BACHELOR OF SCIENCE IN DATA SCIENCE

Program Contact: Jill Shahverdian (Jill.Shahverdian@qu.edu)
203-582-3663

The BS in Data Science program teaches students to analyze data, interpret data and draw meaningful conclusions. Students learn the mathematical and statistical foundations of data science and how those principles may be applied to cutting-edge tools and technology. Our project-based courses provide the opportunity for students to use the analytic skills and technical knowledge of data science to investigate a question in their minor (or second major).

Glassdoor has ranked data scientist as the best job in America for four consecutive years. Opportunities requiring this skillset develop across nearly all industry sectors including finance and insurance; healthcare and social assistance; manufacturing; professional, scientific and technical services; and retail trade.

Students majoring in Data Science must meet the following requirements for graduation. Note: a C- or better is required for all program prerequisites, unless otherwise stated. Students are required to maintain a GPA of 2.00 or better for all courses used to fulfill the Data Science major.

Code	Title	Credits
University Curriculum [1]		**46**
Modern Language Requirement		**3-6**
Data Science Core Courses		**37**
DS 110	Introduction to Data Science	
CSC 110 & 110L	Programming and Problem Solving and Programming and Problem Solving Lab	
or CSC 106	Introduction to Programming for Engineers	
DS 201	Introduction to Python	
MA 151	Calculus I	
MA 229	Linear Algebra	
MA 285	Applied Statistics	
or EC 272	Advanced Applied Statistics	
EC 365	Econometrics	
DS 310	Algorithms for Data Science	
DS 380	Data Mining	
DS 385	Machine Learning	
DS 480	Data Science Capstone	
Data Science Electives (Take two courses from the following list)		**6-8**
DS 215	Communicating with Data	
DS 350	Big Data	
EC 366	Advanced Econometrics	
CSC 325	Database Systems	
MA 153 & MA 154	Calculus II: Part A and Calculus II: Part B	
MA 251	Calculus III	
Minor Courses [2]		**18**
Free Electives		**11-14**
Total Credits		**120**

1

All students must complete the University Curriculum (http://catalog.qu.edu/academics/university-curriculum/) requirements.

2

Students enrolled in the Bachelor of Science in Data Science program are required to complete a minor (typically 18 credits) to complement the knowledge and skills developed in the major. Students may select a minor from any program within or outside of the College of Arts and Sciences.

Upon completion of the Data Science degree, students will:

- **Have a deep understanding** of the mathematical, statistical and computer science concepts necessary for data science.
- **Understand** the technology stack necessary to bring quantitative analysis to production in any industry or academic setting.
- **Utilize** complicated data and advanced machine learning models to solve real-world problems—whether that is predicting customer retention or identifying the impact of rain on floodplain soil conditions.
- **Leverage** these skills and expertise in a chosen domain (e.g., biology, business, economics, history, psychology).

DS 110. Introduction to Data Science. **3 Credits.**
This course introduces students to the foundations of data science and the impact that data science has had on modern society. Topics include the history of data science, descriptive statistics, data collection, an introduction to algorithms and algorithmic thinking, and the ethics of data science. No prior experience in statistics or programming is required.
Prerequisites: Take MA 107 or placement level of 3.
Offered: Every year, Fall and Spring
UC: Breadth Elective

DS 201. Introduction to Python. **1 Credit.**
This course is designed to bridge the gap between CSC106 or CSC110 and the CAS Data Science major. CSC106 and CSC110 provide an important introduction to concepts in computer science and programming. For new programmers, it can be difficult to apply these concepts to a new language. As such, DS201 applies these important concepts to the Python programming language.
Prerequisites: Take CSC 106 or CSC 110.
Offered: Every year, Spring

DS 205. Data, Data Everywhere. **3 Credits.**
This course is the first of two courses leading to the Google Data Analytics Professional Certificate. In this first course, the student will learn about the data life cycle and data analysis process, practical data analytic skills, data preparation, data ethics and data privacy. The student will use spreadsheets and SQL
Prerequisites: None
Offered: Every year, All

DS 206. Data Analytics Scenarios. **3 Credits.**
This course is a continuation of DS 205. Upon successful completion of DS 206 the student will earn the Google Data Analytics Professional Certificate. In this second course, the student will learn to organize and analyze data, visualize and present data findings, examine case study scenarios. The student will use Tableau and R. Prereq DS 205
Prerequisites: Take DS 205
Offered: Every year, All

DS 215. Communicating with Data. **3 Credits.**
Perhaps the most important skill a data scientist can have is the ability to effectively communicate about data. This is especially true in the context of many industries and academic disciplines relying on data to help people make decisions. This course is designed to guide students through the foundations of information visualization and communication using data. In some ways, it differs from many of the courses in the QU Data Science major - students will spend time thinking about color theory, decision-making, and storytelling. In other ways, it is quite similar, as we will investigate methods for dimensionality reduction in the context of visualizations. Importantly, we will also explore tools like Tableau that help practitioners to enrich their analysis.
Prerequisites: Take DS 110;
Offered: As needed, Spring

DS 230. Intermediate Special Topics. **3 Credits.**
This course covers special topics in data science at the intermediate level.
Prerequisites: None
Offered: As needed, All

DS 299. Independent Study Data Science. **1-6 Credits.**
This individual study in a specialized area is open to juniors and seniors by special arrangement with the department chairperson. This is a structured program of reading, problem solving and experiments established through conferences with a member of the data science faculty. Graded by examination or term project.
Prerequisites: None
Offered: As needed, All

DS 300. Tools for Data Science. **3 Credits.**
The course is designed to give students the tools to hit the ground running in a data science/computation production environment. Topics include collaboration and version control systems (git), Linux (Unix) command line programming, cloud computing (AWS), SQL/databases, and more. Some programming experience is required.
Prerequisites: Take CSC 110 or CSC 106 or CIS 245 or BAN 300; Minimum grade C-.
Offered: As needed

DS 310. Algorithms for Data Science. **4 Credits.**
Algorithms and computation are at the core of data science. This course introduces students to the underlying principles behind digital computation and algorithmic development for scientific purposes. Students also learn foundational algorithms for four common tasks: solving linear systems, determining least squares solutions, implementing unconstrained optimization, and using random number generation for simulation and statistical inference. Throughout the course, the advantages and disadvantages of each algorithm are explored, particularly as they relate to a dataset's properties.
Prerequisites: Take DS 110 DS 201 MA 151 MA 229 MA 285 or EC 272 Students must earn a C-
Offered: Every year, Fall

DS 330. Advanced Special Topics. **3 Credits.**
This course covers special topics in data science at the advanced level.
Prerequisites: None
Offered: As needed

DS 350. Big Data. **3 Credits.**
The term "Big Data" means many different things to many different people. For the purposes of this class, it will take on the following meaning - problems and data that are constrained by local memory. This is perhaps one of the largest problems for the modern data scientist. In industry, companies collect petabytes of data on customers and wish to extract value from it. Social sciences such as economics and political science, increasingly use large-scale micro-data to analyze individual behavior. And, of course, hard sciences like physics and genomics have struggled with massive datasets for decades. We will take both a theoretical and practical approach to addressing this issue. Specifically, this course will cover parallel algorithms, distributed computing, databases, cloud resources and computing, and "big data" technologies like Apache Spark.
Prerequisites: Take DS 310; Minimum grade C-.
Offered: As needed, Fall

DS 380. Data Mining. **3 Credits.**
This course introduces students to the concepts and techniques of data mining (the extraction of patterns from large data sets). Topics include data preprocessing, data warehouse architecture, online analytics processing (OLAP), frequent pattern mining, association rules mining, classification analysis.
Prerequisites: Take DS 310 Minimum grade C-
Offered: Every year, Spring

DS 385. Machine Learning. **3 Credits.**
This course introduces students to the theory of machine learning and practical applications. Topics include supervised learning, unsupervised learning, learning theory, regularization models, validation and models.
Prerequisites: Take DS 380. Minimum grade C-
Offered: Every year, Fall

DS 399. Applied Time Series Analysis and Forecasting. **3 Credits.**
Most real-world phenomena involve systems that change through time (e.g., stock market indices, population sizes, salinity levels in a body of water, etc.). Often, the past behavior of these phenomena provides predictive power for future behaviors. This course introduces students to time series analysis, a field of statistics that centers on mathematical relationships between the past and future and how to predict the future through forecasting. Topics include autocorrelation and partial autocorrelation functions, autoregressive models, moving average models, ARMA, ARIMA, and ARMAX. Additional topics may include seasonal models, state-space models and Kalman filtering, volatility models, and machine learning models for forecasting. In all cases, real-world applications and computer implementations in R or similar software are explored.
Prerequisites: Take MA 285 or EC 272; Minimum grade C-
Offered: As needed

DS 480. Data Science Capstone. **3 Credits.**
This course serves as a culminating experience for the Data Science major. Students work on an independent project that will allow them to integrate knowledge from their previous courses in the major and apply that knowledge to a problem in a domain of their interest.
Prerequisites: Take DS 385.
Offered: Every year, Spring

Shown below is one of many possible paths through the curriculum. Each student's individual academic plan is crafted in consultation with their academic adviser.

Code	Title	Credits
First Year		
Milestones: Earn 30 credits, meet with your adviser at least once a semester and have a GPA of 2.00 or higher.		
Fall Semester		
DS 110	Introduction to Data Science	3
MA 151	Calculus I	4
EN 101	Introduction to Academic Reading and Writing	3
FYS 101	First-Year Seminar	3
University Curriculum course		3
Spring Semester		
MA 285	Applied Statistics	3
EN 102	Academic Writing and Research	3
University Curriculum course		3
University Curriculum course		3
Open Elective		3
Second Year		
Milestones: Earn 60 credits and a GPA of 2.00 or higher. Meet with your adviser at least once per semester to discuss academic, experiential learning, career and co-curricular opportunities.		
Fall Semester		
EC 365	Econometrics	3
CSC 110/110L	Programming and Problem Solving	3
Language at the 101 level		3
University Curriculum course		3
Open Elective or minor course		3
Spring Semester		
DS 201	Introduction to Python	1
MA 229	Linear Algebra	3
Language at the 102 level (Satisfies CAS Language Requirement)		3
University Curriculum course		3
Open Elective or minor course		3
Third Year		
Milestones: Earn 90 credits and a GPA of 2.00 or higher. Meet with your adviser at least once per semester. Participate in study abroad, complete internship or research opportunities.		
Fall Semester		
DS 310	Algorithms for Data Science	4
University Curriculum course		3
University Curriculum course		4
Open Elective or minor course		3
Open Elective or minor course		3
Spring Semester		
DS 380	Data Mining	3
University Curriculum course		4
University Curriculum course		3
University Curriculum course		3
Open Elective or minor course		3
Fourth Year		
Milestones: Earn 120 credits and a GPA of 2.00 or higher. Complete possible minor or double major and prepare for graduation.		
Fall Semester		
DS 385	Machine Learning	3
University Curriculum course		3
University Curriculum course		3
Open Elective or minor course		3
Open Elective		3
Spring Semester		
DS 480	Data Science Capstone	3
University Curriculum course		3
Open Elective or minor course		3
Open Elective		3
Open Elective		1
Total Credits		**120**