MICHIGAN STATE UNIVERSITY

Department of Mathematics

Master of Science in Industrial Mathematics Student Handbook

October 31, 2024

This This handbook provides information on how to apply to and meet the degree requirements for the Master of Science in Industrial Mathematics (also known as the Professional Science Master's (PSM) in Industrial Mathematics) program in the Department of Mathematics at Michigan State University. More general information for graduate students is available in the Graduate Student Handbook (online) from the Office of Graduate Studies in the department, as well as other university documents and online resources. If you have questions not addressed here about the MSIM program, please contact the program director, Dr. Peiru Wu, at peiruwu@msu.edu or msim@math.msu.edu.

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I Program Overview

The goal of Master of Science in Industrial Mathematics (MSIM) program is to produce generalized problem solvers of great versatility, capable of moving within an organization from task to task. The program has been successfully training data analysts/data scientists, mathematicians, and problem solvers for leadership in industry for half a century (1999–present) because

- The graduates will have studied standard mathematical and statistical tools, as well as computer science principles, to strengthen data analytics, including data mining and machine learning.
- They will have gained project experience by solving real-world problems proposed by local companies, including applications of data mining, machine learning, and some AI-driven methods, and they will have received training in technical writing for project reports.

PSM in Industrial Mathematics Program

The MSIM program has flourished since its inception in the late 1990s as one of the first Professional Science Master's (PSM) Programs, gaining PSM affiliation in 1998. Supported initially by the Alfred P. Sloan Foundation, the program has earned national recognition as one of the earliest and established Professional Science Master's. As a STEM program, MSIM provides student rigorous training in applied mathematics and data science, with advanced quantitative skills highly valued across industries. PSM programs bridge academic theory with workplace skills, integrating mathematical modeling, computational techniques, and statistical methods (https://www.professionalsciencemasters.org). The MSIM program's major success includes long-standing industrial partnerships, strong ties with local companies, and an exceptional graduate placement rate, supported by an industrial advisory board since 1999, consisting of representatives from renowned companies.

Program Components

The degree requires 30 credits of coursework, completion of a Certificate Course in Project Management, and a successful portfolio defense, as outlined below.

(1) Industrial Mathematical Core Courses (6 credits, MTH 843 (Fall), MTH 844 (Spring))
(2) Elective and Cognate Courses (24 credits, MTH, STT, CSE/CMSE etc.)
(3) Certificate Course in Project Management (PHM 857, "not-for-credit" option, summer only)
(4) Portfolio Defense (last semester)

II Admission Requirements

To be admitted to the program, applicants should have completed (1) mathematics or applied mathematics courses typically required for a bachelor's degree with a major in mathematics, statistics, economics, physics, or engineering, (2) senior-level courses in analysis, linear algebra, and differential equations (*e.g.*, MTH 421, 414, and 442), and (3) have some familiarity with programming languages like MATLAB, Python, and exposure to statistical software or tools.

Applications will be reviewed based on (1) academic records demonstrating a strong foundation for success in the program, (2) professional goals aligned with the program's coursework and training, as shown in personal and academic statements highlighting commitment and potential contributions, and (3) recommendation letters indicating the likelihood of meeting program requirements and completing the MSIM degree.

How to Apply

A complete application to the MSIM program includes the following:

1. MSU Graduate Application at https://admissions.msu.edu/apply/graduate-students .
2. A current CV/Resume, Academic Statement and Personal Statement must be included with the application.
3. Three letters of recommendation are required.
4. Within the application you will select **Industrial Mathematics** as your intended major and you will be asked for supplemental questions. Within these questions should contain the Math and Statistics Classes you have (or will have) taken at the Junior, Senior, or Graduate level.
5. Official transcripts of all college work (undergraduate and graduate), including diplomas and certificate are also required. These are to be sent to our department directly from the school(s) which you attended.

   The mailing address is as follows:

   Graduate Office
   Department of Mathematics
   619 Red Cedar Rd. Room C213
   Michigan State University
   East Lansing, MI 48824

   There is no need to send more than one set of transcripts. We will forward the original transcript to the Office of Admissions.

6. GRE General Scores are required for admission.
7. TOEFL Scores (International Students Only) - Applicants for whom English is not their primary language are required to submit TOEFL (Test of English as a Foreign Language) or IELTS (International English Language Testing System) scores. TOEFL scores must meet the University minimum requirements: no sub-score below 19 for reading, listening, and speaking; no writing sub-score below 22; with a minimum total score of 80. For more details see: grad.msu.edu/sites/default/files/content/apply/ENGLISH LANGUAGE PROFICIENCY.pdf
8. Financial Affidavit and Proof of Financial Support for International Students applying for MSIM degree (See more information regarding the Financial Proof at https://grad.msu.edu/internationalapplicants

Applications are accepted for Fall Semester only. We do not accept applications for Spring or Summer semesters.

You can check your application status through the **Application Portal**.

For any questions regarding the Master of Science in Industrial Mathematics (MSIM) program, please email msim@math.msu.edu.

III Program Curriculum

In addition to meeting the requirements of the University and the College of Natural Science, MSIM students must complete a total of 30 credits of graduate coursework (including core, elective, and cognate courses), the Certificate Course in Project Management, and successfully defend their MSIM portfolio of completed projects.

Core Courses (6 credits)
MTH 843 Survey of Industrial Mathematics (Fall)
MTH 844 Projects in Industrial Mathematics (Spring)

Elective and Cognate Courses (24 credits)
A minimum of two of the following courses:

MTH	810	Error-Correcting Codes
MTH	841	Boundary Value Problems I
MTH	842	Boundary Value Problems II
MTH	847	Partial Differential Equations I
MTH	849	Partial Differential Equations II
MTH	850	Numerical Analysis I
MTH	852	Numerical Methods for ODE
MTH	880	Combinatories
MTH	881	Graph Theory

A minimum of two of the following courses:

STT	801	Design of Experiments
STT	802	Statistical Computation
STT	843	Multivariate Analysis
STT	844	Time Series Analysis
STT	847	Analysis of Survival Data
STT	861	Theory of Probability and Statistics I
STT	862	Theory of Probability and Statistics II
STT	863	Applied Statistics Methods I
STT	864	Applied Statistics Methods II
STT	866	Spatial Data Analysis
STT	875	R Programming for Data Sciences
STT	886	Stochastic Processes and Applications
STT	888	Stochastic Models in Finance

A minimum of two of the following courses:

CMSE	801	Introduction to Computational Modeling
CMSE	802	Methods in Computational Modeling
CMSE	820	Mathematical Foundations of Data Science
CMSE	821	Numerical Methods for Differential Equations
CMSE	822	Parallel Computing
CMSE	823	Numerical Linear Algebra
CSE	802	Pattern Recognition and Analysis

CSE	803	Computer Vision
CSE	830	Design and Theory of Algorithms
CSE	835	Algorithmic Graph Theory
CSE	836	Probabilistic Models and Algorithms in Computational Biology
CSE	841	Artificial Intelligence
CSE	847	Machine Learning
CSE	860	Foundations of Computing
CSE	872	Advanced Computer Graphics
CSE	880	Advanced Database Systems
CSE	881	Data Mining
CSE	885	Artificial Neural Networks
EC	811A	Mathematical Applications in Economics
EC	811B	The Structure of Economic Analysis
EC	812A	Microeconomics I
EC	812B	Microeconomics II
EC	813A	Macroeconomics I
EC	813B	Macroeconomics II and its Mathematical Foundations
EC	820A	Econometrics IA
EC	820B	Econometrics IB
EC	821A	Cross Section and Panel Data Econometrics I
EC	821B	Cross Section and Panel Data Econometrics II
EC	822A	Time Series Econometrics I
EC	822B	Time Series Econometrics II
ECE	848	Evolutionary Computation
ECE	849	Digital Image Processing
ECE	863	Analysis of Stochastic Systems
ME	830	Fluid Mechanics I
ME	840	Computational Fluid Dynamics and Heat Transfer
ME	872	Finite Element Method
MKT	805	Marketing Management
MKT	806	Marketing Research for Decision Making
MKT	816	Marketing Analysis
MKT	819	Advanced Marketing Research
MKT	864	Data Mining in Marketing
SCM	800	Supply Chain Management
SCM	815	Emerging Topics in Supply Management
SCM	826	Manufacturing Design and Analysis
SCM	833	Decision Support Models
SCM	843	Sustainable Supply Chain Management
SCM	853	Operations Strategy
SCM	854	Integrated Logistics Systems

You can learn more about the course descriptions on The Office of the Registrar website at https://reg.msu.edu/Courses/Search.aspx.

You will discuss with the academic advisor (program director) about your course planning prior to fall semester. See Section IV, "Other Information," for examples of course planning.

Certificate Course in Project Management (only offer in summer)

This program requires completion of the course PHM 857 Project Management, which covers topics such as formal project management culture, principles, knowledge areas, and terminology. Typically undertaken during the first year of enrollment as a "not-for-credit" option, certification also involves participation in Industrial Mathematics-specific discussion sessions. Upon approval by the course instructors, the Industrial Mathematics Program, and the Associate Dean of the College of Natural Science, the Office of the Registrar will record the certificate on the student's academic record along with the term in which it was completed.

Portfolio Defense

It requires defending a portfolio of major work to fulfill the requirements of the MSIM program in the last semester. This includes at least three project reports written as part of MTH 843 and the industrial project report(s) done as your participation in MTH 844 project team(s) plus possible projects done under other course during your study in the program. The defense is about 1.5 hours oral examination conducted by three MSU faculty members. The students are expected to be thoroughly conversant with their entire portfolio and so are expected to do the following from memory with little, if any, reference to the individual reports.

IV Other Information

Examples of Course Planning

The following course plans have been completed by MSIM graduates in the past to fulfill the 36-credit MSIM course requirements (*i.e.*, Core (2), MTH (4), STT (2), Cognate (4), totaling 12 courses in general), along with the successful completion of the Certificate Course (PHM 857) and the portfolio defense.

	Student A			Student B		
Semester	Course Code	Course Title	Credits	Course Code	Course Title	Credits
Fall	MTH 843	Survey of Industrial Mathematics	Core	MTH 843	Survey of Industrial Mathematics	Core
	MTH 841	Boundary Value Problems I	MTH	MTH 850	Numerical Analysis I	MTH
	STT 861	Theory of Probability and Statistics I	STT	CSE 872	Theory of Probability and Statistics I	Cognate
Spring	MTH 844	Projects in Industrial Mathematics	Core	MTH 844	Projects in Industrial Mathematics	Core
	MTH 842	Boundary Value Problems II	MTH	MTH 851	Numerical Analysis II	MTH
	MKT 806	Marketing Research for Decision Making	Cognate	STT 843	Multivariate Analysis	STT
Summer	PHM 857	Project Management	Certificate	PHM 857	Project Management	Certificate
Fall	MTH 850	Numerical Analysis I	MTH	MTH 841	Boundary Value Problems I	MTH
	STT 863	Applied Statistics Methods I	STT	STT 801	Design of Experiments	STT
	CSE 881	Data Mining	Cognate	CSE 881	Data Mining	Cognate
Spring	MTH 851	Numerical Analysis II	MTH	MTH 810	Error-Correcting Codes	MTH
	CSE 802	Pattern Recognition and Analysis	Cognate	CSE 830	Design and Theory of Algorithms	Cognate
	CSE 830	Design and Theory of Algorithms	Cognate	MTH 890	Readings in Mathematics (Projects in Industrial Mathematics)	Cognate
	MTH 890	Readings in Mathematics (Projects in Industrial Mathematics)	Cognate			

	Student C			Student D		
Semester	Course Code	Course Title	Credits	Course Code	Course Title	Credits
Fall	MTH 843	Survey of Industrial Mathematics	Core	MTH 843	Survey of Industrial Mathematics	Core
	MTH 850	Numerical Analysis I	MTH	MTH 850	Numerical Analysis I	MTH
	MKT 805	Marketing Management	Cognate	EC 820A	Econometrics IA	Cognate
Spring	MTH 844	Projects in Industrial Mathematics	Core	MTH 844	Projects in Industrial Mathematics	Core
	MTH 810	Error-Correcting Codes	MTH	STT 844	Time Series Analysis	STT
	STT 844	Time Series Analysis	STT	EC 820B	Econometrics IB	Cognate
Summer	PHM 857	Project Management	Certificate	PHM 857	Project Management	Certificate
Fall	MTH 841	Boundary Value Problems I	MTH	MTH 841	Boundary Value Problems I	MTH
	STT 861	Theory of Probability and Statistics I	STT	EC 821A	Cross Section and Panel Data Ecnometrics I	Cognate
	CSE 881	Data Mining	Cognate	CSE 881	Data Mining	Cognate
Spring	MTH 842	Boundary Value Problems II	MTH	MTH 842	Boundary Value Problems II	MTH
	CSE 885	Artificial Neural Networks	Cognate	MTH 852	Numerical Methods for ODE	MTH
	MTH 890	Readings in Mathematics (Projects in Industrial Mathematics)	Cognate	STT 864	Applied Statistical Methods II	STT

Annual Progress Review Form for PSM Students

PERFORMANCE EXPECTATIONS FOR THE STUDENTS IN PSM IN INDUSTRIAL MATHEMATICS AT MICHIGAN STATE UNIVERSITY

Student (Print)_____ **Semester** _____

Student (Signature*)_____ **Date** _____
* Signature acknowledges review; it does not imply that student agrees with all comments.

Advisor (Signature) _____ **Date** _____

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1. PROFESSIONAL CRITERIA:

a) Professional Deportment – In advance of each semester, the student will provide to his/her advisor a formal memo outlining semester courses and goals. Each student is expected to prepare for and attend job fairs, and to inform the program coordinator via memo of the outcome of each fair. All academic and professional duties are to be completed within schedule.

b) Team Building – Each student will promote teamwork while performing as an individual contributor during the course work and projects in MTH 843 and MTH 844. Each team member must be open and candid with their peers and faculty manager. Students are expected to study teaming theory and to continually practice and improve their teaming skills.

c) Communication Skills – Each student will communicate clearly, concisely, and professionally. This requires timely oral and written communications with the program coordinator, peers and faculty manager regarding projects, summer internships (or co-ops), job searches, and professional improvement etc. Students are expected to continually improve their communication skills.

2. PERFORMANCE EXPECTATIONS:

Top: **Performance that substantially exceeds the expectations of the PSM student**	**Middle:** **Performance that fully meets the expectations of the PSM student**	**Low:** **Performance that does not meet the expectations of the PSM student**
▪ Student excelled at obligations as a professional graduate and demonstrated initiative	▪ Followed directions and discharged obligations in this professional training program	▪ Reluctantly followed directions or resisted training in the program
▪ Recognized a need and took significant action in this professional training	▪ Understood role and cooperated with training positively	▪ Minimal understanding of training and minimal action beyond what was asked
▪ Exceeded major goals in a way that benefited personal growth and learning	▪ Successfully achieved professional and personal goals that meet the program requirements	▪ Barely meet the program requirement and minimal improvement related to development goals
▪ Consistently demonstrated PSM professionalism and discipline	▪ Regularly demonstrated PSM professionalism and discipline	▪ Poorly demonstrated PSM professionalism and discipline

3. PERFORMANCE REVIEW AND IMPROVEMENT AREAS BY THE STUDENT*:

* Read items 1 and 2 regarding the criteria and expectations for the students in Professional Science Master's (PSM) Program in Industrial Mathematics.

4. PERFORMANCE SHARED VALUES:

Shared Value	Excellent	Adequate	Needs Development
Professional Improvement			
Integrity/Attitude			
Promptness			
Open/Clear Communication			
Teamwork			
Academic Development			

5. PERFORMANCE IMPROVEMENT AREAS AND COMMENTS BY THE ADVISOR:
