



## Department of Mathematics

### *Master of Science in Industrial Mathematics Student Handbook*

August 21, 2018

This handbook provides a detailed description of the Master of Science in Industrial Mathematics (the Professional Science Master's in Industrial Mathematics) program with specific information for this program. More general information related to academic program and graduates degrees can be found in the **Graduate Student Handbook** (available online) by the Office of Graduate Studies in the Department of Mathematics, and other University documents and online resources. If you have any questions about the requirements, or have a question not answered here, feel free to come to the Office of Graduate Studies, C213 Wells Hall, for help.

For particular information about the program, contact Dr. Peiru Wu, Director of PSM in Industrial Mathematics at [peiruwu@msu.edu](mailto:peiruwu@msu.edu) or [msim@math.msu.edu](mailto:msim@math.msu.edu) .

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# I Program Overview

## 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, mathematician, and problem solvers for leadership positions in industry for two decades because

- The graduates will have studied standard mathematical and statistical tools, and computer science principles to strengthen data analytics skills and machine learning skills.
- They will have gained experience in hands-on project development for real-world problems proposed by local companies and they will received training in technical writing for the project reports to meet industrial standard.

The degree requires 30 credits of coursework, the successful completion of the Certificate Program in Project Management, and the successful completion of an oral masters certifying examination on the student's portfolio of completed projects.

**Program Components** (See **Section III Program Curriculum** for a detailed description)

- Industrial Mathematical Core Courses (6 credits, MTH 843 (Fall), MTH 844 (Spring))
- Elective and Cognate Courses (24 credits, MTH, STT, CSE/CMSE etc.)
- Certificate in Project Management (PHM 857, as for a “not-for-credit” option, first Summer)
- Portfolio Defense (last semester)

**Professional Science Master's (PSM) Program:** The MSIM program has blossomed since its inception since late 90s (PSM affiliation in 1998). With initial support from the Alfred P. Sloan Foundation, our program, called the PSM in Industrial Mathematics continues to get national recognition as one of the earliest and the best-established Professional Science Master's (PSM).

Recall, the PSM program nationwide is an innovative, new graduate degree designed to combine advanced training in science or mathematics, while simultaneously developing workplace skills highly valued by employers. “Professional Science Master's (PSMs) are designed for students who are seeking a graduate degree in science or mathematics and understand the need for developing workplace skills valued by top employers. A perfect fit for professionals because it allows you to pursue advanced training and excel in science or math without a Ph.D., while simultaneously developing highly-valued business skills.” (See the national PSM website at <https://www.professionalsciencemasters.org> for more descriptions). The PSM programs in US have two decades of history with continued success because of High Demand and Science-Plus Curricula (Go to the national PSM website for more details).

One of major successes of the PSM in Industrial Mathematics program at MSU is our twenty years of industrial partnership and strong connections with local companies. We also have the industrial advisory board from 30 companies since 1999 and those industrial advisors include executive, president, vice president, director, technical fellow, and chief analytic officer from

world well-known companies. Another success is that our graduates are employed in 25 states with 100% of placement rate that were actively seeking employment.

## II Admission Requirements

### Admission

Students who wish to apply for admission to the Master of Science in Industrial Mathematics (MSIM) program should

- (1) Have completed the mathematics or applied mathematics course normally required for the bachelor's degree with a major in mathematics, statistics, economics, physics, or any science or engineering.
- (2) Have coursework at the senior level in mathematical analysis, linear algebra and differential equations.
- (3) Have some familiarity with mathematical software programs such as Mathematica, MATLAB, as well as some knowledge of programing languages.

Application is reviewed based on academic record that shows background for success in the program, and professional goal that would be furthered by the coursework and training in the program, as well as recommendations that indicate the likelihood of success for meeting the program requirements and completing the MSIM degree.

### How to Apply

Applications to the Master of Science in Industrial Mathematics (MSIM) must include:

1. MSU Graduate Application at <https://grad.msu.edu/apply/online.aspx> using the program code **3994**.
2. Application to the Department of Mathematics, which you complete by logging into the **Graduate Portal** at <http://www.admissions.msu.edu/gradportal> using your applicant ID and password issued when you completed the MSU Graduate Application.
3. Three letters of recommendation are required and these are included in the **Graduate Portal**. There is a place for you to list the name and email of your recommenders and they will be contacted and asked to upload a letter for you.
4. Official transcripts of all college work (undergraduate and graduate), including diplomas and certificates. These are to be sent to our Department Graduate Studies Office directly from the school(s) which you attended.

MSU requires all incoming admitted students pursuing degrees or who have earned degrees from universities in China to submit a verification report through the China Academic Degrees and Graduate Education Development Center (CDGDC) for their final bachelor degree transcripts. Please go to the CDGDC website at <https://grad.msu.edu/cdgdc> for more details. Our mailing address is:

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

5. The bank statement (Affidavit of Support for Graduate International Students at <https://grad.msu.edu/sites/default/files/content/apply/AffidavitofSupport18-19.pdf>) for all international students to upload to the **Graduate Portal**. Please read the tuition page at [http://www.ctr.msu.edu/COStudentAccounts/Tuition\\_FeesNonResident\\_Intntl\\_Graduate.aspx](http://www.ctr.msu.edu/COStudentAccounts/Tuition_FeesNonResident_Intntl_Graduate.aspx) for more details.
6. TOEFL (Test of English as a Foreign Language) scores or IELTS (International English Language Testing System) scores for international students only if English is not their primary language. TOEFL scores must meet the University minimum requirements: no subscore below 19 for reading, listening, and speaking; no writing subscore below 22; with a minimum total score of 80. Please read English Language Proficiency website at <https://grad.msu.edu/sites/default/files/content/apply/ENGLISH%20LANGUAGE%20PROFICIENCY.pdf> for more details.
7. GRE (Graduate Record Examination) scores. The three standard sections of the GRE, verbal, quantitative, and analytic are required for admission.

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

You will be able to check your application status through the **Graduate Portal** found at <http://www.admissions.msu.edu/gradportal>.

### **III Program Curriculum**

In addition to meeting the requirements of the University and the College of Natural Science, the MSIM student must complete a total of 30 credits of graduate coursework including (1) core courses, (2) elective and cognate courses, (3) the successful completion of the Certificate Program in Project Management, and (4) the successful completion of an oral masters certifying examination on the student's portfolio of completed projects.

#### **Core Courses (6 credits)**

MTH 843 Survey of Industrial Mathematics (fall semester)  
MTH 844 Projects in Industrial Mathematics (spring semester)

#### **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 848 Ordinary Differential Equations  
MTH 849 Partial Differential Equations II  
MTH 850 Numerical Analysis I  
MTH 852 Numerical Methods for ODE  
MTH 880 Combinatorics  
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

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

The students will discuss with the academic advisor (program director) about your course planning prior to fall semester. See Section **IV Other Information** for course planning examples.

#### **Certificate Program in Project Management** (only offer in summer)

It requires completion of PHM 857 Project Management, covering such topics as formal project management culture, principles, knowledge areas, and terminology. It will normally be undertaken **during the first year of enrollment** as a “not-for-credit” option. Certification will also require participation in Industrial Mathematics-specific discussion sessions. After completion of the certificate program is approved by the instructors, the Industrial Mathematics Program, and the Associate Dean of the College of Natural Science, the Office of the Registrar will enter 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 planning are completed by MSIM graduates in the past to meet the course requirements for a total of 36 credits (i.e., Core (2), MTH (4), STT (2), Cognate (4), 12 courses in general) in addition to successful completion of the Certificate Program (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 Econometrics 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	



## Form of Annual Progress Review for the 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 \_\_\_\_\_

#### 1. PROFESSIONAL CRITERIA:

- a) Professional Department – 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
<ul style="list-style-type: none"> <li>▪ Student excelled at obligations as a professional graduate and demonstrated initiative</li> </ul>	<ul style="list-style-type: none"> <li>▪ Followed directions and discharged obligations in this professional training program</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reluctantly followed directions or resisted training in the program</li> </ul>
<ul style="list-style-type: none"> <li>▪ Recognized a need and took significant action in this professional training</li> </ul>	<ul style="list-style-type: none"> <li>▪ Understood role and cooperated with training positively</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal understanding of training and minimal action beyond what was asked</li> </ul>
<ul style="list-style-type: none"> <li>▪ Exceeded major goals in a way that benefited personal growth and learning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Successfully achieved professional and personal goals that meet the program requirements</li> </ul>	<ul style="list-style-type: none"> <li>▪ Barely meet the program requirement and minimal improvement related to development goals</li> </ul>
<ul style="list-style-type: none"> <li>▪ Consistently demonstrated PSM professionalism and discipline</li> </ul>	<ul style="list-style-type: none"> <li>▪ Regularly demonstrated PSM professionalism and discipline</li> </ul>	<ul style="list-style-type: none"> <li>▪ Poorly demonstrated PSM professionalism and discipline</li> </ul>

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

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\* 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:**

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