

M.S. IN DATA SCIENCE

<https://msdatascience.miami.edu/>

Overview

The Master of Science in Data Science is an interdisciplinary graduate program that combines the teaching of domain-specific and technical skills for analyzing large data sets. Built upon a core of foundational data science courses in Computer Science, Engineering, and Mathematics, and a selection of courses from data science application domains, the program is interdisciplinary in nature. Students interested in data science tools will be able to focus on tool principles and tool development, and students interested in data science application domains will be able to focus on the application of data science tools with a selection of courses that develop skills in one of three application areas. The program also provides its students the option of doing an industrial internship, to acquire professional experience. The program allows the various academic units involved to add courses in their specific application domains, thus keeping the program updated and relevant to current practice and industrial needs. The program is both academic and professional in nature, providing courses that are true to a Master's level degree and courses that reflect the needs of the profession.

Admission Requirements

1. Completion of an application.
2. A Baccalaureate degree from a regionally accredited institution or foreign equivalent.
3. A minimum cumulative undergraduate GPA of 3.0.
4. Three letters of recommendation.
5. Official transcripts from each post-secondary institution attended. Official transcripts in languages other than English must also be submitted with a certified English translation.
6. Introduction to Probability and Statistics, Linear Algebra, and Computer Programming I (or equivalents). Students who require prerequisite courses will be admitted as non-degree seeking. Upon passing any required prerequisite courses with a grade of "B" or better, the student would then be eligible for admission to the M.S. program the following semester.
7. Students from non-English speaking countries must send either TOEFL or IELTS
 - TOEFL minimum score: Internet based - 92; Computer based - 237; Paper based 580
 - IELTS minimum score: 6.5
8. A personal statement of intent in which the applicant details their reasons for pursuing this degree.

Curriculum Requirements - General

Code	Title	Credit Hours
Core Courses		
Machine Learning and Data Mining (choose 1 course)		3
CSC 646	Introduction to Machine Learning with Applications	
ECE 648	Machine Learning	
ECE 677	Data Mining	
Data Visualization (choose 1 course)		3
CSC 629	Introduction to Computer Graphics	
JMM 622	Introduction to Infographics and Data Visualization	
Statistics (choose 1 course)		3
EPS 700	Quantitative Methods I	
MTH 642	Statistical Analysis	
ISE 712	Design of Experiments	
Data Science Tools		12
Programming (at least 3 Data Science Tool credits have to be in Programming)		
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	

EPS 704	Computer Applications in Educational and Behavioral Science Research
Database Systems	
CSC 623 or ECE 672	Theory of Relational Databases Object-Oriented and Distributed Database Management Systems
ECE 672	Object-Oriented and Distributed Database Management Systems
ECE 697	Special Topics in Electrical Engineering (Advanced Big Data Analysis)
Data Visualization	
CSC 629	Introduction to Computer Graphics
GEG 681	Spatial Data Analysis II
GEG 691	Geographic Information Systems I
JMM 622	Introduction to Infographics and Data Visualization
JMM 629	Advanced Infographics and Data Visualization
Machine Learning and Data Mining	
CSC 646	Introduction to Machine Learning with Applications
CSC 746 or ECE 653	Neural Networks and Deep Learning Neural Networks
ECE 648	Machine Learning
ECE 677	Data Mining
ECE 730	Statistical Learning
ECE 753	Pattern Recognition and Neural Networks
Mathematics and Statistics	
EPS 702	Quantitative Methods II
EPS 703	Applied Multivariate Statistics
EPS 705	Measurement and Psychometric Theory
EPS 706	Categorical Data Analysis
EPS 707	Item Response Theory
EPS 708 or PSY 633	An Introduction to Structural Equation Modeling for Multivariable Data Structural Equation Modeling
EPS 709 or PSY 634	Introduction to Multilevel Modeling Multilevel Modeling
MTH 624	Introduction to Probability Theory
MTH 625	Introduction to Mathematical Statistics
MTH 642	Statistical Analysis
Data Science Applications 6-9	
This is a sample list. Other electives may be chosen with approval of the MSDS Director.	
ARC 686	Special Problems
ARC 694	Geographic Information Systems in Urban Design
ARC 695	Interactive Multimedia in Design
ARC 697	Designing for the Internet of Things
ATM 774	Advanced Studies
CSC 645	Introduction to Artificial Intelligence
CSC 670	Directed Reading
CSC 686	Topics in Computer Science
ECE 637	Principles of Artificial Intelligence
EPS 711	Advanced Topics in Research, Measurement, and Evaluation
GEG 680	Spatial Data Analysis I
GEG 681	Spatial Data Analysis II
GEG 691	Geographic Information Systems I
GEG 692	Remote Sensing of the Environment
GEG 693	Geographic Information Systems II

GEG 695	Web GIS	
JMM 692	Special Topics in Journalism and Media Management	
MPO 606	Introduction to Ocean Remote Sensing	
MPO 707	Advanced Ocean Remote Sensing	
Capstone		3-6
Total Credit Hours		30

Curriculum Requirements - Technical Data Science Track

Code	Title	Credit Hours
Core		9
Data Science Tools (choose one course from each domain)		12
Programming		
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Database Systems		
CSC 623	Theory of Relational Databases	
ECE 672	Object-Oriented and Distributed Database Management Systems	
Data Analysis		
ECE 697	Special Topics in Electrical Engineering	
ECE 677	Data Mining	
Statistics		
MTH 624	Introduction to Probability Theory	
MTH 625	Introduction to Mathematical Statistics	
Data Science Applications		3-6
Capstone		3-6
CSC 712 or CSC 670	Computer Science Graduate Internship Directed Reading	
Total Credit Hours		30

Curriculum Requirements - Smart Cities Track

Code	Title	Credit Hours
Core		9
Data Science Tools (3 credits must be taken in Programming)		9
Programming Courses		
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Students may choose from other courses throughout the MSDS curriculum to satisfy the Data Science Tools requirement, with advisor approval.		
Data Science Applications		6-9
ARC 694	Geographic Information Systems in Urban Design	
ARC 696	Advanced Topics	
ARC 697	Designing for the Internet of Things	
Capstone		3-6
CSC 712 or ARC 686	Computer Science Graduate Internship Special Problems	
Total Credit Hours		30

Curriculum Requirements - Data Visualization Track

Code	Title	Credit Hours
Core		9
Data Science Tools (3 credits must be taken in Programming)		9
Programming Courses		
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Students interested in spatial visualization may also take any of the following electives:		
Data Science Applications		6-9
CSC 629	Introduction to Computer Graphics	
GEG 681	Spatial Data Analysis II	
GEG 691	Geographic Information Systems I	
GEG 692	Remote Sensing of the Environment	
GEG 693	Geographic Information Systems II	
JMM 622	Introduction to Infographics and Data Visualization	
JMM 692	Special Topics in Journalism and Media Management	
Capstone		3-6
CSC 712 or JMM 692	Computer Science Graduate Internship Special Topics in Journalism and Media Management	
Total Credit Hours		30

Curriculum Requirements - Marine and Atmospheric Sciences Track

Code	Title	Credit Hours
Core		9
Data Science Tools (3 credits must be taken in Programming)		3
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Data Science Applications		12-15
Includes the remaining 6 credits of Data Science Tools material.		
ATM 624 or MPO 624	Applied Data Analysis Applied Data Analysis	
MPO 606	Introduction to Ocean Remote Sensing	
MPO 707	Advanced Ocean Remote Sensing	
MES 660		
MES 661		
MPO 771	Advanced Studies	
Or any other courses selected from the concentration course lists for the RSMAS Master of Professional Science (MPS), with advisor approval		
Capstone		3-6
CSC 712 or ATM 774	Computer Science Graduate Internship Advanced Studies	
Total Credit Hours		30

Curriculum Requirements - Educational Measurement and Statistics Track

Code	Title	Credit Hours
Core		9
Data Science Tools (3 credits must be taken in Programming)		
Programming Courses		
CSC 615	Introduction to Python Programming for Graduate Students	3

CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Mathematics and Statistics Courses		9
EPS 700	Quantitative Methods I	
EPS 701	Introduction to Research Methods	
EPS 702	Quantitative Methods II	
EPS 703	Applied Multivariate Statistics	
EPS 705	Measurement and Psychometric Theory	
EPS 706	Categorical Data Analysis	
EPS 708	An Introduction to Structural Equation Modeling for Multivariable Data	
or PSY 633	Structural Equation Modeling	
EPS 709	Introduction to Multilevel Modeling	
or PSY 634	Multilevel Modeling	
EPS 710	Meta-Analytic Methods for Research Synthesis	
Data Science Applications		3-6
EPS 704	Computer Applications in Educational and Behavioral Science Research	
EPS 707	Item Response Theory	
EPS 711	Advanced Topics in Research, Measurement, and Evaluation	
Capstone		3-6
CSC 712	Computer Science Graduate Internship	
or EPS 798	Advanced Individual Study	
Total Credit Hours		30

Curriculum Requirements - Marketing Track

Please note: The MSDS Marketing Track requires 31 credits.

Code	Title	Credit Hours
Core		9
Data Science Tools (3 credits must be taken in Programming)		
Programming Courses		3
CSC 615	Introduction to Python Programming for Graduate Students	
CSC 632	Introduction to Parallel Computing	
CSC 640	Algorithm Design and Analysis	
Marketing Courses		8
MKT 640	Foundations of Marketing Management	
MKT 641	Marketing Research and Decision Making	
MKT 646	Consumer Behavior	
MKT 675	Marketing Analytics	
Data Science Applications		6-8
includes the remaining 1 credit of Data Science Tools material.		
MKT 647	Advertising and Communications Management	
MKT 648	New Product Development	
MKT 649	Strategic Brand Marketing	
MKT 650	Strategic Marketing	
MKT 677	Strategic Digital Media Management	
Capstone		3-6
CSC 712	Computer Science Graduate Internship	
or MKT 699	Directed Study	
Total Credit Hours		31

Sample Plan of Study - General

Year One		Credit Hours
Fall		
CSC 615	Introduction to Python Programming for Graduate Students (or another approved Programming course)	3
JMM 622	Introduction to Infographics and Data Visualization (or another approved Data Visualization course)	3
CSC 646	Introduction to Machine Learning with Applications (another approved Data Science Tools course)	3
MTH 642	Statistical Analysis (or another approved statistics course)	3
Credit Hours		12
Spring		
CSC 632	Introduction to Parallel Computing (or another approved Programming course)	3
CSC 623	Theory of Relational Databases (or another approved Database Systems course)	3
CSC 746	Neural Networks and Deep Learning (or another approved Machine Learning or Data Mining course)	3
EPS 703	Applied Multivariate Statistics (or another approved Statistics course)	3
Credit Hours		12
Summer		
CSC 712	Computer Science Graduate Internship	6
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Technical Data Science

Year One		Credit Hours
Fall		
CSC 615	Introduction to Python Programming for Graduate Students	3
JMM 622	Introduction to Infographics and Data Visualization (or another approved Data Visualization course)	3
CSC 646	Introduction to Machine Learning with Applications (another approved Data Science Tools course)	3
MTH 642	Statistical Analysis (or another approved statistics course)	3
Credit Hours		12
Spring		
CSC 623	Theory of Relational Databases (or another approved Database Systems course)	3
ECE 697 or 677	Special Topics in Electrical Engineering or Data Mining	3
MTH 624 or 625	Introduction to Probability Theory or Introduction to Mathematical Statistics	3
CSC 645	Introduction to Artificial Intelligence (or another approved Data Science Applications course)	3
Credit Hours		12
Summer		
CSC 712	Computer Science Graduate Internship	6
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Smart Cities

Year One		Credit Hours
Fall		
CSC 615	Introduction to Python Programming for Graduate Students (or another approved Programming course)	3
JMM 622	Introduction to Infographics and Data Visualization (or another approved Data Visualization course)	3
CSC 646	Introduction to Machine Learning with Applications (another approved Data Science Tools course)	3
MTH 642	Statistical Analysis (or another approved statistics course)	3
Credit Hours		12
Spring		
ARC 594	Geographic Information Systems in Urban Design	3
ARC 684	Special Problems	3
ARC 685	Special Problems	3
ARC 697	Designing for the Internet of Things (or another approved ARC elective)	3
Credit Hours		12
Summer		
CSC 712	Computer Science Graduate Internship	6
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Data Visualization

Year One		Credit Hours
Fall		
CSC 615	Introduction to Python Programming for Graduate Students (or another approved Programming course)	3
JMM 622	Introduction to Infographics and Data Visualization (or another approved Data Visualization course)	3
CSC 646	Introduction to Machine Learning with Applications (or another approved Data Science Tools course)	3
MTH 642	Statistical Analysis (or another approved statistics course)	3
Credit Hours		12
Spring		
JMM 622 or CSC 688	Introduction to Infographics and Data Visualization or Topics in Computer Science	3
JMM 692	Special Topics in Journalism and Media Management	3
JMM 663	Applied Data Analytics for Journalism and Media Management (or another approved Data Visualization elective)	3
JMM 696	or another approved Data Visualization elective	3
Credit Hours		12
Summer		
CSC 712	Computer Science Graduate Internship	6
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Marine and Atmospheric Science

Year One		Credit Hours
Fall		
CSC 615	Introduction to Python Programming for Graduate Students (or another approved Programming course)	3

JMM 622	Introduction to Infographics and Data Visualization (or another approved Data Visualization course)	3
CSC 646	Introduction to Machine Learning with Applications (another approved Data Science Tools course)	3
MPO 606	Introduction to Ocean Remote Sensing	3
Credit Hours		12
Spring		
MES 660	or another approved Marine & Atmospheric Science elective	3
ATM 624	Applied Data Analysis	3
MPO 707	Advanced Ocean Remote Sensing	3
MTH 642	Statistical Analysis (or another approved statistics course)	3
Credit Hours		12
Summer		
CSC 712 or ATM 774	Computer Science Graduate Internship or Advanced Studies	6
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Educational Measurement and Statistics

Year One		
Fall		Credit Hours
CSC 615	Introduction to Python Programming for Graduate Students	3
CSC 646	Introduction to Machine Learning with Applications	3
EPS 700	Quantitative Methods I	3
EPS 701	Introduction to Research Methods	3
Credit Hours		12
Spring		
CSC 629	Introduction to Computer Graphics	3
EPS 705	Measurement and Psychometric Theory	3
EPS 711	Advanced Topics in Research, Measurement, and Evaluation	3
EPS 703 or 704	Applied Multivariate Statistics or Computer Applications in Educational and Behavioral Science Research	3
Credit Hours		12
Summer		
EPS 703 or 704	Applied Multivariate Statistics or Computer Applications in Educational and Behavioral Science Research	3
CSC 712 or EPS 798	Computer Science Graduate Internship or Advanced Individual Study	3
Credit Hours		6
Total Credit Hours		30

Sample Plan of Study - Marketing

Year One		
Fall		Credit Hours
Full Term Fall A/B		
CSC 615	Introduction to Python Programming for Graduate Students	3
JMM 622	Introduction to Infographics and Data Visualization	3
Fall A ¹		
MKT 640	Foundations of Marketing Management	2
MKT 641	Marketing Research and Decision Making	2
Fall B		

MKT 646	Consumer Behavior	2
MKT 647	Advertising and Communications Management	2
Credit Hours		14
Spring		
Full Term Spring A/B		
CSC 646	Introduction to Machine Learning with Applications	3
EPS 702	Quantitative Methods II	3
Spring A		
MKT 649	Strategic Brand Marketing	2
MKT 677	Strategic Digital Media Management	2
Spring B		
MKT 650	Strategic Marketing	2
MKT 675	Marketing Analytics	2
Credit Hours		14
Summer		
CSC 712 or MKT 699	Computer Science Graduate Internship or Directed Study	3
Credit Hours		3
Total Credit Hours		31

¹ MKT courses are 2-credit courses offered in 7-week A & B sessions throughout the Fall and Spring terms.

Student Learning Outcomes

Upon completion of the MS in Data Science, students will be able to:

1. Use mathematical, statistical, and computational techniques to analyze large datasets, including collecting data, cleaning data, integrating multiple data sets, and applying the analytical techniques to the data.
2. Write computer programs for accomplishing the aforementioned analysis tasks and the analysis results obtained.
3. Interpret domain data appropriately, and provide insights into the data at hand.
4. Communicate the results of their analysis clearly to the relevant people, including decision-makers, stakeholders, and managers.
5. Generalize data analysis skills to problems in a real-world setting.

Specific to the individual tracks.

(a) For the Technical Data Science track

1. Use machine learning to discover the underlying structures and relationships in large datasets.
2. Apply data analysis and data mining to identify patterns in large datasets and develop classification/prediction models.
3. Deploy appropriate tools for visualizing data and their analysis results.

(b) For the Smart Cities track:

1. Use data science techniques to collect and analyze data from buildings and infrastructure.
2. Use data analysis and visualization skills to inform the design, development, and management of sustainable and resilient environments.

(c) For the Data Visualization track:

1. Use interactive and static visualization techniques for communication and dissemination to audiences with diverse levels of technological background/sophistication.
2. Use visualization techniques for advocacy.

(d) For the Marine and Atmospheric Science track:

1. Use public, private data sets, and their aggregates for domain-specific inquiries.
2. Analyze data that covers large areas over time.
3. Use data science skills to develop plans for analysis and execute them.
4. Apply appropriate technologies to analyze marine and atmospheric data.

(e) For the Educational Measurement & Statistics track:

1. Demonstrate adequate mastery in the advanced statistical and measurement methodology in social and behavioral sciences.
2. Demonstrate adequate mastery for conducting statistical analyses and database management in social and behavioral sciences using the R and SAS programs.

(f) For the Marketing track:

1. Develop models to assess the sales impact of advertising and promotions.
2. Use models to optimize media spend on both traditional channels (TV, radio), online channels (search engines) and social media channels as well as monitor brand equity, customer satisfaction, and customer needs.
3. Develop models for Customer Relationship Management, dynamic pricing, revenue management, sales forecasting, sales force optimization, linking marketing actions to firm value, and balancing the trade-offs between e-Commerce and brick and mortar distribution system