEMS 460-1	*Stochastic Processes I*				
	IEMS 460-2	*Stochastic Processes II*				
	IEMS 435	*Stochastic Simulation*				
	IEMS 488	*Economics of Decision Analysis*				
Application Courses	*Applied Course 1*					
	Applied Course 2					
Major:						
Course 1						
Course 2						
Course 3						
Minor:						
Course 1						
Course 2						

	Date Taken	

Candidacy Exam			
Prospectus Title: ***(Proposal)***			***RESULT*** ***(Pass / Fail)***
Committee Members	*Chair:*		
	Committee Member 1:		
	Committee Member 2:		
	Committee Member 3:		

Student Signature: *Date:*_____

Advisor Signature: *Date:*_____

TGS TA Requirement	***Course***	***Course Professor***	***Quarter/Year***	***Results***

Department Signature: *Date:*_____

Appendix H
*Course Verification Form**

PhD students who entered the program in Fall 2025 or after must use this form.

This must be completed and signed at the time of your prospectus exam.
Please return this form to the Graduate Coordinator at the time of your prospectus exam.

Student Name:		Starting Date:	

Course	Title	Quarter Taken	Professor	Grade	Anticipated Enrollment Quarter (if not yet taken)
Core Courses *You must take all three core courses listed below:*					
IEMS 401	*Applied Mathematical Statistics*				
IEMS 450-1	*Mathematical Optimization I*				
IEMS 460-1	*Stochastic Processes I*				
Advanced Core Courses *You must take two courses among the following: IEMS 402: Statistical Learning, IEMS 450-2: Mathematical Optimization II, IEMS 460-2: Stochastic Processes II, and IEMS 435: Stochastic Simulation*					
Research Courses: *You must only take two IEMS 499: Independent Study in two quarters of the first year. Do not take three IEMS 499.*					
IEMS 499	*Independent Study*				
IEMS 499	*Independent Study*				
Application Courses: *You must take three courses from the list of application courses, along with IEMS 488 (as your third course).*					
IEMS 488	*Economics of Decision Analysis*				
Applied 1					
Applied 2					
Elective Courses: *You must take five elective courses from the list of Approved Elective courses. Advanced Core Courses can also be used as electives if they are not used to satisfy the two-course requirement for Advanced Core Courses above.*					

Exam	***Date***		***Result*** ***(Pass / Fail)***
Candidacy Exam			
Prospectus ***(Proposal)***		*Title:*	
Committee ***Members***	*Co-Chair:*		
	Committee Member 1:		
	Committee Member 2:		
	Committee Member 3:		

TGS TA Requirement	***Course***	***Course Professor***	***Quarter/Year***	***Results***

Student Signature: *Date:*_____

Advisor Signature: *Date:*_____

Department Signature: *Date:*_____