DATA SCIENCE AND APPLIED ARTIFICIAL INTELLIGENCE, MS

Data Everywhere

There has been an explosion of data over the last decade. Everything that people do like listening to music, streaming shows, using social media or rideshares generates data. In fact, almost everything that goes on in the world today is measured and recorded somewhere. Analyzing that data can vastly improve human lives and business performance. So, it's not surprising that analytics are now used routinely even in fields that did not use much data before like the Arts, Music, and Creative Writing. Analytics are also extensively deployed in Business, Engineering and Manufacturing and Government and even in many not-for-profit sectors like education, fundraising and social welfare. It is safe to say that virtually all human activity that affects our lives uses analytics in some way today. Visit this link *(*https://uwm.edu/data-science/*) for more information on how UWM prepares students for careers in data science fields.*

Why should you Consider a Master of Science in Data Science (MSDS)?

With every field turning to data to improve decision-making and performance, Data Science is one of the fastest growing professions today but there aren't enough trained data analysts to fill that need. A Master's degree in Data Science that trains you to analyze data can therefore help you in finding jobs with attractive salaries.

A report from the employment outlook firm Burning Glass produced jointly with IBM and the Business Higher Education Forum identified several job categories in the data science and analytics field, including data driven decision makers ("leverage data to inform strategic and operational decisions") and functional analysts ("utilize data and analytical models to inform specific functions and business decisions"). They estimated a national demand of 1.8 million job postings nationwide for 2020, with a 5-year growth rate of approximately 15%. Importantly, the report also states: "39% of Data Scientists and Advanced Analysts require a Master's or Ph.D. These degrees take additional years of schooling to complete, so it will take a significant time investment to train a larger pool of workers. Therefore, because these roles are already undersupplied and projected to grow rapidly, the skills shortage is in danger of worsening."

The Bureau of Labor Statistics also projects that Computer and Information Research Scientists category of jobs will grow 15% over the 2019-2029 period and describes this as: "…much faster than average for all occupations[1] (p.). Job prospects are expected to be excellent" and states that the "median annual wage for computer and information research scientists was $126,830 in May 2020." BLS also classifies this as a category in which most jobs require a master's degree.

Additional evidence of demand is also seen in investments made by employers like Northwestern Mutual that have invested significant resources of $15 million in the establishment of the Northwestern Mutual Data Science Institute to support the launch and growth of undergraduate and graduate programs related to data including data science and data analytics.

Flexible Curriculum

We understand the needs of working professionals and offer an in-person or online program that will both build your career and enhance your professional networking opportunities. Fulfill your professional goals through a wide selection of courses offered in on-campus, online, and hybrid delivery options.

MS Data Science Courses

To see a list of current classes available for the MS Data Science degree please see our MS Data Science Current Classes (https://uwm.edu/graduateschool/msds-current-classes/) page.

For a complete listing of ALL classes related to the degree please see the Requirements tab (https://catalog.uwm.edu/graduate-school/data-science-applied-artificial-intelligence-ms/#requirementstext).

Why UWM?

The MSDS at UWM is unique because its goal is to train graduates to practice data analytics in a field they are most passionate about. For example, if your interest is healthcare, you can become a data analyst in healthcare. If your passion is education, you can get the training to become an analyst in the field of education. The MSDS is therefore designed to give you the flexibility to build a career in data science in whatever field you want. For more information about the M.S. in Data Science program please attend one of our upcoming Information Sessions (https://uwm.edu/data-science/academics/data-science-ms/information-sessions/).

Ready to Apply?

The Data Science program is a multidisciplinary program. To apply, visit this link (https://uwm.edu/applygrad/).

[1] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, Computer and Information Research Scientists, at https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm (visited *January 04, 2022*)

Admission Requirements

Application Deadlines

Application deadlines vary by program, please review the application deadline chart (http://uwm.edu/graduateschool/program-deadlines/) for specific programs. Other important dates and deadlines can be found by using the One Stop calendars (https://uwm.edu/onestop/dates-and-deadlines/).

Admission

For admission to the M.S. in Data Science and Applied Artificial Intelligence program, students must meet the general requirements of admission to a graduate program at UW-Milwaukee. As stated by the Graduate School, these requirements include: (1) a baccalaureate degree, or its equivalent as determined by the UWM Center on International Education, from a regionally accredited institution, completed before the first term of enrollment in the Graduate School; (2) Proficiency in the English language; and (3) A minimum cumulative undergraduate grade point average (GPA) of 2.75 on a 4.0 scale, or an equivalent measure on a grading system that does not use a 4.0 scale. Applications must include

a reason statement, at least one letter of recommendation, and other materials as specified in the graduate application system. Incomplete applications will not be considered.

Students applying to the program are expected to have proficiency, demonstrated through coursework, exams or a portfolio, in the following areas: Linear Algebra (3 credits), Multivariable Calculus (4 credits), Statistics (3 credits), and Computer Literacy (6 credits). Those without these proficiencies may be admitted when they have 6 credits or fewer of the proficiency requirements remaining to be completed, but proficiency coursework does not count towards the MS.

Ready to Apply?

The Data Science program is a multidisciplinary program. To apply, visit this link (https://admissions.uwm.edu/register/?id=442d088c-4d8a-4572-be4e-00a5267ed73b).

Credits and Courses

Code	Title	Credits
Core Areas		
Complete 18 credits; 1 course from each sub-area below:		
Developing insights from data for applications [1]		*3*
Complete 1 course:		
ATM SCI 600G	Data Analytics	
COMPSCI 425G	Introduction to Data Mining	
ED PSY 821	Psychometric Theory and Scale Development	
ED PSY 822	Item Response Theory	
ED PSY 823	Structural Equation Modeling	
ED PSY 824	Advanced Experimental Design and Analysis	
ED PSY 825	Multivariate Methods	
ED PSY 826	Analysis of Cross-Classified Categorical Data	
ED PSY 827	Survey Research Methods	
ED PSY 832	Theory of Hierarchical Linear Modeling	
INFOST 582G	Introduction to Data Science	
Organizing and maintaining large data sets		*3*
Complete 1 course:		
BUS ADM 749	Data and Information Management	
COMPSCI 557G	Introduction to Database Systems	
INFOST 691G	Special Topics in Information Science: (Topic: Data Management and Curation)	
INFOST 714	Metadata	
INFOST 785	Database Management Systems for Information Professionals	
PH 718	Data Management and Visualization in R	
AI and Machine Learning to extract insight from Data		*3*
Complete 1 course:		
BUS ADM 767	Ideas and Applications of Data Science in Different Fields	
COMPSCI 411G	Machine Learning and Applications	
COMPSCI 422G	Introduction to Artificial Intelligence	
COMPSCI 710	Artificial Intelligence	
COMPSCI 711	Introduction to Machine Learning	
ECON 710	Applied Econometrics	
INFOST 687G	Data Analysis for Data Science	
MATH 804	Industrial Mathematics II	
Probabilistic methods to analyze uncertainty in data		*3*
Complete 1 course:		
ATM SCI 500G	Statistical Methods in Atmospheric Sciences	
ATM SCI 700	Statistical Methods in Atmospheric Sciences II: Signal Detection	
BUS ADM 754	Statistical Analysis	
BUS ADM 713	Business Forecasting Methods	
BUS ADM 714	Multivariate Techniques in Management Research	
BUSMGMT 709	Predictive Analytics for Managers	
COMPSCI 720	Computational Models of Decision Making	
COMPST 701	Computing Fundamentals for IT Professionals	
ECON 411G	Economic Forecasting Methods	
ECON 413G	Statistics for Economists	
ECON 513G	Introduction to Econometrics	
or ECON 703	Econometrics	
ECON 835	Time Series and Financial Econometrics	
ED PSY 724	Statistical Methods for Professionals and Practitioners II	
ED PSY 820	Multiple Regression	
GEOG 737	Qualitative Research	
GEOG 747	Spatial Analysis	
IND ENG 575G	Design of Experiments	
IND ENG 765	Advanced Mathematical Optimization: Algorithms, Math Modeling, and Theory	
MATH 783	Introduction to Probability Models	
MTHSTAT 361G	Introduction to Mathematical Statistics I	
MTHSTAT 362G	Introduction to Mathematical Statistics II	
MTHSTAT 563G	Regression Analysis	
or MTHSTAT 763	Regression Analysis	
MTHSTAT 564G	Time Series Analysis	
or MTHSTAT 764	Time Series Analysis	
MTHSTAT 871	Mathematical Statistics I	
MTHSTAT 872	Mathematical Statistics II	
PH 702	Introduction to Biostatistics	
PH 711	Intermediate Biostatistics	
PH 818	Statistical Computing	
POL SCI 701	Techniques of Political Science Research	
POL SCI 702	Advanced Techniques of Political Science Research	
PSYCH 510G	Advanced Psychological Statistics	
PSYCH 610G	Experimental Design	
SOCIOL 461G	Social Data Analysis Using Regression	

SOCIOL 760	Advanced Statistical Methods in Sociology	
SOCIOL 982	Advanced Quantitative Analysis	
Advanced Programming for Data Collection and Data Science		*3*
Complete 1 course:		
BUSMGMT 744	R Programming for Business Analytics	
COMPST 702	Introductory Programming Using Python	
COMPST 751	Data Structures and Algorithms	
INFOST 350G	Introduction to Application Development	
MTHSTAT 566G	Computational Statistics	
or MTHSTAT 766	Computational Statistics	
URBPLAN 794	Internet Geographic Information Systems (GIS)	
Ethics and Society		*3*
Complete 1 course:		
BUS ADM 743	Information Privacy, Security & Continuity	
INFOST 465G	Legal Aspects of Information Products and Services	
INFOST 583G	Survey of Information Security	
INFOST 660G	Information Policy	
INFOST 661G	Information Ethics	
INFOST 784	Information Security Management	
Electives [2, 3]		**12**
Complete 4 courses:		
ANTHRO 380G	Anthropological Applications of GIS	
ANTHRO 562G	Techniques and Problems in Archaeology	
ANTHRO 768	Topics in Advanced Research Design in Anthropology	
ART 313G	Creative Coding:	
ART 316G	Creative Interfaces:	
ART 317G	3D Environments and XR	
ART 427G	Advanced Design Workshop:	
ART 526G	Research in Universal Design and Fabrication	
BUS ADM 741	Web Mining and Analytics	
BUS ADM 742	Big Data in Business	
BUS ADM 745	Artificial Intelligence for Business	
BUS ADM 763	Marketing Analytics	
BUS ADM 769	Database Marketing	
BUS ADM 812	Machine Learning for Business	
BUS ADM 813	Social Media Analytics for Business	
BUS ADM 816	Business Intelligence Technologies & Solutions	
BUS ADM 817	Connected Systems for Business	
COMPSCI 423G	Introduction to Natural Language Processing	
or COMPSCI 723	Natural Language Processing	
COMPSCI 444G	Introduction to Text Retrieval and Its Applications in Biomedicine	
or COMPSCI 744	Text Retrieval and Its Applications in Biomedicine	
COMPSCI 469G	Introduction to Computer Security	
COMPSCI 535G	Algorithm Design and Analysis	
COMPSCI 704	Analysis of Algorithms	
COMPSCI 712	Image Processing	
COMPSCI 725	Robot Motion Planning	
COMPSCI 755	Information and Coding Theory	
COMPSCI 759	Data Security	
COMPSCI 811	Advanced Machine Learning	
CRM JST 520G	Analysis Oriented Technology: Spatial Data Analysis; Crime Mapping; ArcGIS	
CRM JST 713	Measuring Crime & Analyzing Crime Data	
CRM JST 716	Advanced Analytic Techniques for Crime Analysts	
CRM JST 910	Methods and Practice Capstone for Crime Analysts	
ECON 734	Econometrics and Machine Learning Methods	
ECON 735	Causal Inference and Panel Data Econometrics	
ED PSY 821	Psychometric Theory and Scale Development	
ED PSY 822	Item Response Theory	
ED PSY 823	Structural Equation Modeling	
ED PSY 824	Advanced Experimental Design and Analysis	
ED PSY 825	Multivariate Methods	
ED PSY 826	Analysis of Cross-Classified Categorical Data	
ED PSY 827	Survey Research Methods	
ED PSY 832	Theory of Hierarchical Linear Modeling	
GEOG 704	Remote Sensing: Environmental and Land Use Analysis	
GEOG 705	Cartography	
GEOG 716	Watershed Analysis and Modeling	
GEOG 726	Geographic Information Science	
GEOG 804	Advanced Remote Sensing	
GEOG 826	Intermediate Geographic Information Science	
INFOST 584G	Survey of Web and Mobile Content Development	
INFOST 671G	Applied Web 3.0: Artificial Intelligence and Blockchain	
INFOST 695G	Ethical Hacking I	
INFOST 696G	Ethical Hacking II	
INFOST 771	Data Curation	
MATH 803	Industrial Mathematics I	
PH 812	Statistical Learning & Data Mining	
POL SCI 390G	Political Data Analysis	
POL SCI 392G	Survey Research	
SOCIOL 750	Research Methods in Sociology	
SOCIOL 952	Social Network Analysis	

URBPLAN 692G	Special Topics in Urban Planning: (Topic: Transportation Planning and GIS)
URBPLAN 791	Introduction to Urban Geographic Information Systems for Planning
URBPLAN 792	Using Urban Geographic Information Systems (GIS) for Planning
Optional: Internship/Thesis Capstone [4]	
BUS ADM 799	Reading and Research
COMPSCI 990	Masters Thesis
COMPSCI 995	Master's Capstone Project
ECON 790	Research Seminar for M.A. Students
ED PSY 790	Research or Thesis
ED PSY 799	Independent Reading
GEOG 798	GIS/Cartography Internship
GEOG 890	Research and Master Thesis
GEOG 999	Independent Work
INFOST 897	Information Science and Technology Independent Study
INFOST 991	Fieldwork in Information Science and Technology
MATH 890	Master's Thesis
MATH 892	Industrial Internship
URBPLAN 793	Applied Projects in Urban Geographic Information Systems
URBPLAN 991	Legislative/Administrative Agency Internship
URBPLAN 999	Independent Study
Qualifying Exam [5]	
Total Credits	**30**

1 The ED PSY courses in this category can either count in the *Developing Insights* category or as elective courses. There is no double counting of ED PSY courses.

2 INFOST 691 (Topic: Artificial Intelligence and Disruptive Technologies) may also be used as an elective. Every student's program of electives must be approved by the program director; students may be able to count as Electives some courses in the "core" categories not applied to the core requirements (subject to Director's approval). Students wishing to apply other courses not listed here towards these electives must have each course approved by the program director.

3 One of the ED PSY elective courses can be taken as a *Developing Insights* course. There is no double counting of ED PSY courses.

4 Of the required 12 elective credits, up to 3 degree credits may be awarded for a thesis or internship. Students who choose this option must complete a relevant thesis or internship that is approved by the program director. Students who choose to complete a thesis must work with a thesis advisor and have the thesis approved by the advisor and the program director. Students who choose to pursue an internship must also obtain approval from the program director. Students may select from courses such as those listed in the table or enroll for thesis credits with their thesis advisor (in the advisor's department).

5 Students who do not choose to pursue the optional capstone course/thesis/internship option are required to pass a qualifying exam. During this exam, students are given a data set and a research problem to be addressed with the data, using data science techniques. Students must submit a final report in which they use the provided data set to address the research question and demonstrate that they have developed a sufficient level of expertise to work as a data scientist. This is a take-home exam.

Additional Requirements

Major Professor as Advisor

Admitted students are assigned a faculty advisor who will work with the student to assemble a program of study.

Time Limit

The student must complete all degree requirements within five years of initial enrollment.

Data Science MS Learning Outcomes

Students in the M.S. program in Data Science will:

1. Develop insights from data, for applications.
2. Learn how to work with large data sets.
3. Gain experience in advanced computer programming for data science.
4. Become skilled in specific areas of data science such as artificial intelligence and machine learning.
5. Understand how to deal with uncertainty which is an inherent characteristic of data science.
6. Recognize and internalize the importance of ethical use of data and data science.