DATA SCIENCE, MSE

Penn's Master of Science in Engineering (MSE) in Data Science prepares students for a wide range of data-centric careers, whether in technology and engineering, consulting, science, policy-making, or understanding patterns in literature, art or communications.

The Data Science Program can typically be completed in one-and-a-half to two years. It blends leading-edge courses in core topics such as machine learning, big data analytics, and statistics, with a variety of electives and an opportunity to apply these techniques in a domain specialization of choice.

The domain specialization offers both preparatory coursework and a thesis or practicum in a data science application area. Potential areas of specialization include network science (the Warren Center for Network and Data Science), digital humanities (the Price Lab for Digital Humanities), biomedicine (the Institute for Biomedical Informatics), and public policy (the Penn Wharton Budget Model and the Annenberg Center for Public Policy) — as well as more traditional opportunities in Computer and Information Science and Electrical and Systems Engineering. For students interested in applying data analysis and modeling to other areas within engineering and the physical sciences, Penn offers a specialized and synergistic program in Scientific Computing.

For more information: https://dats.seas.upenn.edu/program/

For students interested in learning more about **MSE-DS Online**, click here (https://online.seas.upenn.edu/degrees/mse-ds-online/).

Curriculum

10 course units are required for the Data Science degree.[1]

Code	Title	Course Units
Foundations (2 cu's)		
CIT 5900	Programming Languages and Techniques	1
or CIT 5910	Introduction to Software Development	
Select one of the following:		
CIS 5150	Fundamentals of Linear Algebra and Optimization	1
or MATH 5130	Computational Linear Algebra	
Core Requirements (3 cu's)		
ESE 5420	Statistics for Data Science	1
CIS 5450	Big Data Analytics	1
Select one of the following:		
CIS 5190	Applied Machine Learning	1
or CIS 5200	Machine Learning	
or STAT 5710	Modern Data Mining	
or ENM 5310	Data-driven Modeling and Probabilistic Scientific Computing	
or ESE 5450	Data Mining: Learning from Massive Datasets	
Technical Electives (5 cu's)		
Students must choose from at least 3 of the buckets listed below		5
Total Course Units		**10**

[1] The ten course units for the Data Science degree are divided into three categories: Foundations, Core Requirements and Technical Electives. (As long as the prerequisites for the courses are met, students can complete these courses in any sequence)

Technical Electives [1]

Code	Title	Course Units
Applications		
A. TitleThesis/Practicum (two course units)		
Register for 2 course units of DATS 5970 Master's Thesis Research/Master's Thesis or 2 course units of DATS 5990 Master's Indep Study/Master's Independent Study. [2]		
B. Bio medicine		
BE 5210	Brain-Computer Interfaces	
BE 5660	Networked Neuroscience	
BMIN 5210	Advanced Methods and Health Applications in Machine Learning	
BMIN 5220	Natural Language Processing for Health	
CIS 5360	Fundamentals of Computational Biology	
CIS 5370	Biomedical Image Analysis	
PHYS 5585	Theoretical and Computational Neuroscience	
C. Social/Network Science		
CIS 5230	Ethical Algorithm Design	
ECON 7300	Econometrics I: Fundamentals	
ECON 8310	Econometrics III: Advanced Techniques of Cross-Section Econometrics	
ECON 8320	Econometrics IV: Advanced Techniques of Time-Series Econometrics	
MKTG 7760	Applied Probability Models in Marketing	
D. Data-centric Programming		
CIS 5050	Software Systems	
CIS 5500	Database and Information Systems	
CIS 5520	Advanced Programming	
CIS 5550	Internet and Web Systems	
CIS 5590	Programming and Problem Solving	
CIS 5730	Software Engineering	
CIT 5950	Computer Systems Programming	
E. Surveys and Statistical Methods		
MKTG 7120	Data and Analysis for Marketing Decisions	
OIDD 6120	Business Analytics	
STAT 9200	Sample Survey Methods	
STAT 9210	Observational Studies	
STAT 9740	Modern Regression for the Social, Behavioral and Biological Sciences	
STAT 6210	Accelerated Regression Analysis for Business	
STAT 5350	Forecasting Methods for Management	
STAT 7220	Predictive Analytics for Business	
F. Data Analysis, Artificial Intelligence		
CIS 5210	Artificial Intelligence	
CIS 5220	Deep Learning for Data Science	

CIS 5300	Natural Language Processing
CIS 5800	Machine Perception
CIS 5810	Computer Vision & Computational Photography
CIS 6200	Advanced Topics in Machine Learning
CIS 6250	Theory of Machine Learning
CIS 6800	Advanced Topics in Machine Perception
ESE 5140	Graph Neural Networks
ESE 6500	Learning in Robotics
STAT 5710	Modern Data Mining
ESE 5460	Principles of Deep Learning
G. Simulation Methods for Natural Science / Engineering	
CBE 5250	Molecular Modeling and Simulations
CBE 5440	Computational Science of Energy and Chemical Transformations
CBE 5590	Multiscale Modeling of Chemical and Biological Systems
MEAM 5270	Finite Element Analysis
MEAM 6460	Computational Mechanics
MSE 5610	Atomic Modeling in Materials Science
H. Mathematical and Algorithmic Foundations	
AMCS 5141	Advanced Linear Algebra
CIS 5020	Analysis of Algorithms
CIT 5960	Algorithms and Computation
CIS 6770	Advanced Topics in Algorithms and Complexity
ENM 5020	Numerical Methods and Modeling
ESE 5030	Simulation Modeling and Analysis
ENM 5310	Data-driven Modeling and Probabilistic Scientific Computing
ESE 5450	Data Mining: Learning from Massive Datasets
ESE 6050	Modern Convex Optimization
ESE 6740	Information Theory
OIDD 9300	Stochastic Models
STAT 5150	Advanced Statistical Inference I
STAT 9270	Bayesian Statistical Theory and Methods

[1] Students must choose courses from 3 different buckets.

[2] Suggestions for projects will be provided to students. Students may choose from these suggested projects or may also come up with their own project/advisor ideas. Students will be mentored jointly by the Program Director and by an advisor in the area of the project, and must receive approval by Faculty Director.

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2023 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.

Penn's online Master of Science in Engineering (MSE) in Data Science builds on the achievements of its on-campus counterpart, preparing students for a wide range of data-centric careers, whether in technology and engineering, consulting, science, policy-making, or understanding patterns in literature, art or communications. No matter the discipline, fluency with data analysis methods is becoming essential in today's world.

Flexible and accessible in its online format, MSE-DS Online is available for both the full-time and part-time student. Its curriculum dives deeply into topics such as artificial intelligence, big data systems, data science for health, deep learning, natural language processing, internet and web systems, machine learning, etc. Graduates in MSE-DS Online will be able to apply a background in scalable, robust computational and statistical methods in whatever field they choose to pursue.

For more information: https://online.seas.upenn.edu/degrees/mse-ds-online/

For students interested in learning more about the MSE in Data Science on campus program, click here (https://dats.seas.upenn.edu/program/).

Curriculum

10 course units are required for the MSE-DS Online degree. The ten course units are divided into three categories: Core Courses, Technical Electives and Open Electives. (As long as the prerequisites for the courses are met, students can complete these courses in any sequence.)

Code	Title	Course Units
Core Courses		**4**
CIS 5450	Big Data Analytics	
CIS 5500	Database and Information Systems	
ESE 5410	Machine Learning for Data Science	
ESE 5420	Statistics for Data Science	
or CIS 5150	Fundamentals of Linear Algebra and Optimization	
Only one (ESE 5420 or CIS 5150) can be taken to satisfy the MSE-DS Core.		
Technical Electives		**4**
CIS 5210	Artificial Intelligence	
CIS 5300	Natural Language Processing	
ESE 5460	Principles of Deep Learning	
CIS 5510	Computer and Network Security	
CIS 5550	Internet and Web Systems	
CIS 5810	Computer Vision & Computational Photography	
CIT 5820	Blockchains and Cryptography	
Open Electives		**2**
CIS 5470	Software Analysis	
CIS 5490	Wireless Communications for Mobile Networks and Internet of Things	
CIS 5530	Networked Systems	
DATS 5750	Cloud Technologies Practicum	
DATS 5990	Master's Independent Study	
Or one of the Core Courses or Technical Electives		
Note: Students may take CIT 5950 Computer Systems Programming and/or CIT 5960 Algorithms and Computation as one of the two Open Electives.		
Total Course Units		**10**

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2023 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.