

# Data Science, B.S.

## Learning Outcomes

### Data Curation Skills

Graduates will be able to:

- understand issues associated with data collection, management, provenance, storage, merging, sharing, and preparation;
- work with multiple-source, multiple-format data;
- investigate the quality of the data; and
- have a basic understanding of ethical and confidentiality issues associated with data collection, storage, merging, and sharing.

### Computational Skills

Graduates will be able to:

- use critical thinking skills to translate substantive questions into well-defined computational problems and choose appropriate computational techniques for a given problem;
- understand the foundational software skills and associated algorithmic and computational problem-solving methods used in computer science;
- be proficient in computational methods for collecting, managing, storing, preparing, sharing, and describing data numerically and graphically from a variety of sources to design and carry out basic simulation studies; and
- use professional statistical software and understand the principles of programming and algorithmic problem solving that underlie these packages.

### Statistical/Probabilistic Skills

Graduates will be able to:

- use critical thinking skills to translate substantive questions into well-defined statistical or probability problems and choose the appropriate graphical or numerical descriptive and/or inferential statistical techniques for a given problem;
- understand the importance of, and issues related to, the choice of the study design, such as designed experiment versus probability sample versus convenience sample, used to produce data;
- understand that uncertainty, variability, and randomness play significant roles in data-driven decision making;
- understand how to measure and display uncertainty, the effect of randomness, confidence/credibility, and the likelihood of incorrect inferences;
- understand and be able to explain common misperceptions, paradoxes, and fallacies of probability and statistics; and
- understand basic regression, prediction, simulation, and visualization methods.

### Mathematical Skills

Graduates will:

- have a firm grasp of the mathematical tools underlying statistical and computational methods which are primarily based on ideas in calculus, linear algebra, and discrete mathematics, including distribution theory, uncertainty quantification (e.g., probability theory), the

probabilistic basis of formal statistical inference, models, and algorithms, and combinatorial analysis and recursion, which are used for algorithmic analysis, design, and for distribution theory.

### Communication Skills

Graduates will be able to:

- clearly justify and communicate study results to a nontechnical audience;
- write accurate and meaningful reports that describe the statistical and computational analyses and summarize important findings; and
- work effectively as part of a team to address substantive questions that can be handled using statistical and computational methods.

### Requirements

The Bachelor of Science with a major in data science requires a minimum of 120 s.h., including at least 59 s.h. of work for the major. Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences GE CLAS Core.

Data science majors may not earn a major or minor in computer science or statistics, a major in computer science and engineering, or the Certificate in Social Science Analytics.

The B.S. with a major in data science requires the following coursework.

Code	Title	Hours
Prerequisite Courses		12-16
Core Courses		26
Advanced Courses		9
Advanced Electives		9
Capstone Courses		3
<b>Total Hours</b>		<b>59-63</b>

### Prerequisite Courses

Students choose one of the following sequences.

Code	Title	Hours
These:		
MATH:1550	Engineering Mathematics I: Single Variable Calculus	4
MATH:1560	Engineering Mathematics II: Multivariable Calculus	4
MATH:2700	Introduction to Linear Algebra	4
Or these:		
MATH:1850	Calculus I	4
MATH:1860	Calculus II	4
MATH:2700	Introduction to Linear Algebra	4
MATH:2850	Calculus III	4

### Core Courses

Code	Title	Hours
All of these:		
CS:1210	Computer Science I: Fundamentals	4

CS:2210	Discrete Structures	3
CS:2230	Computer Science II: Data Structures	4
CS:3330	Algorithms	3
STAT:2010	Statistical Methods and Computing	3
STAT:3100/ IGPI:3100	Introduction to Mathematical Statistics I	3
STAT:3101/ IGPI:3101	Introduction to Mathematical Statistics II	3
STAT:3200/ IGPI:3200/ISE:3760	Applied Linear Regression	3

## Advanced Courses

Code	Title	Hours
Both of these:		
CS:4400	Database Systems	3
STAT:4580/ IGPI:4580	Data Visualization and Data Technologies	3
One of these:		
CS:5430	Machine Learning	3
STAT:4540/ IGPI:4540	Statistical Learning	3

## Advanced Electives

Code	Title	Hours
Three of these, with at least one computer science course and one statistics course:		
CS:4440	Web Mining	3
CS:4470	Health Data Analytics	3
CS:4700/ MATH:4860	High Performance and Parallel Computing	3
CS:5630	Cloud Computing Technology	3
STAT:3210	Experimental Design and Analysis	3
STAT:4520/ IGPI:4522/ PSQF:4520	Bayesian Statistics	3
STAT:4560	Statistics for Risk Modeling	3
STAT:5810/ BIOS:5310/ IGPI:5310	Research Data Management	3

Other advanced computer science or statistics courses approved by advisor

## Capstone Courses

Code	Title	Hours
Both of these:		
DATA:4880	Data Science Creative Component	1
DATA:4890	Data Science Practicum	2

### Combined Programs

## B.S./M.S. in Business Analytics (Career Subprogram)

Students majoring in data science who are interested in earning a master's degree in business analytics with a career

subprogram may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of business analytics before they complete their bachelor's degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the business analytics program, see the M.S. in business analytics (career) in the Tippie College of Business section of the Catalog.

## B.S./M.S. in Finance

Students majoring in data science who are interested in earning a master's degree in finance may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of finance before they complete their bachelor's degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the finance program, see the M.S. in finance (Tippie College of Business) in the Catalog.

### Honors

## Honors in the Major

Students majoring in data science have the opportunity to graduate with honors in the major. They must maintain a g.p.a. of at least 3.67 in their major and a cumulative University of Iowa g.p.a. of at least 3.33. Students must complete an honors thesis.

Students are responsible for finding a faculty member willing to supervise their honors project. The faculty member must approve the proposed project and a timetable for the work. Credit for thesis work must be earned in either CS:3990 Honors in Computer Science or Informatics for work supervised by a computer science faculty member or an honors course supervised by a statistics and actuarial science faculty member.

Honors in data science also satisfies the 12 s.h. experiential learning requirement for University of Iowa honors students.

## University of Iowa Honors Program

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the University's honors program.

Membership in the UI Honors Program is not required to earn honors in the data science major.

### Career Advancement

Today, nearly every business, government, social media platform, and educational institution collects and analyzes data about its users, logistics and operations, and media presence in the hope of extracting valuable insights and utilizing the resulting efficiencies.

As an example, Amazon is the company most closely identified with a data-driven business model. Starting just over 25 years ago as an online book seller with a relatively crude crowdsourced book review platform and simple recommender system technology, it was subsequently augmented with extensive tracking of customer page views, advertising hits, data about prior purchases, and an aggressive emphasis on data-driven operational efficiencies. Amazon has become the major player in U.S. retail and a prime example of the strategic value of big data.

Data science graduates may pursue careers as data scientists. This position allows them to apply their understanding of statistics, as well as algorithm and software design, to create and develop the next generation of data analysis tools.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

## Academic Plans

### Four-Year Graduation Plan

The Four-Year Graduation Plan is not available to students majoring in data science. Students work with their advisors on individual graduation plans.

### Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

### Data Science, B.S.

Course	Title	Hours
<b>First Year</b>		
<b>Fall</b>		
MATH:1550	Engineering Mathematics I: Single Variable Calculus <sup>a, b</sup>	4
ENGL:1200 or RHET:1030	The Interpretation of Literature or Rhetoric	3 - 4
CS:1210	Computer Science I: Fundamentals	4
GE CLAS Core: World Languages First Level Proficiency or elective course <sup>c</sup>		4 - 5
CSI:1600	Success at Iowa	2
<b>Hours</b>		<b>17-19</b>
<b>Spring</b>		
MATH:1560	Engineering Mathematics II: Multivariable Calculus	4
STAT:2010	Statistical Methods and Computing	3
CS:2210	Discrete Structures	3
ENGL:1200 or RHET:1030	The Interpretation of Literature or Rhetoric	3 - 4
GE CLAS Core: World Languages Second Level Proficiency or elective course <sup>c</sup>		4 - 5
<b>Hours</b>		<b>17-19</b>
<b>Second Year</b>		
<b>Fall</b>		
STAT:3200	Applied Linear Regression	3
CS:2230	Computer Science II: Data Structures	4
GE CLAS Core: Natural Sciences without Lab <sup>d</sup>		3
GE CLAS Core: Historical Perspectives <sup>d</sup>		3

GE CLAS Core: World Languages Second Level Proficiency or elective course <sup>c</sup>	4 - 5
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**Hours 17-18**

#### Spring

CS:3330	Algorithms	3
MATH:2700	Introduction to Linear Algebra	4
GE CLAS Core: International and Global Issues <sup>d</sup>		3
GE CLAS Core: World Languages Fourth Level Proficiency or elective course <sup>c</sup>		4 - 5
Elective course <sup>e</sup>		3

**Hours 17-18**

#### Third Year

##### Fall

STAT:3100	Introduction to Mathematical Statistics I <sup>f</sup>	3
CS:4400	Database Systems	3
GE CLAS Core: Natural Sciences with Lab <sup>d</sup>		4
GE CLAS Core: Social Sciences <sup>d</sup>		3
Elective course <sup>e</sup>		3

**Hours 16**

##### Spring

CS:5430 or STAT:4540	Machine Learning <sup>g</sup> or Statistical Learning	3
STAT:3101	Introduction to Mathematical Statistics II <sup>h</sup>	3
STAT:4580	Data Visualization and Data Technologies <sup>h</sup>	3
GE CLAS Core: Literary, Visual, and Performing Arts <sup>d</sup>		3

Elective course <sup>e</sup>	3
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**Hours 15**

#### Fourth Year

##### Fall

Major: advanced elective I course <sup>i</sup>	3	
Major: advanced elective II course <sup>i</sup>	3	
GE CLAS Core: Diversity and Inclusion <sup>d</sup>	3	
DATA:4880	Data Science Creative Component	1
Elective course <sup>e</sup>	3	

**Hours 13**

##### Spring

Major: advanced elective III course <sup>i</sup>	3	
GE CLAS Core: Values and Culture <sup>d</sup>	3	
DATA:4890	Data Science Practicum	2
Elective course <sup>e</sup>	1	
Elective course <sup>e</sup>	3	

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall) <sup>j</sup>

**Hours 12**

**Total Hours 124-130**

- Enrollment in math courses requires completion of a placement exam.
- Fulfills a major requirement and may fulfill a GE requirement.
- Students who have completed four years of a single language in high school have satisfied the GE CLAS Core World Languages requirement. Enrollment in world languages courses requires a placement exam, unless enrolling in a first-semester-level course.
- GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.

- e Students may use elective courses to earn credit towards the total s.h. required for graduation or to complete a double major, minors, or certificates.
- f Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
- g Typically STAT:4540 is offered in fall semesters only and CS:5430 is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
- h Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
- i Students should select at least one computer science course and one statistics course for their advanced electives.
- j Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Graduation Services.