Data Sciences, B.S. (Engineering)

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Data Sciences is an interdisciplinary field concerned with the integration of methods, processes, systems, and tools from Computer Science, Informatics, and Statistics, to discover, validate, and apply knowledge and actionable insights from data, across a broad range of application domains. The curriculum for the major is designed to equip students with the knowledge and the skills needed to elicit, formulate, and solve data sciences problems using modern computer science, informatics, and statistics tools for data management, machine learning, information integration, and predictive modeling, and effectively communicate their findings to a broad range of stakeholders. The students will gain the critical analytical skills needed to assess the feasibility, benefits, limitations, risks, and ethical implications of applying data sciences methods in different settings. Through experiences such as the capstone project, students should be prepared to function effectively as members of interdisciplinary data science teams to harness the potential of data to enable discovery, optimize products and processes, and inform public policy. The students in the major will specialize in one of the following options: applied, computational, or statistical modeling data sciences, as described below.

Applied Data Sciences (DATSC_BS)

Only available through the College of Information Sciences and Technology

This option focuses on the principles, methods, and tools for assembly, validation, organization, analysis, visualization, and interpretation of large and heterogeneous data, to support data-driven discovery and decision making, with emphasis on addressing pressing scientific, organizational, and societal challenges. A combination of required and elective courses provides students with the training and skills needed to develop advanced tools and domain-specific analyses that yield actionable knowledge from data. This option also provides critical analytical skills needed to assess the benefits and limitations of data analytics across a broad range of applications involving Big Data.

Computational Data Sciences (DTSCE_BS)

Only available through the College of Engineering

This option focuses on the computational foundations of the data sciences, including the design, implementation and analysis of software that manages the volume, heterogeneity and dynamic characteristics of large data sets and that leverages the computational power of multicore hardware. Students in this option will take upper-level courses in computer science and related fields to develop the skills necessary to construct efficient solutions to computational problems involving Big Data.

Statistical Modeling Data Sciences (DTSCS_BS)

Only available through the Eberly College of Science

This option focuses on statistical models and methods that are needed to discover and validate patterns in Big Data. Students in this option will take upper-level statistics and mathematics courses, learning to apply the theoretical machinery of quantitative models to the solution of real-world problems involving Big Data.

What is Data Sciences?

Data Sciences is a field that explores the methods, systems, and processes used to extract knowledge from data and turn these insights into discoveries, decisions, and actions. The emergence of massive amounts of data – also known as “big data” – found in our world through healthcare records, human sensors, digital media, and a number of other sources has increased the need for individuals who can obtain useful knowledge from big data and apply it to address major societal challenges across a variety of fields. Students pursuing this degree will develop the knowledge and skills needed to manage and analyze large-scale, unstructured data to address an expanding range of problems in industry, government, and academia.

MORE INFORMATION ABOUT DATA SCIENCES (https://ist.psu.edu/prospective/undergraduate/academics/data-sciences/)

You Might Like This Program If...

- You are curious about analyzing information to discover new insights.
- You want to apply data analytics to make strategic decisions.
- You want to understand how data can be used to visualize phenomena and predict different outcomes.
- You are interested in statistics, mathematics, and the social sciences, and want to combine these disciplines to understand what data is really telling us.

MORE INFORMATION ABOUT WHY STUDENTS CHOOSE TO STUDY DATA SCIENCES (https://ist.psu.edu/prospective/undergraduate/academics/data-sciences/)

Entrance to Major

To be eligible for entrance into the Data Sciences major, a degree candidate must satisfy requirements for entrance to the major.

Specific entrance requirements include:

1. The degree candidate must be taking, or have taken, a program appropriate for entry to the major as shown in the bulletin.
2. The degree candidate must complete the following entrance-to-major requirements: CMPSC 121* or CMPSC 131*, CMPSC 122* or CMPSC 132*, MATH 140*, MATH 141*, STAT 200* or DS 200*. These courses must be completed by the end of the semester during which the entrance to major process is carried out.

* Course requires a grade of C or better.

Degree Requirements

For the Bachelor of Science degree in Data Sciences, a minimum of 123 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Electives</td>
<td>0-9</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>75-84</td>
</tr>
</tbody>
</table>

6 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 6 credits of GQ courses.
Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Common Requirements for the Major (All Options)

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</table>

Prescribed Courses
- DS 435 Ethical Issues in Data Science Practice 3
- DS 220 Data Management for Data Sciences 3
- DS 340W Applied Data Sciences 3
- MATH 140 Calculus With Analytic Geometry I 4
- MATH 141 Calculus with Analytic Geometry II 4
- MATH 220 Matrices 2
- STAT 184 Introduction to R 2
- STAT 380 Data Science Through Statistical Reasoning and Computation 3

Additional Courses
1 credit of First-Year Seminar 1
- DS 440 Data Sciences Capstone Course 3
  or DS 440W Data Science Capstone 3
- CMPSC 121 Introduction to Programming Techniques 3
  or CMPSC 131 Programming and Computation I: Fundamentals 3
- CMPSC 122 Intermediate Programming 3
  or CMPSC 132 Programming and Computation II: Data Structures 3
- STAT/MATH 318 Elementary Probability 3
  or STAT/MATH 418 Introduction to Probability and Stochastic Processes for Engineering 3

Requirements for the Option
Select an option 38-47

Requirements for the Option
Applied Data Sciences (DATSC_BS): 41 credits

Only Available through the College of Information Sciences and Technology

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
</table>

Prescribed Courses
- DS 300 Privacy and Security for Data Sciences 3
- DS 200 Introduction to Data Sciences 4
- DS 310 Machine Learning for Data Analytics 3
- DS 320 Data Integration 3
- DS 330 Visual Analytics for Data Sciences 3
- DS/CMPSC 410 Programming Models for Big Data 3
- IST 495 Internship 1

Additional Courses
Select 6 credits from any combination: 6
- DS 402 Emerging Trends in the Data Sciences
- DS 420 Network Analytics
- DS/CMPSC 442 Artificial Intelligence
- DS 494 Research Project

LIST OF APPLIED DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/information-sciences-technology/data-sciences-bs/#suggestedacademicplancontent)

Computational Data Sciences (DTSCE_BS): 47 credits

Only Available through the College of Engineering

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</table>

Prescribed Courses
- CMPSC 442 Artificial Intelligence 3
- CMPSC 448 Machine Learning and Algorithmic AI 3
- CMPSC 461 Programming Language Concepts 3
- DS/CMPSC 410 Programming Models for Big Data 3
- MATH 230 Calculus and Vector Analysis 4
- STAT/MATH 414 Introduction to Probability Theory 3
- CMPSC 221 Object Oriented Programming with Web-Based Applications 3
- CMPSC 360 Discrete Mathematics for Computer Science 3
- CMPSC 465 Data Structures and Algorithms 3
- STAT/MATH 415 Introduction to Mathematical Statistics 3

Additional Courses
Select 6 credits from Computational Option List A in Appendix C 6
Select 6 credits from Computational Option List B in Appendix C 6

LIST OF COMPUTATIONAL DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/other/computational-data-sciences)

Statistical Modeling Data Sciences (DTSCS_BS): 38 credits

Only Available through the Eberly College of Science

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
</table>

Prescribed Courses
- STAT/MATH 414 Introduction to Probability Theory 3
- MATH 230 Calculus and Vector Analysis 4

Additional Courses
Select 3 credits from the following:
- CMPSC 360 Discrete Mathematics for Computer Science
- DS/CMPSC 411 Language, Logic, and Discrete Mathematics
- DS/CMPSC 410 Concepts of Discrete Mathematics

Supporting Courses and Related Areas
Select 12 credits from Application Focus courses in Appendix B, 6 credits must be at the 300- or 400-levels.

1 Students may apply up to 3 credits of ROTC as option Application Focus list credits and 3 credits of ROTC as GHW credits.

LIST OF APPLIED DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/information-sciences-technology/data-sciences-bs/#suggestedacademicplancontent)

LIST OF COMPUTATIONAL DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/other/computational-data-sciences)

LIST OF COMPUTATIONAL DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/other/computational-data-sciences)

LIST OF APPLIED DATA SCIENCES COURSES (https://bulletins.psu.edu/undergraduate/colleges/information-sciences-technology/data-sciences-bs/#suggestedacademicplancontent)
University Degree Requirements

First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements
• United States Cultures: 3 credits
• International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Academic Advising
The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of-class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/)

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### General Education
Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

### Foundations (grade of C or better is required.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

### Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

### Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 6 credits

### Supporting Courses and Related Areas

1. Students may apply up to 3 credits of ROTC as option list credits and 3 credits of ROTC as GHW credits.

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### List of Statistical Modeling Data Sciences Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS 200</td>
<td>Introduction to Data Sciences</td>
<td>4</td>
</tr>
<tr>
<td>or STAT 200</td>
<td>Elementary Statistics</td>
<td></td>
</tr>
<tr>
<td>DS 310</td>
<td>Machine Learning for Data Analytics</td>
<td>3</td>
</tr>
<tr>
<td>or CMPSC 448</td>
<td>Machine Learning and Algorithmic AI</td>
<td></td>
</tr>
<tr>
<td>MATH 311W</td>
<td>Concepts of Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>or CMPSC 360</td>
<td>Discrete Mathematics for Computer Science</td>
<td></td>
</tr>
</tbody>
</table>

1. Students may apply up to 3 credits of ROTC as option list credits and 3 credits of ROTC as GHW credits.

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### Requirements of a program. For additional information, see the [Bulletin and consult your academic adviser.](https://bulletins.psu.edu/undergraduate/general-education-program/)
Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2022-23 academic year. To access previous years’ suggested academic plans, please visit the archive (https://bulletins.psu.edu/undergraduate/archive/) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contains suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

Computational Data Sciences Option: Data Sciences, B.S. at University Park Campus

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

If you are starting at a campus other than the one this plan is ending at, please refer to: http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 121 or 131 (GQ)</td>
<td>3</td>
<td>CMPSC 122 or 132 (GQ)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140 (GQ)</td>
<td>4</td>
<td>MATH 141 (GQ)</td>
<td>3</td>
</tr>
<tr>
<td>DS 200 or STAT 200 (GQ)</td>
<td>3</td>
<td>ENGL 15 (GWS)</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course</td>
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<td>General Education Course</td>
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   **15**

Second Year

<table>
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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 221</td>
<td>3</td>
<td>CMPSC 360</td>
<td>3</td>
</tr>
</tbody>
</table>

   **16**

Third Year

<table>
<thead>
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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 442 or DS 442</td>
<td>3</td>
<td>CMPSC 410 or DS 410</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 465</td>
<td>3</td>
<td>CMPSC 448</td>
<td>3</td>
</tr>
<tr>
<td>DS 300</td>
<td>3</td>
<td>CMPSC 455</td>
<td>3</td>
</tr>
<tr>
<td>STAT 415</td>
<td>3</td>
<td>General Education Course</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course</td>
<td>3</td>
<td>General Education Course</td>
<td>3</td>
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</table>

   **15**

Fourth Year

<table>
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<th>Fall</th>
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<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS 340W</td>
<td>3</td>
<td>DS 440</td>
<td>3</td>
</tr>
<tr>
<td>List A Course</td>
<td>3</td>
<td>List A Course</td>
<td>3</td>
</tr>
<tr>
<td>List B Course</td>
<td>3</td>
<td>List B Course</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 202C (GWS)</td>
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<td>Department List (General Elective)</td>
<td>3</td>
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<tr>
<td>Department List (General Elective)</td>
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<td>General Education Course (GHW)</td>
<td>1.5</td>
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<tr>
<td>General Education Course (GHW)</td>
<td>1.5</td>
<td>General Education Course (GHW)</td>
<td>1.5</td>
</tr>
</tbody>
</table>

   **16.5**

Total Credits 126

* Course requires a grade of C or better for the major
‡ Course requires a grade of C or better for General Education
† Course is an Entrance to Major requirement
‡† Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of C or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.
College Notes:

- **Health and Physical Activity Elective:** Students who complete the ROTC program may substitute 3 ROTC credits for the GHW requirement.
- **Natural Sciences Elective:** Nine credits of Natural Science (GN) are required. Any GN courses except the following may be used: ASTRO 1, 7N, 10, 11, 120, 140; all BI SC courses; All courses below CHEM 110 (except 3 credits of CHEM 106 may be used); PHYS 250, 251, and any course below PHYS 211; GEOSC 20
- **OPTION A:** CMPEN 454, CMPSC 450, or CMPSC 456
- **OPTION B:** CMPSC 431W, EE 456, IST 441, STAT 416, or STAT 440
- Department List Course (General Elective): See page 13, 14, & 15 of this document: [http://assets.engr.psu.edu/EECS/docs/Computational Data Sciences 2016.pdf](http://assets.engr.psu.edu/EECS/docs/Computational Data Sciences 2016.pdf)

Career Paths

Data Sciences blends the technical expertise needed to analyze, interpret, and manage big data with the interpersonal skills needed to communicate insights to a variety of audiences. The program prepares students to meet the growing need for professionals who have the analytical and problem-solving skills to address a wide range of societal challenges. Many companies participate in career fairs in Engineering, IST and Science with an express interest in hiring data science interns or graduates. A growing number of M.S. and Ph.D. programs await those who wish to pursue more advanced studies.

Careers

Because our courses blend technical knowledge with skills in communication and business, a Data Sciences degree allows students to compete for leading-edge analytics positions across many different industry sectors. Possible careers include: Data Analyst, Data and Analytics Manager, Data Architect, Data Engineering, Data Visualizer, Statistician.

MORE INFORMATION FOR THE APPLIED DATA SCIENCES OPTION ([https://www.ist.psu.edu/current/careers/development/process/path/](https://www.ist.psu.edu/current/careers/development/process/path/))

MORE INFORMATION FOR THE COMPUTATIONAL DATA SCIENCES OPTION ([http://www.eecs.psu.edu/students/undergraduate/Data-Sciences.aspx](http://www.eecs.psu.edu/students/undergraduate/Data-Sciences.aspx))

MORE INFORMATION FOR THE STATISTICAL MODELING DATA SCIENCES OPTION ([https://science.psu.edu/stat/undergraduate-programs/](https://science.psu.edu/stat/undergraduate-programs/))

Professional Resources

- Association for Computing Machinery ([http://acm.psu.edu](http://acm.psu.edu))
- Association for Information Science and Technology ([http://www.asist.org](http://www.asist.org))

Contact

University Park
College of Engineering
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
W209 Westgate Building
University Park, PA 16802
814-865-9505

arc88@psu.edu

https://www.eecs.psu.edu

College of Information Sciences and Technology

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Eberly College of Science

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stat-advising@psu.edu

http://stat.psu.edu/about-us/contact-us ([http://stat.psu.edu/about-us/contact-us/](http://stat.psu.edu/about-us/contact-us/))