

# DATA SCIENCE & QUANTITATIVE ECONOMICS (M.S.)

## Overview

The economics and computer and information sciences (CIS) departments offer an interdisciplinary M.S. degree program in data science and quantitative economics. This interdisciplinary degree program was developed in response to the increasing importance of computational methods and data analytic skills in the job market.

Students who pursue this degree option gain a deeper understanding of economic theory and computational methods, while engaging in research projects that link data science and economics. This degree entails 10 courses (30 credits) essential to both economic and data science domains, which can be taken sequentially or concurrently as needed.

The benefit of this program is that it allows students to combine powerful theoretical approaches with modern tools to understand complex problems. It prepares students well for careers in data-driven professions by providing strong analytic training with hands-on applications across a variety of fields such as finance, health policy, environmental policy, economic development, family and disability studies, and monetary policy.

## Learning Goals

The master's in data science & quantitative economics program enables students to attain, by the time of graduation:

- A background in economic theory through instruction in ECON 6010 Microeconomic Theory I and ECON 6020 Macroeconomic Theory I.
- Updated skills in math and statistics through CISC 5450 Mathematics for Data Science or ECON 5710 Mathematical Analysis in Economics, and through ECON 6910 Applied Econometrics or ECON 6950 Financial Econometrics.
- Advanced technical skills to build and assess computational models and apply data science concepts and methods to economics data through CISC 5790 Data Mining and CISC 5800 Machine Learning.
- An understanding of the theoretical framework of big data processing and hands-on experience in big data analytics and its applications.
- An ability to effectively communicate data science-related information to any audience and transform findings into actionable solutions to real-world problems.

## CIP Code

45.0603 - Econometrics and Quantitative Economics.

You can use the CIP code to learn more about career paths associated with this field of study and, for international students, possible post-graduation visa extensions. Learn more about CIP codes and other information resources.

## Admissions

The M.S. in data science & quantitative economics has the same admissions requirements as the M.A. in economics and the M.S. in data science.

These requirements are: completed online application, 3 letters of recommendation (for non-Fordham students, 2 letters for Fordham undergraduates), official transcripts from all prior undergraduate and/or graduate institutions, statement of intent, official GRE test scores, and official TOEFL or IELTS scores for non-native English speakers.

## English Proficiency Requirements

International applicants whose native language is not English are required to complete and submit to GSAS prior to matriculation their official scores from one of the following accepted English language competency exams:

- Test of English as a Foreign Language (TOEFL) - GSAS accepts the following TOEFL tests:
  - TOEFL iBT (including the Home Edition and Paper Edition)
  - TOEFL Essentials
- International English Language Testing System (IELTS)—Cambridge English Proficiency Level
- Duolingo English Test
- PTE Academic
- Cambridge English Qualifications - We accept the B2 First, C1 Advanced, or C2 Proficiency exams

Official TOEFL, IELTS, DET, PTE Academic, or Cambridge English Qualifications scores should be sent directly by the testing service to the Office of Graduate Admissions, Fordham University, Graduate School of Arts and Sciences (our ETS TOEFL score code #2259).

Preferred minimum score requirements:

Exam	Score
TOEFL iBT	100
IELTS	7.0 band score
DET	130
PTE Academic	68
Cambridge English Qualifications	185 Overall Score on the B2, C1 Advanced, or C2 Proficiency exam

## Exemptions to the English Language Requirement

Exemptions from this requirement can be requested by the applicant in her/his application, or can be made in writing by the applicant to fuga@fordham.edu. Exemptions are generally permitted for international applicants who:

1. are native English speakers from countries where English is an official language; and/or
2. have completed, within the past five years, at least two years of study at an undergraduate or graduate institution in the United States or in a country where English is the official language of instruction.

GSAS retains the right to request language evaluation from any applicant. The Fordham English Language Test (FELT), administered by Fordham's Institute of American Language and Culture (IALC), may be required for

those students whose English proficiency scores do not meet GSAS program requirements. Additional coursework may also be recommended by the IALC.

Students are permitted to register for two GSAS courses during the academic term in which they are completing any IALC-recommended coursework, which generally occurs during their first semester of study.

Please note: Tuition costs associated with the learning of English as a second language are the responsibility of the student and will not be covered by a GSAS tuition scholarship. GSAS merit-based tuition scholarships are not applicable to the costs of additional coursework recommended by the IALC.

For more information about admissions to the Graduate School of Arts and Sciences, please visit their page on the Fordham website.

## Prerequisites

### Economics

An undergraduate degree in a field emphasizing economics and/or quantitative skills—such as a degree in economics or mathematical economics; or a degree in math, finance, psychology, computer science, or business with a minor in economics—is expected. The following courses or equivalent should be taken prior to beginning the M.S. in data science & quantitative economics program:

- Intermediate-level Macroeconomics and Microeconomics
- Math for Economists OR Calculus I and Linear Algebra
- Statistics I and Statistics II

If these classes were not completed with a previous degree, then the required classes will be added to a student's admission. These classes must be taken in the first semester or prior to beginning the program (e.g., during the summer or previous semester). Alternatively, we offer a "bridge course," ECON 5012 Foundations of Economics, for students in quantitative fields without an economics background. This bridge course can be taken concurrently with courses that fulfill degree requirements.

### Data Science

- Applicants with undergraduate degrees in non-computer science areas are welcome.
- An undergraduate degree in a field emphasizing quantitative skills is expected, such as a degree in computer science, information science, engineering, math, physical science, health science, business, economics, psychology, social science, or urban and city planning.
- Knowledge of discrete math, probability and statistics, including permutations, combinations, descriptive statistics, and basic probabilities concepts.
- Basic programming knowledge and a familiarity with Python programming is expected. This knowledge can be acquired via completion of CISC 5380 Programming with Python.

Admitted students who seek to bypass CISC 5380 Programming with Python must take a placement examination (CISC 0940), which is administered by the Computer and Information Sciences department prior to the beginning of each entry term. The exam covers fundamentals of Python programming language. Students who earn a grade lower than a B are required to enroll in CISC 5380 Programming with Python in their

first semester of study. This bridge course can be taken concurrently with courses that fulfill degree requirements.

## Requirements

The M.S. in data science & quantitative economics requires completion of 30 credits, as follows:

Course	Title	Credits
<b>Economics Core</b>		
ECON 6010	Microeconomic Theory I	3
ECON 6020	Macroeconomic Theory I	3
ECON 6910 or ECON 6950	Applied Econometrics Financial Econometrics	3
<b>Data Science Core</b>		
CISC 5790	Data Mining	3
CISC 5800	Machine Learning	3
<b>Math Core</b>		
ECON 5710 or CISC 5450	Mathematical Analysis in Economics Mathematics for Data Science	3
<b>Electives</b>		
<i>One Economics elective drawn from any of the following areas:</i> <sup>1</sup>		3
Applied Microeconomics		
Finance		
Special Topics		
<i>One Data Science elective</i> <sup>2</sup>		3
<i>One Economics OR Data Science elective</i> <sup>1</sup>		3
<b>Capstone/Internship/Thesis (one of the following)</b>		<b>3</b>
<i>Capstone Project Option</i>		
CISC 6080 or ECON 6080	Capstone Project in Data Science Capstone Project in Economics	
<i>Internship Option</i>		
CISC 6081 or ECON 6081	Data Science Practicum Economics Practicum	
<i>Thesis Option</i> <sup>3</sup>		
Select one of the following:		
CISC 6085 & CISC 6086	Master's Thesis in Data Science I and Master's Thesis in Data Science II	
ECON 6085 & ECON 6086	Master's Thesis in Economics I and Master's Thesis in Economics II	
<b>Total Credits</b>		<b>30</b>

<sup>1</sup> See below for lists of courses fulfilling this requirement. Economics electives can be drawn from any of the three areas.

<sup>2</sup> See list below of courses that fulfill this requirement.

<sup>3</sup> Completion of a thesis requires 6 credits. Students who complete a 6-credit thesis will take one less elective as part of the degree.

## Economics Electives

### Applied Microeconomics elective courses

*Courses in this group have the EDAM attribute.*

Course	Title	Credits
ECON 5105	Topics in Economic History	3
ECON 5260	Epidemics and Development Policy	3
ECON 5280	Urban Economics	3
ECON 5415	Gender & Economic Development	3
ECON 5590	Health Economics	3
ECON 5600	Health and Development	3
ECON 6440	Development Economics	3
ECON 6460	Agriculture and Development	3
ECON 6480	Environmental and Resource Economics	3
ECON 6970	Applied Microeconometrics	3

## Finance elective courses

*Courses in this group have the EDFI attribute.*

Course	Title	Credits
ECON 5006	Programming Economics and Finance	3
ECON 6240	Financial Economics	3
ECON 6340	Financial Theory	3

## Specialized Topics elective courses

*Courses in this group have the EDST attribute.*

Course	Title	Credits
ECON 5730	Econometrics and Finance Using R - Part I	3
ECON 5750	Game Theory	3
ECON 5760	Computational Macroeconomics/Finance	3
ECON 6310	Monetary Policy	3
ECON 6320	Monetary Theory	3
ECON 6470	Growth and Development	3
ECON 6510	International Trade	3
ECON 6530	International Economics of Growth and Development	3
ECON 6560	International Finance	3
ECON 6990	Topics in Econometric Theory	3

## Data Science Electives

*Courses in this group have the EDDS attribute.*

Course	Title	Credits
CISC 5325	Database	3
CISC 5500	Data Analytics Tools and Scripting	3
CISC 5550	Cloud Computing	3
CISC 5640	Nosql Database Systems	3
CISC 5835	Algorithms for Data Science	3
CISC 5900	Information Fusion	3
CISC 5950	Big Data Computing	3
CISC 6000	Deep Learning	3
CISC 6210	Natural Language Processing	3
CISC 6525	Artificial Intelligence	3
CISC 6745	Data Visualization	3