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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prerequisite Courses</td>
<td>12-16</td>
</tr>
<tr>
<td></td>
<td>Core Courses</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Advanced Courses</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Advanced Electives</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Capstone Courses</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td><strong>59-63</strong></td>
</tr>
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</table>

Prerequisite Courses

Students choose one of the following sequences.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>These:</td>
<td></td>
</tr>
<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I:</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Single Variable Calculus</td>
<td></td>
</tr>
<tr>
<td>MATH:1560</td>
<td>Engineering Mathematics II:</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Multivariable Calculus</td>
<td></td>
</tr>
<tr>
<td>MATH:2700</td>
<td>Introduction to Linear Algebra</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Or these:</td>
<td></td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1860</td>
<td>Calculus II</td>
<td>4</td>
</tr>
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</table>
### Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:2700</td>
<td>Introduction to Linear Algebra</td>
<td>4</td>
</tr>
<tr>
<td>MATH:2850</td>
<td>Calculus III</td>
<td>4</td>
</tr>
</tbody>
</table>

### Advanced Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both of these:</td>
<td>Database Systems</td>
<td>3</td>
</tr>
<tr>
<td>STAT:4580/IGPI:4580</td>
<td>Data Visualization and Data Technologies</td>
<td>3</td>
</tr>
<tr>
<td>One of these:</td>
<td>Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>STAT:3200/IGPI:3200/ISE:3760</td>
<td>Applied Linear Regression</td>
<td>3</td>
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</tbody>
</table>

### Advanced Electives

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

### 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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
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<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I: Single Variable Calculus a, b</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030 or ENGL:1200</td>
<td>Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
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<tr>
<td>CS:1210</td>
<td>Computer Science I: Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages First Level</td>
<td>Proficiency or elective course c</td>
<td>4 - 5</td>
</tr>
<tr>
<td>CSI:1600</td>
<td>Success at Iowa</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td><strong>17-19</strong></td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH:1560</td>
<td>Engineering Mathematics II: Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>STAT:2010</td>
<td>Statistical Methods and Computing</td>
<td>3</td>
</tr>
<tr>
<td>CS:2210</td>
<td>Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>ENGL:1200 or RHET:1030</td>
<td>The Interpretation of Literature or Rhetoric</td>
<td>3 - 4</td>
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<tr>
<td>GE CLAS Core: World Languages Second Level</td>
<td>Proficiency or elective course c</td>
<td>4 - 5</td>
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<tr>
<td></td>
<td><strong>Hours</strong></td>
<td><strong>17-19</strong></td>
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<tr>
<td>Second Year</td>
<td></td>
<td></td>
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<tr>
<td>Fall</td>
<td></td>
<td></td>
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<tr>
<td>STAT:3200</td>
<td>Applied Linear Regression</td>
<td>3</td>
</tr>
<tr>
<td>CS:2230</td>
<td>Computer Science II: Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: Natural Sciences without Lab d</td>
<td></td>
<td>3</td>
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<td>GE CLAS Core: Historical Perspectives d</td>
<td></td>
<td>3</td>
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<tr>
<td>GE CLAS Core: World Languages Second Level</td>
<td>Proficiency or elective course c</td>
<td>4 - 5</td>
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<tr>
<td></td>
<td><strong>Elective course e</strong></td>
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<tr>
<td></td>
<td><strong>Hours</strong></td>
<td><strong>17-18</strong></td>
</tr>
<tr>
<td>Spring</td>
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<tr>
<td>CS:3330</td>
<td>Algorithms</td>
<td>3</td>
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<tr>
<td>MATH:2700</td>
<td>Introduction to Linear Algebra</td>
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<td>GE CLAS Core: International and Global Issues d</td>
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<td>GE CLAS Core: World Languages Fourth Level</td>
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<td><strong>Elective course e</strong></td>
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<tr>
<td></td>
<td><strong>Hours</strong></td>
<td><strong>17-18</strong></td>
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<td>Third Year</td>
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<tr>
<td>Fall</td>
<td></td>
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<tr>
<td>STAT:3100</td>
<td>Introduction to Mathematical Statistics I f</td>
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<tr>
<td>CS:4400</td>
<td>Database Systems</td>
<td>3</td>
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<tr>
<td>GE CLAS Core: Natural Sciences with Lab d</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>GE CLAS Core: Social Sciences d</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Elective course e</strong></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
<td><strong>16</strong></td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAT:4540 or CS:5430</td>
<td>Statistical Learning g or Machine Learning</td>
<td></td>
</tr>
<tr>
<td>STAT:3101</td>
<td>Introduction to Mathematical Statistics II h</td>
<td></td>
</tr>
<tr>
<td>STAT:4580</td>
<td>Data Visualization and Data Technologies h</td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: Literary, Visual, and Performing Arts d</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Elective course e</strong></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Hours</strong></td>
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</tr>
<tr>
<td>Fourth Year</td>
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<tr>
<td>Fall</td>
<td></td>
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<tr>
<td>Major: advanced elective I course i</td>
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<td>3</td>
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<tr>
<td>Major: advanced elective II course i</td>
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<td>DATA:4880</td>
<td>Data Science Creative Component</td>
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<td><strong>Elective course e</strong></td>
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<td></td>
<td><strong>Hours</strong></td>
<td><strong>13</strong></td>
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<tr>
<td>Spring</td>
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<tr>
<td>Course</td>
<td>Hours</td>
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<td>GE CLAS Core: Values and Culture(^d)</td>
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<tr>
<td>Elective course(^e)</td>
<td>3</td>
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</tr>
</tbody>
</table>

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)\(^j\)

Hours 12

Total Hours 124-130

\(^a\) Fulfills a major requirement and may fulfill a GE requirement.
\(^b\) Enrollment in math courses requires completion of a placement exam.
\(^c\) 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.
\(^d\) 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.