

DATA SCIENCES, B.S. (ENGINEERING)

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Not all options are available at all Colleges. Contact the College you are interested in entering to determine which options are offered.

The intercollege Data Sciences major will educate students on the technical fundamentals of data sciences, with a focus on developing 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. The underlying knowledge for data sciences derives from machine learning, data mining, computer science, statistics, and visualization, and the emerging science of managing and analyzing data at scale. Students will gain breadth of knowledge through common core classes, as well as depth in one of three options. After taking common courses during the pre-major stage, students will choose among options focused on application (College of IST), computation (College of Engineering) and science (College of Science). Students in all three options will come together in their junior and senior years for two shared capstone experiences. In combination the three options position Penn State to offer highly trained professionals who understand data science's multiple dimensions for a growing segment of the U.S. economy.

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.

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.

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/students/undergrad/majors/ds/>)

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://issuu.com/istpsu/docs/data-sciences-major/>)

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 125 credits is required (at least 18 credits must be taken at the 400 level):

Requirement	Credits
General Education	45
Electives	5-14
Requirements for the Major	72-81

6 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 6 credits of GQ courses.

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 (<http://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

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.

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)

Code	Title	Credits
Prescribed Courses		
<i>Prescribed Courses: Require a grade of C or better</i>		
DS 220	Data Management for Data Sciences	3
DS 300	Privacy and Security for Data Sciences	3
DS 340W	Applied Data Sciences	3
DS 440	Data Sciences Capstone Course	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
<i>Additional Courses: Require a grade of C or better</i>		
CMPSC 121	Introduction to Programming Techniques	3
or CMPSC 131	Programming and Computation I: Fundamentals	
CMPSC 122	Intermediate Programming	3
or CMPSC 132	Programming and Computation II: Data Structures	
STAT/MATH 318	Elementary Probability	3
or STAT/ MATH 414	Introduction to Probability Theory	

Requirements for the Option

Select an option		35-44
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Requirements for the Option

Computational Data Sciences (DTSCE_BS): 44 credits
Only Available through the College of Engineering

Code	Title	Credits
Prescribed Courses		
CMPSC 448	Machine Learning and Algorithmic AI	3
<i>Prescribed Courses: Require a grade of C or better</i>		
CMPSC 221	Object Oriented Programming with Web-Based Applications	3

CMPSC 360	Discrete Mathematics for Computer Science	3
CMPSC 442	Artificial Intelligence	3
CMPSC 455	Introduction to Numerical Analysis I	3
CMPSC 465	Data Structures and Algorithms	3
DS 410	Programming Models for Big Data	3
MATH 230	Calculus and Vector Analysis	4
STAT 415	Introduction to Mathematical Statistics	3

Additional Courses

Additional Courses: Require a grade of C or better

DS 200	Introduction to Data Sciences	4
or STAT 200	Elementary Statistics	

Supporting Courses and Related Areas¹

Select 6 credits from Applied Option List A in Appendix D	6
Select 6 credits from Applied Option List B in Appendix D	6

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

LIST OF COMPUTATIONAL DATA SCIENCES COURSES (<http://www.eecs.psu.edu/students/undergraduate/Data-Sciences.aspx>)

Applied Data Sciences (DATSC_BS): 38 credits
Only Available through the College of Information Sciences and Technology

Code	Title	Credits
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Prescribed Courses

Prescribed Courses: Require a grade of C or better

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 410	Programming Models for Big Data	3
IST 230	Language, Logic, and Discrete Mathematics	3
IST 495	Internship	1

Additional Courses

Select 6 credits from any combination: 6

DS 402	Emerging Trends in the Data Sciences	
DS 442	Artificial Intelligence	
IST 441	Information Retrieval and Organization	
IST 442	Information Technology in an International Context	
IST 445	Globalization Trends and World Issues	
IST 462	Database Modeling and Applications	
SODA 308	Research Design for Social Data Analytics	

Supporting Courses and Related Areas¹

Select 12 credits from the lists of Application Focus courses in Appendix B; 6 credits must be at the 400 level. 12

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 (<http://bulletins.psu.edu/undergraduate/colleges/information-sciences-technology/data-sciences-bs/#suggestedacademicplantext>)

Statistical Modeling Data Sciences (DTSCS_BS): 35 credits
Only Available through the Eberly College of Science

Code	Title	Credits
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Prescribed Courses

Prescribed Courses: Require a grade of C or better

MATH 230	Calculus and Vector Analysis	4
STAT 415	Introduction to Mathematical Statistics	3
STAT 440	Computational Statistics	3
STAT 462	Applied Regression Analysis	3

Additional Courses

Additional Courses: Require a grade of C or better

DS 200	Introduction to Data Sciences	4
or STAT 200	Elementary Statistics	
DS 310	Machine Learning for Data Analytics	3
or CMPSC 448	Machine Learning and Algorithmic AI	
MATH 311W	Concepts of Discrete Mathematics	3
or CMPSC 360	Discrete Mathematics for Computer Science	

Supporting Courses and Related Areas¹

Select 6 credits from Quantitative Modeling Option List A courses, see Appendix D 6

Select 6 credits from Quantitative Modeling Option List B courses, see Appendix D 6

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

LIST OF STATISTICAL MODELING DATA SCIENCES COURSES (<http://bulletins.psu.edu/undergraduate/colleges/eberly-science/data-sciences-bs/#suggestedacademicplantext>)

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 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

University Park College of Engineering

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College of Information Sciences and Technology

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Eberly College of Science

Undergraduate Statistics Office

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Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2020-21 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 contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

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

Fall	Credits Spring	Credits
CMPSC 121 or 131 (GQ) ^{*#†}	3 CMPSC 122 or 132 ^{*#}	3
MATH 140 (GQ) ^{*†#†}	4 MATH 141 (GQ) ^{*†#}	4
DS 200 or STAT 200 ^{*#}	4 DS 220 [*]	3
General Education Course	3 ENGL 15 (GWS) [†]	3
First-Year Seminar	1 General Education Course	3
	15	16

Second Year

Fall	Credits Spring	Credits
CMPSC 221 [*]	3 CMPSC 360 [*]	3
STAT 184 [*]	2 STAT 380 [*]	3
MATH 230 [*]	4 STAT 414 [*]	3
MATH 220 [*]	2 General Education Course	3
CAS 100A or 100B (GWS) ^{††}	3 General Education Course	3
General Education Course	3	
	17	15

Third Year

Fall	Credits Spring	Credits
CMPSC 442 or DS 442 [*]	3 CMPSC 410 or DS 410 [*]	3

CMPSC 465 [*]	3 CMPSC 448	3
DS 300 [*]	3 CMPSC 455	3
STAT 415 [*]	3 General Education Course	3
General Education Course	3 General Education Course	3
	15	15

Fourth Year

Fall	Credits Spring	Credits
DS 340W [*]	3 DS 440 [*]	3
List A Course	3 List A Course	3
List B Course	3 List B Course	3
ENGL 202C (GWS) ^{††}	3 General Education Course	3
Department List (General Elective)	3 Department List (General Elective)	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	16.5	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%20Data%20Sciences%202016.pdf> (<http://assets.engr.psu.edu/EECS/docs/Computational Data Sciences 2016.pdf>)

Eberly College of Science

DEPARTMENT OF STATISTICS
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<http://stat.psu.edu/about-us/contact-us> (<http://stat.psu.edu/about-us/contact-us/>)

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/students/careers/>)

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

Professional Resources

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

Contact

University Park

College of Engineering

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College of Information Sciences and Technology

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