DATA SCIENCE, B.S.

Students in the Data Science major will be able to apply computational, mathematical, and statistical thinking to data-rich problems in a wide variety of fields in a responsible and ethical manner. This includes the ability to manage, process, model, gain meaning and knowledge, and present data. Data Science is one of the fastest growing career sectors in Wisconsin and across the nation.

By its very nature, the field of data science is one that teaches novel and cutting-edge ways to engage in the “continual sifting and winnowing by which alone the truth can be found.”

HOW TO GET IN

To declare the data science major, student should set up an appointment with a data science major advisor prior to attaining senior standing (86 credits). There are no specific courses that must be completed before declaration.

Please see the Data Science major page (https://stat.wisc.edu/undergraduate-data-science-studies/) on the Department of Statistics website for information on how to declare the major and meet with advisors.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

General Education
  • Breadth—Humanities/Literature/Arts: 6 credits
  • Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
  • Breadth—Social Studies: 3 credits
  • Communication Part A & Part B *
  • Ethnic Studies *
  • Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE DEGREE REQUIREMENTS: BACHELOR OF SCIENCE (B.S.)

Students pursuing a Bachelor of Science degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either the Bachelor of Arts or the Bachelor of Science degree requirements.

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

Mathematics
Complete two courses of 3+ credits at the Intermediate or Advanced level in MATH, COMP SCI, or STAT subjects. A maximum of one course in each of COMP SCI and STAT subjects counts toward this requirement.

Foreign Language
Complete the third unit of a foreign language.

L&S Breadth
Complete:
  • 12 credits of Humanities, which must include at least 6 credits of Literature; and
  • 12 credits of Social Science; and
  • 12 credits of Natural Science, which must include 6 credits of Biological Science and 6 credits of Physical Science.

Liberal Arts and Science Coursework
Complete at least 108 credits.

Depth of Intermediate/Advanced Coursework
Complete at least 60 credits at the Intermediate or Advanced level.

Major
Declare and complete at least one major.

Total Credits
Complete at least 120 credits.

UW-Madison Experience
Complete both:
  • 30 credits in residence, overall, and
  • 30 credits in residence after the 86th credit.

Quality of Work
  • 2.000 in all coursework at UW–Madison
  • 2.000 in Intermediate/Advanced level coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements. They do not need to complete the L&S Degree Requirements above.

REQUIREMENTS FOR THE MAJOR

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOUNDATIONAL MATH COURSES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>MATH 217 Calculus with Algebra and Trigonometry II</td>
<td>5</td>
</tr>
<tr>
<td>or</td>
<td>MATH 275 Topics in Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>MATH 222</td>
<td>Calculus and Analytic Geometry 2</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td>MATH 276 Topics in Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Credits</td>
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<td>--------</td>
<td>-------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>STAT 240</td>
<td>Introduction to Data Modeling I</td>
<td>4</td>
</tr>
<tr>
<td>STAT 340</td>
<td>Introduction to Data Modeling II</td>
<td>4</td>
</tr>
<tr>
<td>COMP SCI 220</td>
<td>Data Science Programming I</td>
<td>4</td>
</tr>
<tr>
<td>or COMP SCI 300</td>
<td>Programming II</td>
<td></td>
</tr>
<tr>
<td>COMP SCI 320</td>
<td>Data Science Programming II</td>
<td>4</td>
</tr>
<tr>
<td>LI S 461</td>
<td>Data and Algorithms: Ethics and Policy</td>
<td>3-4</td>
</tr>
</tbody>
</table>

### Electives

Students must complete at least one course from each of the four following categories and then additional electives to reach the minimum credits. Additional courses taken within each category may count towards other electives.

#### Machine Learning

Complete one of the following:

- COMP SCI/ECE/MM 532 Matrix Methods in Machine Learning
- COMP SCI/ECE/MM 539 Introduction to Artificial Neural Networks
- COMP SCI 540 Introduction to Artificial Intelligence
- MATH 535 Mathematical Methods in Data Science
- STAT 451 Introduction to Machine Learning and Statistical Pattern Classification
- STAT 453 Introduction to Deep Learning and Generative Models

#### Advanced Computing

Complete one of the following:

- COMP SCI 400 Programming III
- COMP SCI 412 Introduction to Numerical Methods
- COMP SCI/STAT 471 Introduction to Computational Statistics
- COMP SCI/MATH 513 Numerical Linear Algebra
- COMP SCI/MATH 514 Numerical Analysis
- COMP SCI/ECE/IIE 524 Introduction to Optimization
- COMP SCI 564 Database Management Systems: Design and Implementation
- GEOG 573 Advanced Geocomputing and Geospatial Big Data Analytics
- GEOG 574 Geospatial Database Design and Development

#### Statistical Modeling

Complete one of the following:

- ECON 400 Introduction to Applied Econometrics
- ECON 410 Introductory Econometrics
- STAT/MATH 309 Introduction to Probability and Mathematical Statistics I
- STAT/MATH 310 Introduction to Probability and Mathematical Statistics II
- STAT 311 Introduction to Theory and Methods of Mathematical Statistics I
- STAT 312 Introduction to Theory and Methods of Mathematical Statistics II
- STAT 349 Introduction to Time Series
- STAT 351 Introductory Nonparametric Statistics
- STAT 421 Applied Categorical Data Analysis
- STAT/MATH 424 Statistical Experimental Design
- STAT/MATH 431 Introduction to the Theory of Probability
- STAT 443 Classification and Regression Trees
- STAT 456 Applied Multivariate Analysis
- STAT 461 Financial Statistics
- MATH 531 Probability Theory
- MATH/IIE/ICT 632 Introduction to Stochastic Processes
- MATH 635 An Introduction to Brownian Motion and Stochastic Calculus
- MATH 320 Linear Algebra and Differential Equations
- MATH 340 Elementary Matrix and Linear Algebra
- MATH 341 Linear Algebra
- MATH 375 Topics in Multi-Variable Calculus and Linear Algebra
- COMP SCI/ECE/MM 532 Matrix Methods in Machine Learning

#### Other Electives

For additional electives students may complete courses from the list below or additional courses from the required categories above:

- ECE 203 Signals, Information, and Computation
- ECON 570 Fundamentals of Data Analytics for Economists
- GEOG 572 Graphic Design in Cartography
- GEOG 575 Interactive Cartography & Geovisualization
- IIE 323 Operations Research-Deterministic Modeling
- IIE 412 Fundamentals of Industrial Data Analytics
- IIE/E/M/E 512 Inspection, Quality Control and Reliability
- IIE 575 Introduction to Quality Engineering
- IIE 612 Information Sensing and Analysis for Manufacturing Processes
- COMP SCI/IIE/MM 425 Introduction to Combinatorial Optimization
- COMP SCI/IIE/MM 525 Linear Optimization
LEARNING OUTCOMES

1. Integrate foundational concepts and tools from mathematics, computer science, and statistics to solve data science problems.
2. Demonstrate competencies with tools and processes necessary for data management and reproducibility.
3. Produce meaning from data employing modeling strategies.
4. Demonstrate critical thinking related to data science concepts and methods.
5. Conduct data science activities aware of and according to policy, privacy, security and ethical considerations.
6. Demonstrate oral, written, and visual communication skills related to data science.

FOOTNOTES

1. Students who take COMP SCI/E C E/M E 532 may count the course towards both their linear algebra and machine learning requirements. However, students should be aware that some elective courses, in MATH in particular, require linear algebra courses as a prerequisite.

2. Upper-level in the major includes LIS 461 and all courses listed in the Data Science Electives (i.e. Machine Learning, Advanced Computing, Statistical Modeling, Linear Algebra, and Other Electives).

UNIVERSITY DEGREE REQUIREMENTS

Total Degree
To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency
Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work
Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

SAMPLE FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

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Freshman

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
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<tbody>
<tr>
<td>COMP SCI 220</td>
<td>4</td>
<td>COMP SCI 320</td>
<td>4</td>
</tr>
<tr>
<td>Communication A</td>
<td>3 MATH 221</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Biological Science Breadth</td>
<td>3 Ethnic Studies</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Foreign Language (if needed)</td>
<td>4 Foreign Language (if needed)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>16</td>
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</table>

Sophomore

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<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 222</td>
<td>4</td>
<td>STAT 340</td>
<td>4</td>
</tr>
<tr>
<td>STAT 240</td>
<td>4 Linear Algebra course</td>
<td>3</td>
<td></td>
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<tr>
<td>Literature Breadth</td>
<td>3 Humanities Breadth</td>
<td>3</td>
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<tr>
<td>Physical Science Breadth</td>
<td>3 Literature Breadth</td>
<td>3</td>
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<tr>
<td>INTER-LS 210</td>
<td>1 Social Science Breadth</td>
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<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td>16</td>
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Junior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIS 461 (enroll in Communication B section)</td>
<td>3-4 Statistical Modeling course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine Learning course</td>
<td>3 Physical Science Breadth</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>3</td>
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</tbody>
</table>
Biological Science Breadth  3  Social Science Breadth  3
Social Science Breadth  3  Electives  6
Elective  3  16  15

Senior
Fall  Credits  Spring  Credits
Advanced Computing course  3  Data Science elective  3
Data Science elective  3  Electives  10
Social Science Breadth  3
Electives  6  15  13

Total Credits 120

THREE-YEAR PLAN

SAMPLE THREE-YEAR PLAN

This Sample Three-Year Plan is a tool to assist students and their advisor(s). Students should use it — along with their DARS report, the Degree Planner, and Course Search & Enroll tools — to make their own three-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests.

Three-year plans may vary considerably from student to student, depending on their individual preparation and circumstances. Students interested in graduating in three years should meet with an advisor as early as possible to discuss feasibility, appropriate course sequencing, post-graduation plans (careers, graduate school, etc.), and opportunities they might forgo in pursuit of a three-year graduation plan.

DEPARTMENTAL EXPECTATIONS

A three-year degree is feasible for students with a variety of backgrounds and specific preparation. Students should ideally be entering the University with a minimum of 30 advanced standing credits, and have satisfied the following requirements with course credit or via placement examination:

- MATH 221 Calculus and Analytic Geometry 1
- MATH 222 Calculus and Analytic Geometry 2
- 3-4 units of foreign language

First Year

Fall  Credits  Spring  Credits
STAT 240  4  STAT 340  4
COMP SCI 220  4  COMP SCI 320  4
Communications A complete during first year  3  Ethnic Studies complete within first 60 credits  3
Social Science Breadth  3

14  14

Second Year

Fall  Credits  Spring  Credits
L I S 461 (meets Humanities Breadth, 4cr section meets Communication B)  3-4  Machine Learning Course  3

15  15

Total Credits 90

ADVISING AND CAREERS

LOOKING FOR DATA SCIENCE ADVISING?

Students who are interested in data science academic advising should check out the advising information on our website (https://stat.wisc.edu/undergraduate-data-science-studies/) or send an email to dsmajor@stat.wisc.edu.

WHAT DO DATA SCIENTISTS DO?

Data Scientists are trained to manage, process, model, gain meaning and knowledge, and present data. These skills can be employed in a wide variety of different sectors of employment. Examples of interests of our students include finance, banking, sports analytics, marketing, retail, humanities, psychology, biosciences, healthcare, and consulting, just to name a few. Students are encouraged to combine data science with majors, certificates, and courses from differing areas to best be able to apply their data science in the area of their choosing.

Data science is one of the fastest growing area of jobs in the U.S. and in Wisconsin. All of the major job search engines regularly list thousands of jobs, for example, in 2018 Data Scientist was the #1 job on the web site Glassdoor with over 25,000 jobs, Monster.com listed over 12,000 jobs in data science nationally, and Indeed.com had over 1,000 jobs for data analysts just in the state of Wisconsin.

Additionally, the Occupational Outlook Handbook (OOH) from the Bureau of Labor Statistics shows the job growth outlook from 2016-26 for Mathematicians and Statisticians to be 33% (much faster than average) and for Computer and Information Research Scientists to be 19% (much faster than average).

Some students may want to continue to develop additional advanced data science skills through graduate education.

L&S CAREER RESOURCES

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, and liberal arts degree; explore and try out different career paths; participate in internships; prepare for the job search and/or graduate school.
applications; and network with professionals in the field (alumni and employers). In short, SuccessWorks helps students in the College of Letters & Science discover themselves, find opportunities, and develop the skills they need for success after graduation.

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

Students should set up their profiles in Handshake (https://careers.ls.wisc.edu/handshake/) to take care of everything they need to explore career events, manage their campus interviews, and apply to jobs and internships from 200,000+ employers around the country.

- SuccessWorks (https://careers.ls.wisc.edu/)
- Set up a career advising appointment (https://careers.ls.wisc.edu/make-an-appointment/)
- INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)—for more information, see Inter-LS 210: Career Development, Taking Initiative (https://careers.ls.wisc.edu/inter-ls-210-career-development-taking-initiative/)
- INTER-LS 215 Communicating About Careers (3 credits, fulfills Com B General Education Requirement)
- Handshake (https://careers.ls.wisc.edu/handshake/)
- Learn how we're transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/lsci/)

PEOPLE

ADVISING STAFF
Information regarding the Data Science advisors and how to make appointment can be found on the program page (https://stat.wisc.edu/undergraduate-data-science-studies/).

DATA SCIENCE MAJOR PROGRAM COMMITTEE
- Michael Ferris (Computer Sciences)
- Bret Larget, Program Director (Statistics), committee chair
- Sebastien Roch (Mathematics)
- Sara Rodock (Statistics), advising representative
- Alan Rubel (iSchool)