

Data Science, MS

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Master of Science Program Director: Praveen Madiraju, Ph.D.

Certificate Program Director: Walter Bialkowski, Ph.D.

Department of Computer Science website (<https://www.marquette.edu/computer-science/>)

Data Science Master of Science website (<https://www.marquette.edu/grad/programs-data-science-masters-degree.php>)

Department Affiliation

The master of science in data science is affiliated with the Department of Computer Science in the Klingler College of Arts and Sciences.

Degree Offered

Master of Science

Program Description

The data science master of science targets the growing demand for data science talent through a unique Marquette mission-oriented curriculum of theory-based and hands-on data analytics courses that prepare graduate students to tackle today's problems in the ever-growing data-driven world.

Learning outcomes for students completing the master's program:

1. Represent, manipulate, analyze and interpret big data using exploratory, inferential methods and use packages/tools in effective ways.
2. Recognize and analyze ethical and social issues in data science.
3. Apply and evaluate complex models to devise solutions for data science tasks.
4. Interpret data science analysis outcomes and draw conclusions using effective written, graphical, and verbal tools and techniques.

Data Science Master of Science

Students are admitted to the master of science in data science program under the non-thesis option (Plan B). Students may apply for the thesis option (Plan A) on approval of a thesis outline by their adviser and the department's data science program director.

Program Requirements

Required Courses

All students must successfully complete the following six 3-credit core courses, for a total of 18 credits.

Code	Title	Hours
COSC 6510 or MSSC 5720	Data Intelligence Statistical Methods	3
COSC 6520 or MSSC 5780	Data Analytics Regression Analysis	3
COSC 5500	Visual Analytics	3
COSC 6820	Data Ethics	3
COSC 6570 or COSC 6260 or EECE 6810	Data at Scale Advanced Algorithms Algorithm Analysis and Applications	3
COSC 5610	Data Mining	3
Total Credit Hours:		18

The department recommends that students start the program by taking COSC 6510 Data Intelligence or MSSC 5720 Statistical Methods, followed by COSC 6520 Data Analytics or MSSC 5780 Regression Analysis.

Thesis (Plan A) Requirements

Plan A master's students must complete 18 credit hours of core courses, 6 credit hours of approved electives, and 6 thesis credit hours, for a total of 30 credit hours.

Code	Title	Hours
Required core courses		18
Graduate electives as approved by adviser		6
COSC 6999	Master's Thesis	6
Total Credit Hours:		30

NON-THESIS (PLAN B) REQUIREMENTS

Plan B master's students must complete 18 credit hours of core courses and 15 credit hours of approved electives, for a total of 33 credit hours. Students have four options in Plan B and are outlined below.

No specialization (Generalist Degree)

If a student does not choose a specialization, they must complete the 18 credit hours of core courses along with 15 additional adviser-approved graduate elective credit hours, for a total of 33 credit hours.

Code	Title	Hours
Required core courses		18
Graduate electives as approved by adviser		15
Total Credit Hours:		33

Machine Learning SPECIALIZATION

Students choosing the machine learning specialization must successfully complete the following courses for a total of 33 credit hours.

Code	Title	Hours
Required core courses		18
Choose three of the following:		9
COSC 5600	Fundamentals of Artificial Intelligence	6
or EECE 6820	Artificial Intelligence	
COSC 5800	Principles of Database Systems	3
COSC 6330	Advanced Machine Learning	
EECE 5850	Introduction to Intelligent Systems	3
EECE 5890	Developments in Intelligent Systems	
EECE 6822	Machine Learning	3
MSSC 6250	Statistical Machine Learning	
Graduate electives as approved by adviser		6
Total Credit Hours:		33

Big Data SPECIALIZATION

Students choosing the big data specialization must successfully complete the following courses for a total of 33 credit hours.

Code	Title	Hours
Required core courses		18
COSC 5800	Principles of Database Systems	3
COSC 6060	Parallel and Distributed Systems	3
COSC 6380	Big Data Systems	3
Graduate electives as approved by adviser		6
Total Credit Hours:		33

Statistics and Modeling SPECIALIZATION

Students choosing the statistics and modeling specialization must successfully complete the following courses for a total of 33 credit hours.

Code	Title	Hours
Required core courses		18
Choose three of the following:		9
MSSC 5540	Numerical Analysis	3
MSSC 5630	Mathematical Modeling and Analysis	

MSSC 5650	Theory of Optimization
MSSC 5700	Theory of Probability
MSSC 5710	Mathematical Statistics
MSSC 5750	Computational Statistics
MSSC 5760	Time Series Analysis
MSSC 5790	Bayesian Statistics
MSSC 6000	Scientific Computing
MSSC 6010	Computational Probability
MSSC 6020	Statistical Simulation
MSSC 6040	Applied Linear Algebra
MSSC 6250	Statistical Machine Learning
EECE 6020	Probability and Random Processes in Engineering
EECE 6510	Optimal and Adaptive Digital Signal Processing
EECE 6932	Advanced Topics in Electrical and Computer Engineering

Graduate electives as approved by adviser

6

Total Credit Hours:

33

MASTER'S DEGREE WITH THE DATA SCIENCE CERTIFICATE

The Department of Computer Science offers a data science certificate. If a data science master's student chooses to also earn the certificate, admission to both programs may be concurrent. The same courses may be used to satisfy the requirements of the master's program and certificate, as outlined in the university bulletin for each program. Students are expected to be admitted into all programs they intend to complete, although course work completed prior to admission may be allowed to apply toward program requirements.

Students who are dually enrolled in the data science master's and the data science certificate may enroll in a secondary master's that also accepts the data science certificate and complete the remaining requirements for that degree.

Details on the data science certificate can be found in this section of the bulletin.

Accelerated Bachelor's–Master's Degree Program (ADP)

The Department of Computer Science also offers an accelerated degree program where eligible students may obtain both a bachelor's degree and the master of science degree in data science in five years. Students are eligible to apply to this program as early as the final term of their sophomore year. Students wishing to participate in the five-year program must apply and be admitted to the program before their senior year.

Minimal criteria for application to the ADP include a cumulative GPA of at least 3.000.

The summer term may be taken immediately after the senior year or the following summer. Within the undergraduate degree program, the student enrolls in the required programming and data structures courses and 12 graduate credits related to data science. After completing the undergraduate program, there are three terms of graduate study. In these three terms, the student receives an additional 18 or 21 graduate credits, resulting in a total of 30-33 graduate credits.

University Policies

- Academic Censure - Graduate School (<https://bulletin.marquette.edu/policies/academic-censure/graduate/>)
- Academic Integrity (<https://bulletin.marquette.edu/policies/academic-integrity/>)
- Academic Misconduct (<https://bulletin.marquette.edu/policies/academic-misconduct-policy/>)
- Academic Program Definitions (<https://bulletin.marquette.edu/policies/academic-programs-defined/>)
- Accelerated Degree Programs (<https://bulletin.marquette.edu/policies/accelerated-degree-programs/>)
- Attendance - Graduate School (<https://bulletin.marquette.edu/policies/attendance/graduate/>)
- Awarding Diplomas and Certificates (<https://bulletin.marquette.edu/policies/awarding-diplomas-certificates/>)
- Background Checks, Drug Testing (<https://bulletin.marquette.edu/policies/background-checks-drug-testing/>)
- Class Rank (<https://bulletin.marquette.edu/policies/class-rank/>)
- Commencement (<https://bulletin.marquette.edu/policies/commencement/>)
- Conferral of Degrees and Certificates (<https://bulletin.marquette.edu/policies/conferral-degrees-certificates/>)
- Course Levels (<https://bulletin.marquette.edu/policies/course-levels/>)
- Credit Hour (<https://bulletin.marquette.edu/policies/credit/>)
- Credit Load - Graduate School (<https://bulletin.marquette.edu/policies/credit-load/graduate/>)

- Faculty Grading (<https://bulletin.marquette.edu/policies/faculty-grading/>)
- Family Education Rights and Privacy Act-FERPA (<https://bulletin.marquette.edu/policies/ferpa/>)
- Grade Appeals (<https://bulletin.marquette.edu/policies/grade-appeals/>)
- Grading System - Graduate School and Graduate School of Management (<https://bulletin.marquette.edu/policies/grading-system/graduate-management/>)
- Graduation - Graduate School (<https://bulletin.marquette.edu/policies/graduation/graduate/>)
- Immunization and Tuberculosis Screening Requirements (<https://bulletin.marquette.edu/policies/immunization-and-tuberculosis-screening/>)
- Last Date of Attendance/Activity (<https://bulletin.marquette.edu/policies/last-dateof-attendance-activity/>)
- Military Call to Active Duty or Training (<https://bulletin.marquette.edu/policies/militarycall-active-duty-training/>)
- Registration - Graduate School (<https://bulletin.marquette.edu/policies/registration/graduate/>)
- Repeated Courses - Graduate School (<https://bulletin.marquette.edu/policies/repeated-courses/graduate/>)
- Student Data Use and Privacy (<https://bulletin.marquette.edu/policies/student-data-use-privacy/>)
- Transcripts-Official (<https://bulletin.marquette.edu/policies/transcripts-official/>)
- Transfer Course Credit - Graduate School (<https://bulletin.marquette.edu/policies/transfer-course-credit-policy/graduate/>)
- Withdrawal - Graduate School (<https://bulletin.marquette.edu/policies/withdrawals/graduate/>)

Graduate School Policies

- Academic Performance (<https://bulletin.marquette.edu/graduate/policies/academic-performance/>)
- Academic Programs Overview (<https://bulletin.marquette.edu/graduate/policies/academic-programs-overview/>)
- Advising (<https://bulletin.marquette.edu/graduate/policies/advising/>)
- Assistantships and Fellowships (<https://bulletin.marquette.edu/graduate/policies/assistantships-andfellowships/>)
- Certificate Concurrent Enrollment (<https://bulletin.marquette.edu/graduate/policies/certificate-concurrent-enrollment/>)
- Conduct (<https://bulletin.marquette.edu/graduate/policies/conduct/>)
- Confidentiality of Proprietary Information (<https://bulletin.marquette.edu/graduate/policies/confidentiality-proprietary-information/>)
- Continuous Enrollment (<https://bulletin.marquette.edu/graduate/policies/continuous-enrollment/>)
- Courses and Prerequisites (<https://bulletin.marquette.edu/graduate/policies/courses-prerequisites/>)
- Cross-listed Courses (<https://bulletin.marquette.edu/graduate/policies/cross-listed-courses/>)
- Deadlines (<https://bulletin.marquette.edu/graduate/policies/deadlines/>)
- Graduate Credit (<https://bulletin.marquette.edu/graduate/policies/graduate-credit/>)
- Graduate School Policies (<https://bulletin.marquette.edu/graduate/policies/>)
- Independent Study (<https://bulletin.marquette.edu/graduate/policies/independent-study/>)
- Intellectual Property (<https://bulletin.marquette.edu/graduate/policies/intellectual-property/>)
- Research Involving Humans, Animals, Radioisotopes or Recombinant DNA/Transgenic Organisms (<https://bulletin.marquette.edu/graduate/policies/research-involving-humans-animals-radioisotopes-recombinant-dnatransgenic-organisms/>)
- Temporary Withdrawal from Graduate Program (<https://bulletin.marquette.edu/graduate/policies/temporary-withdrawal-graduate-program/>)
- Time Limitations (<https://bulletin.marquette.edu/graduate/policies/time-limitations/>)
- Working with Minors (<https://bulletin.marquette.edu/graduate/policies/working-minors/>)

Computer Science Graduate Programs

- Applied Statistics, MS (<https://bulletin.marquette.edu/graduate/applied-statistics-ms/>)
- Bioinformatics, MS (<https://bulletin.marquette.edu/graduate/bioinformatics-ms/>)
- Computer Science, PHD (<https://bulletin.marquette.edu/graduate/computer-science-phd/>)
- Computer and Information Science, MS (<https://bulletin.marquette.edu/graduate/computer-information-science-ms/>)
- Data Science, Certificate (<https://bulletin.marquette.edu/graduate/data-science-certificate/>)
- Data Science, MS (p. 1)

COSC 5010 Teaching Computer Science (3 credits)

Historical background, problems, curricular materials and pedagogy in computer science pertinent to the needs of secondary school teachers.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205010>)

COSC 5290 Real-Time and Embedded Systems (3 credits)

Focuses on event-driven programming, real-time scheduling, and synchronization; worst-case execution time analysis and deadline analysis; real-time operating systems and real-time programming languages.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205290>)

COSC 5300 Network Design and Security (3-4 credits)

Focuses on the design and protocols of the upper layers of the Internet architecture, including the TCP/IP protocol suite, packet switching and routing, network programming and applications. Emphasizes related security attacks and defenses, including DNSSEC, TSL, IPsec and the BGP PKI protections. Taught as a lecture only or as a lecture with lab component.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205300>)

COSC 5360 Software and System Security (3 credits)

Fosters comprehension of cybersecurity foundations such as cryptography, operating system security, threat modeling, and secure programming. Develops passion for cybersecurity essential to performance of professional roles as developers, engineers, and managers.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205360>)

COSC 5370 Internet of Things (IoT) (3 credits)

Topics include the definition of IoT, trends in the adoption of IoT, the importance of the IoT in society, the current components of typical IoT devices and trends for the future. Focuses on IoT design considerations, constraints, and interfacing between the physical world and the device. Students are presented with design trade-offs between hardware and software, technologies behind the Internet of Things – RFID, NFC, Wireless networks, WSN, RTLS, GPS, agents, multiagent systems, IoT in retail, NFC applications for the IoT, and IoT in healthcare.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2022 Summer Term, 2021 Summer Term, 2020 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205370>)

COSC 5400 Compiler Construction (3 credits)

Lexical analysis, parsing, code generation and optimization. Includes theoretical foundations and the practical concerns of implementation.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205400>)

COSC 5500 Visual Analytics (3 credits)

Focuses on developing data products using the Javascript/D3 framework by combining concepts from human-computer interaction, visualization and design. Also focuses on model visualization, interpretation, A/B testing and design thinking.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205500>)

COSC 5550 Social and Collaborative Computing (3 credits)

Introduces Social Computing and Computer-Supported Cooperative Work (CSCW). Field includes theory, technology and study of computing systems that support groups of users and facilitate collaboration. Example applications and case studies include email, social networking sites, peer production, crowdsourcing, calendars, scheduling and meeting apps, online dating sites, multiplayer games, discussion forums, instant messaging, collaborative editors and analysis tools.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205550>)

COSC 5600 Fundamentals of Artificial Intelligence (3 credits)

An introduction to the broad field of artificial intelligence. Topics include problem solving by searching, knowledge representation, reasoning, planning, decision making, learning, perception and language processing.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205600>)

COSC 5610 Data Mining (3 credits)

Techniques for extracting and evaluating patterns from large databases. Introduction to knowledge discovery process. Fundamental tasks including classification, prediction, clustering, association analysis, summarization and discrimination. Basic techniques including decision trees, neural networks, statistics, partitional clustering and hierarchical clustering.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205610>)

COSC 5800 Principles of Database Systems (3 credits)

Topics include database concepts and architecture, data modeling, formal query languages such as relational algebra, commercial query language SQL, database access from application programs and a brief examination of advanced concepts including transactions, distributed databases, security and XML.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205800>)

COSC 5860 Component-Based Software Construction (3 credits)

Introduction to software components in the context of the object-oriented paradigm. Component development, component selection and adaptation/customization, component deployment and assembly/integration, and system architecture. Industry standards such as JavaBeans, CORBA Component Model, and Microsoft COM/DOM/COM+.

Level of Study: Graduate

Last four terms offered: 2011 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205860>)

COSC 5931 Topics in Computer Science (1-3 credits)

Topics selected from one of the various branches of computer science. Specific topics to be announced in the Schedule of Classes.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%205931>)

COSC 6050 Elements of Software Development (3 credits)

Students explore the software design and development processes through a term project. Concepts covered include: requirements gathering and analysis, mapping requirements to a design, sound coding and documentation practices, configuration management, testing and quality assurance, system deployment and maintenance.

Prerequisite: Programming in a high-level language, knowledge in data structures such as stacks, recursion, queues, trees and graphs.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206050>)

COSC 6051 Professional Software Engineering 1 (3 credits)

Covers software engineering topics typically including: the software development life cycle (SDLC), development methodologies, software quality overview, configuration management, designing for risks and fault tolerance, languages and design, object-oriented programming, observational research and prototyping, requirements, software architectures, operating systems design and real time systems. Offered at General Electric facilities. As this course extends beyond the Marquette term, students receive the grade of IC initially. The IC grade converts to an A-F grade at the completion of the course.

Prerequisite: GE employee in the Software Edison program.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Fall Term, 2018 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206051>)

COSC 6052 Professional Software Engineering 2 (3 credits)

Covers software engineering topics typically including: systems and communication networks, security and distributed systems, interoperability and standards, design for "ility" (e.g., usability and reliability) and performance, design for parallel processing, embedded systems hardware for software developers, embedded systems software, software design patterns and algorithms. Offered at General Electric facilities. As this course extends beyond the Marquette term, students receive the grade of IC initially. The IC grade converts to an A-F grade at the completion of the course.

Prerequisite: GE employee in the Software Edison program.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Fall Term, 2018 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206052>)

COSC 6053 Professional Software Engineering 3 (3 credits)

Covers software engineering topics typically including: database systems, decision science, data quality and analytics, user interface design, design for globalization, debugging and troubleshooting, approach, method, implementation and emerging software technologies. Offered at General Electric facilities. As this course extends beyond the Marquette term, students receive the grade of IC initially. The IC grade converts to an A-F grade at the completion of the course.

Prerequisite: GE employee in the Software Edison program.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Fall Term, 2018 Fall Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206053>)

COSC 6054 Professional Software Engineering 4 (3 credits)

Covers design topics related to system design with embedded computing. Topics typically include: design of controls, design for low cost, design for serviceability, design for usability, design for reliability, program management, innovation, requirements management and design thinking. Offered at General Electric facilities. As this course extends beyond the Marquette term, students receive the grade of IC initially. The IC grade converts to an A-F grade at the completion of the course.

Prerequisite: GE employee in the Software Edison program.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Fall Term, 2018 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206054>)

COSC 6055 Software Quality Assurance (3 credits)

Provides a perspective on people, organizations, controls, processes and tools that collectively influence the success of a Software Quality Assurance (SQA) strategy. Discussion topics include quality approaches as they apply to: requirements, design, release, configuration management, testing, defect management, operations and support. Topics are discussed in the context of a traditional development approach (waterfall, CMMI) and more contemporary models driven by lean and agile practices. Covers considerations specific to implementing an SQA approach within a regulated setting. Approach emphasizes a hands-on view of SQA, thereby providing realistic takeaways to practice in a professional career.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Spring Term, 2019 Spring Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206055>)

COSC 6060 Parallel and Distributed Systems (3 credits)

Students use and develop software for parallel and distributed computing systems. Topics include: job submission and management, tools for parallel and distributed software development, approaches for implementing parallel and distributed computation, parallel and distributed system architectures, and essential evaluation techniques.

Prerequisite: COSC 3100 or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206060>)

COSC 6090 Research Methods/Professional Development (1 credits)

Designed to introduce the process of research and communication of research in computer science, including presentation and publication of research, preparation of grant proposals, and ethical considerations. May be repeated.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2021 Spring Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206090>)

COSC 6260 Advanced Algorithms (3 credits)

Covers advanced paradigms for the design and analysis of efficient algorithms. Emphasizes fundamental algorithms and advanced methods of algorithmic design, analysis, and implementation. Domains include: string algorithms, network optimization, parallel algorithms, computational geometry, external memory and streaming algorithms, and advanced data structures.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206260>)

COSC 6270 Advanced Operating Systems (3 credits)

Fundamental concepts of operating systems including kernel data structures; process control and scheduling; interprocess communication and synchronization; virtual memory and memory management; mass storage systems and device control; protection and security; and protection and virtualization; evaluation and prediction of performance. Students are expected to spend at least three hours per week gaining hands-on experience in using and modifying a small operating system.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206270>)

COSC 6280 Advanced Computer Security (3 credits)

Symmetric key and public key cryptography, hash functions, random numbers and cryptanalysis; authentication and authorization, password-based security, ACLs and capabilities, covert channels, security models, firewalls and intrusion detection systems; authentication protocols, session keys, SSH, SSL, IPSec, Kerberos, WEP, and GSM; flaws and malware, buffer overflows, viruses and worms, malware detection, software reverse engineering, digital rights management, secure software development and operating systems security; fundamentals about bitcoin and cryptocurrency technologies. Students write programs for assignments using the C programming language.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206280>)

COSC 6330 Advanced Machine Learning (3 credits)

Provides a graduate-level introduction to machine learning and statistical pattern recognition and in-depth coverage of new and advanced methods in machine learning, as well as their underlying theory. Emphasizes approaches with practical relevance and discusses a number of recent applications of machine learning, such as data mining, computer vision, robotics, text and web data processing. An open research project is a major part of the course.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206330>)

COSC 6340 Component Architecture (3 credits)

Focuses on designing and implementing software components, and streamlining the translation from business intent into realized application behavior in a practical hands-on, business-based environment. Introduces service-oriented architecture (SOA) and principles such as loose coupling, abstraction, reusability, autonomy, statelessness, discoverability, interoperability and composability.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term, 2011 Fall Term, 2010 Spring Term, 2008 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206340>)

COSC 6345 Mobile Health (mHealth) (3 credits)

Offers a multidisciplinary overview of the emerging technologies used in mobile health (mHealth). Research and innovations in this area promise solutions to the need for broader access to affordable and effective healthcare by enabling consumers and their caregivers to take charge of their health and well-being. mHealth is the provision of health information and services using sensor data via mobile phones and tablets. Students develop foundational knowledge of understanding the behaviors, different data models, security and privacy issues.

Level of Study: Graduate

Last four terms offered: 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206345>)

COSC 6350 Distributed Computing (3 credits)

Introduces a broad spectrum of topics encompassing system architecture, software abstractions, distributed algorithms and issues pertaining to distributed environments such as replication, consistency, fault tolerance, transactions and security.

Level of Study: Graduate

Last four terms offered: 2014 Spring Term, 2012 Spring Term, 2009 Spring Term, 2007 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206350>)

COSC 6355 Mobile Computing (3 credits)

Focuses on the fundamentals of mobile computing, challenges in mobile computing, mobility management and mobile data management. Also focuses on context awareness and wireless communications, ubiquity of wireless communication technologies and standards, seamless access network services and resources from anywhere, at anytime, middleware for mobile computing, operation systems, programming languages, network protocols and security aspects of mobile computing. Explores concepts in sensor networks, including operating systems, programming languages, network protocols and programming models.

Prerequisite: COSC 2100 or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Summer Term, 2020 Summer Term, 2019 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206355>)

COSC 6360 Enterprise Architecture (3 credits)

Focuses on key topics and concepts that represent enterprise architecture (EA). Addresses the people, process and technology elements of EA from both a business and technical perspective. Explores the background, history, planning, governing, maintaining and common methodologies associated with EA. Prototypes some of the technology used in enterprises today to gain a better understanding of how information is represented, systems are integrated and standards are put into practice.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2020 Fall Term, 2019 Fall Term, 2018 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206360>)

COSC 6375 Web Technologies (3 credits)

Exposes students to design and architectural principles in developing web applications. Focuses on the client side, middleware and service layer of web applications. Topics range from HTML, JavaScript, JQuery, Java Servlets, MVC Design Pattern, Java Spring MVC, SQL, JDBC, Hibernate, AngularJS and Cloud Computing.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206375>)

COSC 6380 Big Data Systems (3 credits)

Focuses on newer, advanced database techniques in the areas of Big Data, NoSQL, Hadoop and Apache Spark. Covers main NoSQL data management topics such as document databases, key-value stores and graph databases.

Prerequisite: Database Systems or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206380>)

COSC 6390 Professional Seminar in Computing (1 credits)

Topic to be chosen each term from among issues important to all professionals in computing. All students specifically in the computing program are expected to participate for the fall and spring terms, and one of the two summer terms. S/U grade assessment.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206390>)

COSC 6500 Foundations of Computing (7 credits)

Presents the breadth and current status of computer science in our computerized society and the fundamentals of professional knowledge, skills and abilities. Foundational topics are intermixed with study of software development which include an introduction to abstraction, algorithmic thinking, simulation and testing for computer-based problem solving using higher-level programming languages. Algorithm analysis and computational complexity are presented in the context of considering data structures, algorithms and alternatives. Students program exercises using graphical user interfaces, data base connections, parallel computing and interfaces to the World Wide Web (WWW). Experience includes using an interactive development environment, studying software development methodology, and testing code, basic system administration, computer networking and operating system configuration.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206500>)

COSC 6510 Data Intelligence (3 credits)

Foundational topics in data intelligence. Includes properties and benefits for data intelligence and methodology for the development of data intelligence solutions. Examines technology employed for managing data and creating visualizations and dashboards. Topics include developing a business case, evaluating performance and managing data. Presents overview of data architectures commonly used in data intelligence solutions and includes exercises using common techniques for prediction and time series analysis.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206510>)

COSC 6520 Data Analytics (3 credits)

Foundational topics in the analysis of data. Includes methodology for the development of data analytics systems. Examines technology employed for data analytics in a variety of industry segments and the benefits derived from data analytics. Foundations of text and data mining techniques commonly used for classification, clustering and prediction. Students are presented techniques for developing a business case, evaluating predictive performance and managing data. Includes exercises using analytic technology and a project to apply analytics to a customer application. Students without programming experience are advised to complete COSC 6510 Data Intelligence before attempting COSC 6520.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206520>)

COSC 6530 Concepts of Data Warehousing (3 credits)

Provides an introduction to data warehousing design. Reviews topics in data modeling, database design and database access. Data warehouse planning, design, implementation and administration. The role of data warehouse in supporting decision support systems (DSS), business intelligence and business analytics.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206530>)

COSC 6550 Introduction to Cybersecurity (3 credits)

Provides an introduction to cybersecurity threats, methods and security techniques. Foundations of various cybersecurity frameworks and methods for applying them to different types of organizations. Includes cyber threat environment, along with methods, tools and techniques that can help mitigate vulnerabilities and reduce risks to an organization.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206550>)

COSC 6560 Principles of Service Management and System Administration (3 credits)

Introduction to the concepts, principles and practices involved in the operations of secure computing systems. Presents principles of service management and explores how the principles of system administration are derived from concepts of delivering quality services. Lab exercises performing rudimentary tasks of a system administrator using virtual machine environments. Foundation topics include: cryptography, popular operating systems for servers, network configuration, system components, networked systems, host management, user management, configuration of servers and services, incident management, change management, security, monitoring and analysis of operations.

Prerequisite: Basic knowledge of scripting, operating systems and services.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206560>)

COSC 6570 Data at Scale (3 credits)

Combines ideas from parallel databases, distributed systems and programming languages to analyze data at scale. Relevant technologies are introduced and taught in an accessible and inclusive way. Some examples include cloud computing, SQL and NoSQL databases, MapReduce ecosystem, Spark and its contemporaries and graph databases.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206570>)

COSC 6580 Data Security and Privacy (3 credits)

Focuses on fundamental and advanced topics in data security and privacy, including differential privacy, secure multi-party computation, homomorphic encryption, data perturbation, data anonymization, security and privacy in AI, location privacy, and social network privacy. Students also learn practical skills via projects.

Prerequisite: Basic knowledge on statistics, databases, machine learning/data mining, and distributed systems.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206580>)

COSC 6820 Data Ethics (3 credits)

A comprehensive overview of the current ethical and social implications of our data-driven society. A sociotechnical approach is used to unpack issues of privacy and surveillance, algorithmic biases, fairness, transparency, and accountability across various contexts.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206820>)

COSC 6931 Topics in Computer Science (3 credits)

Topics vary. Students may enroll more than once as the subject matter changes.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206931>)

COSC 6960 Seminar in Computer Science (1-3 credits)

Seminar topics selected from one of the various branches of computer science. Specific topics to be announced in the Schedule of Classes.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206960>)

COSC 6964 Practicum for Research and Development in Computing (3-6 credits)

S/U grade assessment. Available only to full-time students. Cons. of the computing dir. of graduate studies or cons. of dept. ch.

Prerequisite: 3.00 MU GPA; must be enrolled in Plan B option of the M.S. in computing program and have completed at least 15 credit hours earned in graduate (6000-level) courses.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206964>)

COSC 6965 Curriculum Integrated Practicum in Computing (1-2 credits)

Involves practical application of the knowledge and skills being studied concurrently, and previously studied, in other course work for computing professionals.

Prerequisite: Admission to the COMP program's integrated practicum option; cons. of the computing dir. of graduate studies or cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2022 Spring Term, 2021 Fall Term, 2021 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206965>)

COSC 6974 Practicum for Research and Development in Computer Science (1-6 credits)

Students in the MS in Computing program should be registering for COSC 6964, Practicum for Research and Development in Computing. S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206974>)

COSC 6975 Curriculum Integrated Practicum in Computer Science (0 credits)

Involves advancing practical research and development of the computer science doctoral program student.; cons. of the co-op chair or grad. chair or dept. chair.

Prerequisite: Admitted to the COSC-PHD prog.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206975>)

COSC 6995 Independent Study in Computer Science (1-6 credits)

An in-depth study on a topic or subject matter usually not offered in the established curriculum with faculty and independent of the classroom setting.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206995>)

COSC 6998 Professional Project in Computer Science (0 credits)

SNC/UNC grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Fall Term, 2021 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206998>)

COSC 6999 Master's Thesis (1-6 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Fall Term, 2021 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%206999>)

COSC 8995 Independent Study in Computer Science (1-3 credits)

A doctorate level in-depth research on a topic or subject matter usually not offered in the established curriculum with faculty and independent of the classroom setting.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%208995>)

COSC 8999 Doctoral Dissertation (1-12 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%208999>)

COSC 9970 Graduate Standing Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as less than half-time status only, cannot be used in conjunction with other courses, and does not qualify students for financial aid or loan deferment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209970>)

COSC 9974 Graduate Fellowship: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209974>)

COSC 9975 Graduate Assistant Teaching: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209975>)

COSC 9976 Graduate Assistant Research: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209976>)

COSC 9987 Doctoral Qualifying Examination Preparation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their doctoral qualifying exam.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209987>)

COSC 9988 Doctoral Qualifying Examination Preparation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Fall Term, 2021 Spring Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209988>)

COSC 9989 Doctoral Qualifying Examination Preparation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209989>)

COSC 9991 Professional Project Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their professional project. Any professional project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209991>)

COSC 9992 Professional Project Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their professional project. Any project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209992>)

COSC 9993 Professional Project Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their professional project. Any professional project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209993>)

COSC 9994 Master's Thesis Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2020 Summer Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209994>)

COSC 9995 Master's Thesis Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209995>)

COSC 9996 Master's Thesis Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209996>)

COSC 9997 Doctoral Dissertation Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209997>)

COSC 9998 Doctoral Dissertation Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209998>)

COSC 9999 Doctoral Dissertation Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=COSC%209999>)

MSSC 5020 The Teaching of Mathematics (3 credits)

Historical background, problems, curricular materials, and teaching procedures in the various areas of mathematics pertinent to the needs of a secondary school mathematics teacher. In addition, a three-hour time block on one day each week between 8 a.m. and 3 p.m. must be kept free for clinical experience.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2018 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205020>)

MSSC 5030 Concepts in Geometry and Calculus from an Advanced Standpoint (3 credits)

Topics chosen primarily from geometry and calculus, taught from an advanced standpoint to enrich and deepen the student's understanding. Emphasis on alternative approaches, generalizations, historical contexts and connections with prior mathematical studies.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Spring Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205030>)

MSSC 5040 Concepts in High School Algebra and Number Theory from an Advanced Standpoint (3 credits)

Topics closely related to the high school mathematics curriculum, chosen primarily from algebra and number theory, taught from an advanced standpoint to enrich and deepen the student's understanding. Emphasis on alternative approaches, generalizations, historical contexts and connections with prior mathematical studies.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term, 2014 Spring Term, 2012 Spring Term, 2010 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205040>)

MSSC 5120 Abstract Algebra 1 (3 credits)

Sets, mappings, operations on sets, relations and partitions. A postulational approach to algebraic systems including semigroups, groups, rings and fields. Homomorphisms of groups and rings, number systems, polynomial rings.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205120>)

MSSC 5121 Abstract Algebra 2 (3 credits)

A continuation of MSSC 5120 with emphasis on groups, rings, fields and modules.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2019 Spring Term, 2017 Spring Term, 2014 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205121>)

MSSC 5200 Intermediate Analysis 1 (3 credits)

Limits and continuity, differentiability, Riemann integration. Topology of N-dimensional spaces.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2019 Fall Term, 2017 Fall Term, 2015 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205200>)

MSSC 5201 Intermediate Analysis 2 (3 credits)

Transformations of N-spaces, line and surface integrals, sequences and series, uniform convergence.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205201>)

MSSC 5210 Complex Variables (3 credits)

Complex numbers, analytic functions, differentiation, series expansion, line integrals, singularities and residues.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2020 Spring Term, 2016 Spring Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205210>)

MSSC 5310 History of Mathematical Ideas (3 credits)

Topics selected from the following: development of the number system (need for irrational and complex numbers); development of geometry including the effects of the discovery of non-Euclidean geometry; limit concept; need for axiomatic structures; twentieth-century problems. Current mathematics research and place of mathematics in today's world.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Spring Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205310>)

MSSC 5320 Theory of Numbers (3 credits)

Integers, unique factorization theorems, arithmetic functions, theory of congruences, quadratic residues, partition theory.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2020 Spring Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205320>)

MSSC 5420 Foundations of Geometry (3 credits)

Modern postulational development of Euclidean and non-Euclidean geometries.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205420>)

MSSC 5450 Topology (3 credits)

Topological spaces, mappings, metric spaces, product and quotient spaces. Separation axioms, compactness, local compactness and connectedness.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2019 Spring Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205450>)

MSSC 5500 Theory of Differential Equations (3 credits)

Existence and uniqueness theorems, linear and non-linear systems, numerical techniques, stability.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2016 Fall Term, 2014 Fall Term, 2012 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205500>)

MSSC 5510 Elementary Partial Differential Equations (3 credits)

Fourier series, method of separation of variables, eigenfunction expansions, application of eigenfunctions to partial differential equations, Green's functions and transform methods.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2019 Spring Term, 2017 Spring Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205510>)

MSSC 5540 Numerical Analysis (3 credits)

Numerical solution of algebraic and transcendental equations, linear systems and the algebraic eigenvalue problem, interpolation and approximation, numerical integration, difference equations, numerical solution of differential equations and finite difference methods.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205540>)

MSSC 5630 Mathematical Modeling and Analysis (3 credits)

Construction and analysis of mathematical models from biological, behavioral and physical sciences.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Fall Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205630>)

MSSC 5650 Theory of Optimization (3 credits)

Fundamental theorems describing the solution of linear programs and matrix games. Minimax, duality, saddle point property, simplex and specialized algorithms. Zero sum games, transportation and assignment problems, applications to economics.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205650>)

MSSC 5670 Applied Combinatorial Mathematics (3 credits)

Permutations and combinations, recurrence relations, inclusions and exclusion, Polya's theory of counting, graph theory, transport networks, matching theory.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2020 Spring Term, 2018 Spring Term, 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205670>)

MSSC 5700 Theory of Probability (3 credits)

Random variables, distributions, moment generating functions of random variables, various derived probabilistic models and applications.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205700>)

MSSC 5710 Mathematical Statistics (3 credits)

Sampling theory and distributions, estimation and hypothesis testing, regression, correlation, analysis of variance, non-parametric methods, Bayesian statistics.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205710>)

MSSC 5720 Statistical Methods (3 credits)

Probability, discrete and continuous distributions. Treatment of data, point and interval estimation, hypothesis testing. Large and small sample method, regression, non-parametric methods. An introduction to the basic understanding of statistical methods. Applications-oriented.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205720>)

MSSC 5730 Introduction to R for Statistics and Data Science (1 credits)

An introductory course to the statistical analysis software R. Topics include basic R programming, importing and cleaning data, data visualization, performing descriptive and inferential statistics, and creating reproducible reports.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205730>)

MSSC 5740 Biostatistical Methods and Models (3 credits)

Introduction to the statistics of life science and the use of mathematical models in biology. Data analysis and presentation, regression, analysis of variance, correlation, parameter estimation and curve fitting. Biological sequence analysis, discrete and continuous mathematical models and simulation.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205740>)

MSSC 5750 Computational Statistics (3 credits)

Explores computational data analysis, an essential part of modern statistics. Introduces statistical computing including statistical programming, Monte Carlo simulation and parallel computing, smoothing and density estimation, implementing numerical methods in R (e.g., Expectation-Maximization algorithm), fitting models to data, statistical prediction and cross-validation.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205750>)

MSSC 5760 Time Series Analysis (3 credits)

Basic concepts of probability. Stationary time series. Autocorrelation and spectrum. Descriptive methods for time series data. ARMA and ARIMA models: estimation and forecasting. Identification and diagnostic techniques. Periodogram and spectral analysis. Use of software for time series analysis.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2020 Spring Term, 2018 Spring Term, 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205760>)

MSSC 5770 Statistical Machine Vision (3 credits)

Object recognition and tracking for automatic machine vision systems. Topics include image representation, convolution, filter design, statistical deconvolution, discrete Fourier transform, automated object identification, text analysis, video object tracking and line tracing. Real-world applications such as object tracking within sequence of images, identification of item placement location in industrial settings, and autonomous lane departure identification. Additional topics may include object feature representations and statistical classification of objects. Computational implementation and examples utilize high-level programming language.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205770>)

MSSC 5780 Regression Analysis (3 credits)

Basic concepts of statistical inference, simple linear regression, multiple linear regression, diagnostic analysis, selecting the best equation, stepwise methods, nonlinear regression, use of statistical software.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205780>)

MSSC 5790 Bayesian Statistics (3 credits)

Bivariate, conditional and marginal distributions. The Bayesian philosophy, quantification of a priori information, prior, likelihood and posterior distributions. Bayesian linear models, posterior parameter estimation including maximum posteriori and marginal expectations. Topics may include numerical integration and Markov chain Monte Carlo techniques. Use of a high-level software package.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205790>)

MSSC 5931 Topics in Mathematical or Statistical Sciences (1-3 credits)

Topics selected from one of the various branches of mathematics or statistics. Specific topics to be announced in the Schedule of Classes.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%205931>)

MSSC 6000 Scientific Computing (3 credits)

Foundational methods and techniques of scientific computing in the mathematical and statistical sciences. Covers fundamental computational algorithms aimed toward applications in science and engineering. Students implement algorithms, and visualize and validate their outcomes. Further, students are introduced to and implement best programming practices.; introductory statistics course or cons. of instr.; and programming competency in a high-level language.

Prerequisite: Calculus course or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206000>)

MSSC 6010 Computational Probability (3 credits)

A modern course in probability. Foundations of probability for modeling random processes with computational techniques. Topics include counting techniques, probability of events, random variables, distribution functions, probability functions, probability density functions, expectation, moments, moment generating functions, special discrete and continuous distributions, sampling distributions, transformation of variables, prior and posterior distributions, Law of Large Numbers, Central Limit Theorem, the Bayesian paradigm. Numerical and computational methods will be covered throughout topics.

Prerequisite: Three semesters of mathematics beyond calculus and MATH 4720 or equiv.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206010>)

MSSC 6020 Statistical Simulation (3 credits)

Elements of statistical simulation and modeling with applications. Generation of random variables, simulating statistical models, Monte Carlo method, Markov chains, birth-and-death processes, queues, variance reduction, Markov chain Monte Carlo (MCMC) methods and applications, bootstrapping, validation and analysis of simulated data.

Prerequisite: MSSC 6010 and programming competency in a high-level language.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206020>)

MSSC 6030 Applied Mathematical Analysis (3 credits)

Foundational topics in analysis considered from a modeling and numerical viewpoint. Emphasizes techniques of proof and approximation, and their role in the solution of problems arising in applications.

Prerequisite: Multivariable calculus and linear algebra.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206030>)

MSSC 6040 Applied Linear Algebra (3 credits)

Foundational linear algebra considered from a numerical viewpoint. Focuses on solutions of linear systems of equations, eigenvalues and eigenvectors, and transformations. Emphasizes and illustrates proof and numerical implementation using problems arising in applications.

Prerequisite: Multivariable calculus and linear algebra.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2022 Spring Term, 2021 Fall Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206040>)

MSSC 6090 Research Methods/Professional Development (1 credits)

Designed to introduce the process of research and communication of research in the mathematical and statistical sciences, including presentation and publication of research, preparation of grant proposals, and ethical considerations. May be repeated.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206090>)

MSSC 6110 Applied Discrete Mathematics (3 credits)

Applied discrete mathematics for the mathematics, engineering and computer science graduate student. Emphasis on graph theory and counting problems that serve as a foundation for research areas in the second term. Theory and applications are covered for topics including trees, graph coloring, chromatic polynomials, generating functions, recurrence relations, distinct colorings and Polya's Theorem.; MATH 1451 and MATH 2100 or equiv.

Prerequisite: COSC 1020 and MATH 1450 or equiv.

Level of Study: Graduate

Last four terms offered: 2008 Fall Term, 2006 Fall Term, 2003 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206110>)

MSSC 6120 Optimization (3 credits)

Principles of deterministic model building in operations research. Linear programming and duality. Dynamic and integer programming. Nonlinear optimization and parameter estimation.

Prerequisite: MATH 3100 or equiv.

Level of Study: Graduate

Last four terms offered: 2007 Fall Term, 2005 Fall Term, 2003 Fall Term, 1999 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206120>)

MSSC 6130 Dynamical Systems (3 credits)

Theory of discrete and continuous dynamical systems. Periodic solutions, bifurcations, chaotic systems, attractors, fractal dimension and simulation of these systems.

Prerequisite: MATH 4200 or equiv.

Level of Study: Graduate

Last four terms offered: 2007 Spring Term, 2005 Spring Term, 2001 Spring Term, 1998 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206130>)

MSSC 6210 Theory of Statistics (3 credits)

Brief review of sampling distributions, convergence, Central Limit Theorem and Law of Large Numbers. Estimation, testing hypotheses, regression and correlation analysis, non-parametric methods.

Prerequisite: MATH 4700 or equiv.

Level of Study: Graduate

Last four terms offered: 2009 Spring Term, 2007 Spring Term, 2005 Spring Term, 2003 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206210>)

MSSC 6220 Analysis of Variance and Covariance (3 credits)

Review of statistical inference. One-way layout and multiple comparison. Two-, three- and higher-way layouts. Latin squares, incomplete block and nested design. Analysis of covariance.

Prerequisite: MATH 4710 or equiv.

Level of Study: Graduate

Last four terms offered: 2009 Fall Term, 2007 Fall Term, 2005 Fall Term, 2003 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206220>)

MSSC 6230 Multivariate Statistical Analysis (3 credits)

Basic properties of random vectors, multivariate normal distribution, estimations of mean vector and covariance matrix, Wishart distribution, hypothesis testing, Hotelling's T^2 , multivariate analysis of variance, principal component analysis, factor analysis, canonical correlation analysis, classification and discriminant analysis. A high level programming language may be used.

Prerequisite: MATH 3100 or equiv; MATH 4710 or equiv.

Level of Study: Graduate

Last four terms offered: 2010 Spring Term, 2008 Spring Term, 2006 Spring Term, 2004 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206230>)

MSSC 6240 Design and Analysis of Scientific Experiments (3 credits)

Single factor, two-factor and multi-factor designs and their analysis, Latin-square design and its analysis; power analysis and sample size selection; 2^k factorial designs; confounding/blocking designs; orthogonality and orthogonal contrasts; 3^k factorial designs; response surface methodology.

Prerequisite: A course in statistical methods, such as MATH 4720 or equiv.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206240>)

MSSC 6250 Statistical Machine Learning (3 credits)

Multivariate data and exploratory analysis, random vector and multivariate normal distribution, multivariate linear regression, principal component and other dimensional reduction techniques, linear discriminant analysis, recursive partition and tree-based methods including classification tree and regression tree, cluster analysis, neural network and support vector machine., cons. of instr.

Prerequisite: A course in statistical methods, such as MATH 4720, and a course in linear algebra, such as MATH 3100, MATH 4780 or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206250>)

MSSC 6410 Real Analysis (3 credits)

Involves study of algebraic structures of real analysis, function spaces, introduction to linear operators, measure and integration theory, convergence theorems, limits, continuity and derivatives.

Prerequisite: MATH 4200.

Level of Study: Graduate

Last four terms offered: 2007 Fall Term, 2005 Fall Term, 2003 Fall Term, 2001 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206410>)

MSSC 6420 Algebra (3 credits)

Studies groups, rings, fields and vector spaces including Sylow's theorems, field of quotients of an integral domain, structure of finitely generated modules over a principal ideal domain, Galois theory of equations, ordered fields and classical groups.

Prerequisite: MATH 4120 or equiv.

Level of Study: Graduate

Last four terms offered: 2010 Spring Term, 2006 Fall Term, 2004 Fall Term, 2002 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206420>)

MSSC 6430 Logic and Set Theory (3 credits)

Naive set theory, first-order logic, elementary model theory, non-standard analysis, Godel's incompleteness theorems for elementary arithmetic, axioms for set theory, ordinal and cardinal arithmetic, the continuum hypothesis, methods of inner models and forcing for proving consistency and independence results.

Prerequisite: MATH 4120 or equiv.

Level of Study: Graduate

Last four terms offered: 2007 Fall Term, 2005 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206430>)

MSSC 6440 Topology (3 credits)

Metric spaces, fundamental topology notions, subspace topology, product spaces, quotient spaces, separation axioms, Tietze's theorem, compactness, metrization, uniform spaces, function spaces, homotopy relation, fundamental group, computing manifold groups.

Prerequisite: MATH 4200 or equiv.

Level of Study: Graduate

Last four terms offered: 2005 Fall Term, 2000 Fall Term, 1997 Fall Term, 1993 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206440>)

MSSC 6770 Innovations in Secondary Mathematics: Meeting the NCTM Standards (3 credits)

Online course designed for teachers of secondary mathematics. Emphasizes relevant NCTM standards through discussion, projects, and implementation in a secondary mathematics classroom. Mathematics content amplifies and extends selected topics of secondary mathematics. Topics vary. Credit may be earned multiple times if completed under a different topic.; one term of calculus and access to an algebra or geometry class of secondary students; or cons. of course coordinator; admitted to MSST or College of Education.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206770>)

MSSC 6931 Topics in Mathematical or Statistical Sciences (3 credits)

Topics vary. Multiple enrollments allowed under different topics.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2019 Summer Term, 2019 Spring Term, 2018 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206931>)

MSSC 6952 Colloquium in Mathematical or Statistical Sciences (0-1 credits)

Research and scholarly presentations on selected topics in the mathematical or statistical sciences by visiting researchers, departmental faculty and graduate students.

Prerequisite: Grad. stndg.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206952>)

MSSC 6953 Seminar in Mathematics Curriculum Development and Material 1 (3 credits)

The historical evolution of mathematics learning theories and research-generated conceptions of mathematics learning; comparisons of various learning theories and their impact on research in mathematics learning; implications of research and learning theories on curriculum development; implications of mathematics learning research/theories on the teaching and learning of mathematics.

Prerequisite: Admitted to MSST or College of Education.

Level of Study: Graduate

Last four terms offered: 2011 Fall Term, 2008 Fall Term, 2003 Summer Term, 1994 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206953>)

MSSC 6954 Seminar in Mathematics Curriculum Development and Material 2 (3 credits)

Philosophy of education with particular attention to mathematics education; development by students of useful curricula in the form of teaching units, evaluation materials, and student and teacher bibliographies for specific topics, grade levels, and ability groups; aspects of supervision as related to the role of department chairperson.

Prerequisite: MSSC 6953; admitted to MSST or College of Education.

Level of Study: Graduate

Last four terms offered: 1989 Summer Session 2

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206954>)

MSSC 6960 Seminar in Mathematical or Statistical Sciences (0-3 credits)

Topics selected from one of the various branches of mathematics or statistics. Specific topics are announced in the Schedule of Classes.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2021 Fall Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206960>)

MSSC 6974 Practicum for Research in Mathematical or Statistical Sciences (1-3 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2019 Summer Term, 2018 Fall Term, 2018 Spring Term, 2017 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206974>)

MSSC 6975 Practicum in Applied Statistics and Data Science (3 credits)

Provides students with the opportunity to explore real-world examples of data analysis as a statistical consultant.

Prerequisite: 3.000 MU GPA; completed at least 12 credit hours; cons. of the applied statistics dir. of graduate studies; or cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206975>)

MSSC 6995 Independent Study in Mathematical or Statistical Sciences (1-5 credits)

Faculty-supervised, independent study/research of a specific area or topic in mathematics or statistics.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Fall Term, 2021 Spring Term, 2020 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206995>)

MSSC 6998 Professional Project in Mathematical or Statistical Sciences (0 credits)

SNC/UNC grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2019 Summer Term, 2019 Spring Term, 2018 Spring Term, 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206998>)

MSSC 6999 Master's Thesis (1-6 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%206999>)

MSSC 8995 Independent Study in Mathematical or Statistical Sciences (1-3 credits)

In-depth research on a topic or subject matter usually not offered in the established curriculum with faculty and independent of the classroom setting.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%208995>)

MSSC 8999 Doctoral Dissertation (1-12 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%208999>)

MSSC 9970 Graduate Standing Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as less than half-time status only, cannot be used in conjunction with other courses, and does not qualify students for financial aid or loan deferment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2020 Spring Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209970>)

MSSC 9974 Graduate Fellowship: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2012 Spring Term, 2010 Summer Term, 2009 Fall Term, 2009 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209974>)

MSSC 9975 Graduate Assistant Teaching: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2019 Spring Term, 2017 Fall Term, 2016 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209975>)

MSSC 9976 Graduate Assistant Research: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Fall Term, 2019 Spring Term, 2018 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209976>)

MSSC 9987 Doctoral Qualifying Examination Preparation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their doctoral qualifying exam.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Spring Term, 2017 Fall Term, 2017 Spring Term, 2016 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209987>)

MSSC 9988 Doctoral Qualifying Examination Preparation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term, 2015 Fall Term, 2015 Spring Term, 2012 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209988>)

MSSC 9989 Doctoral Qualifying Examination Preparation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Spring Term, 2017 Fall Term, 2016 Fall Term, 2016 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209989>)

MSSC 9991 Professional Project Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their professional project. Any professional project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Fall Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209991>)

MSSC 9992 Professional Project Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their professional project. Any project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2016 Summer Term, 2016 Spring Term, 2015 Summer Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209992>)

MSSC 9993 Professional Project Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their professional project. Any professional project credits required for the degree should be completed before registering for non-credit Professional Project Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Fall Term, 2018 Summer Term, 2018 Spring Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209993>)

MSSC 9994 Master's Thesis Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Summer Term, 2019 Spring Term, 2018 Fall Term, 2018 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209994>)

MSSC 9995 Master's Thesis Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2018 Fall Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209995>)

MSSC 9996 Master's Thesis Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Summer Term, 2018 Fall Term, 2018 Spring Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209996>)

MSSC 9997 Doctoral Dissertation Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2019 Fall Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209997>)

MSSC 9998 Doctoral Dissertation Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Spring Term, 2020 Fall Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209998>)

MSSC 9999 Doctoral Dissertation Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=MSSC%209999>)