

# DATA SCIENCES, B.S. (INFORMATION SCIENCES AND TECHNOLOGY)

**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.

### 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.

### 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/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](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 be enrolled in the College of Information Sciences and Technology, the College of Engineering, the Eberly College of Science, or the Division of Undergraduate Studies and 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\*, CMPSC 122, MATH 140\*, MATH 141\*, STAT 200\*, and IST 210\*. 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                  | 5-18    |
| Requirements for the Major | 77-90   |

**15 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GWS courses and 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 |
|---|--|---------|
| <b>Prescribed Courses</b>                                 |  |         |
| ENGL 202C   | Effective Writing: Technical Writing                       | 3       |
| <i>Prescribed Courses: Require a grade of C or better</i> |  |         |
| CMPSC 121   | Introduction to Programming Techniques                     | 3       |
| CMPSC 122   | Intermediate Programming                                   | 3       |
| 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       |
| IST 210   | Organization of Data                                       | 3       |
| MATH 140  | Calculus With Analytic Geometry I                          | 4       |
| MATH 141  | Calculus with Analytic Geometry II                         | 4       |
| MATH 220  | Matrices   | 2       |
| STAT 200  | Elementary Statistics                                      | 4       |
| STAT 380  | Data Science Through Statistical Reasoning and Computation | 3       |
| <b>Additional Courses</b>                                 |  |         |
| CAS 100   | Effective Speech   | 3       |
|   | or ENGL/CAS Rhetoric and Civic Life I 137H                 |         |
| ENGL 15   | Rhetoric and Composition                                   | 3       |
|   | or ENGL/CAS Rhetoric and Civic Life II 138T                |         |
| <i>Additional Courses: Require a grade of C or better</i> |  |         |
| STAT/MATH 318   | Elementary Probability                                     | 3       |

|                      |                                    |
|----------------------|------------------------------------|
| or STAT/<br>MATH 414 | Introduction to Probability Theory |
|----------------------|------------------------------------|

**Requirements for the Option**

|                  |       |
|------------------|-------|
| Select an option | 27-40 |
|------------------|-------|

**Requirements for the Option**

**Applied Data Sciences (DATSC\_BS): 40 credits**

**Only Available through the College of Information Sciences and Technology**

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Prescribed Courses**

*Prescribed Courses: Require a grade of C or better*

|         |   |   |
|---------|---|---|
| DS 200  | Introduction to Data Sciences             | 3 |
| 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 110 | Information, People and Technology        | 3 |
| IST 230 | Language, Logic, and Discrete Mathematics | 3 |
| IST 495 | Internship                                | 1 |

**Additional Courses**

|                                      |   |
|--------------------------------------|---|
| Select 3 credits from the following: | 3 |
|--------------------------------------|---|

|  |  |  |
|--|--|--|
| IST 442                                | Information Technology in an International Context |  |
| IST 445                                | Globalization Trends and World Issues              |  |
| SODA 308                               | Research Design for Social Data Analytics          |  |
| SRA 231                                | Decision Theory and Analysis                       |  |
| Select 3 credits from the following: 3 |  |  |
| DS 402                                 | Emerging Trends in the Data Sciences               |  |
| IST 337                                | Technologies for Digital Entrepreneurs             |  |
| IST 441                                | Information Retrieval and Organization             |  |
| IST 462                                | Database Modeling and Applications                 |  |

**Supporting Courses and Related Areas <sup>1</sup>**

|   |   |
|---|---|
| Select 6 credits from Applied Option List A | 6 |
| Select 6 credits from Applied Option List B | 6 |

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

LIST OF APPLIED DATA SCIENCES COURSES (<https://ist.psu.edu/education/degree/bs/ds/ads>)

**Computational Data Sciences (DTSCE\_BS): 38 credits**

**Only Available through the College of Engineering**

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Prescribed Courses**

|           |                                     |   |
|-----------|-------------------------------------|---|
| CMPSC 442 | Artificial Intelligence             | 3 |
| CMPSC 448 | Machine Learning and Algorithmic AI | 3 |
| CMPSC 461 | Programming Language Concepts       | 3 |

*Prescribed Courses: Require a grade of C or better*

|               |   |   |
|---------------|---|---|
| CMPSC 360     | Discrete Mathematics for Computer Science | 3 |
| CMPSC 465     | Data Structures and Algorithms            | 3 |
| DS 410        | Programming Models for Big Data           | 3 |
| MATH 230      | Calculus and Vector Analysis              | 4 |
| STAT/MATH 415 | Introduction to Mathematical Statistics   | 3 |

**Additional Courses**

|                                       |   |
|---------------------------------------|---|
| Select 1 credit of First-Year Seminar | 1 |
|---------------------------------------|---|

**Supporting Courses and Related Areas <sup>1</sup>**

|   |   |
|---|---|
| Select 6 credits from Option List A courses | 6 |
| Select 6 credits from Option List B courses | 6 |

<sup>1</sup> 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>)

**Statistical Modeling Data Sciences (DTSCS\_BS): 27 credits**

**Only Available through the Eberly College of Science**

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Prescribed Courses**

|          |                              |   |
|----------|------------------------------|---|
| MATH 230 | Calculus and Vector Analysis | 4 |
| STAT 184 | Introduction to R            | 1 |
| STAT 440 | Computational Statistics     | 3 |
| STAT 462 | Applied Regression Analysis  | 3 |

**Additional Courses**

|                                       |   |
|---------------------------------------|---|
| Select 1 credit of First-Year Seminar | 1 |
|---------------------------------------|---|

*Additional Courses: Require a grade of C or better*

|              |   |   |
|--------------|---|---|
| MATH 311W    | Concepts of Discrete Mathematics          | 3 |
| or CMPSC 360 | Discrete Mathematics for Computer Science |   |

**Supporting Courses and Related Areas <sup>1</sup>**

|   |   |
|---|---|
| Select 6 credits from Quantitative Modeling Option List A courses | 6 |
| Select 6 credits from Quantitative Modeling Option List B courses | 6 |

<sup>1</sup> 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 Information Sciences and Technology

#### Office of Undergraduate Academic Advising

E103 Westgate Building  
University Park, PA 16802  
814-865-8947  
[advising@ist.psu.edu](mailto:advising@ist.psu.edu)

**College of Engineering****Mark Mahon**

Associate Teaching Professor  
W209A Westgate Building  
University Park, PA 16802  
814-867-5396  
mpm11@psu.edu

**Eberly College of Science****Undergraduate Statistics Office**

Academic Advising  
323 Thomas Building  
University Park, PA 16802  
814-865-1348  
stat-advising@psu.edu

**Suggested Academic Plan**

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2019-20 academic year. To access previous years' suggested academic plans, please visit the archive (<http://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.

**First Year**

| Fall                                | Credits Spring                  | Credits |
|-------------------------------------|---------------------------------|---------|
| MATH 140 <sup>*†#</sup>             | 4 MATH 141 <sup>*#</sup>        | 4       |
| CMPSC 121 <sup>*#</sup>             | 3 CMPSC 122 <sup>*#</sup>       | 3       |
| STAT 200 <sup>*†#</sup>             | 4 IST 210 <sup>*#</sup>         | 3       |
| ENGL 15, 30, or ESL 15 <sup>‡</sup> | 3 General Education Course (GA) | 3       |
| IST 110 <sup>*</sup>                | 3 General Education Course (GS) | 3       |
|                                     | 17                              | 16      |

**Second Year**

| Fall                              | Credits Spring                  | Credits |
|-----------------------------------|---------------------------------|---------|
| DS 200 <sup>*</sup>               | 3 DS 220 <sup>*</sup>           | 3       |
| MATH 220 <sup>*</sup>             | 2 STAT 318 <sup>*</sup>         | 3       |
| IST 230 or CMPSC 360 <sup>*</sup> | 3 STAT 380 <sup>*</sup>         | 3       |
| General Education Course (GH)     | 3 CAS 100 <sup>‡</sup>          | 3       |
| General Education Course (GN)     | 3 General Education Course (GN) | 3       |
|                                   | 14                              | 15      |

**Third Year**

| Fall                | Credits Spring         | Credits |
|---------------------|------------------------|---------|
| DS 300 <sup>*</sup> | 3 DS 320 <sup>*</sup>  | 3       |
| DS 310 <sup>*</sup> | 3 DS 340W <sup>*</sup> | 3       |

|  |                                    |    |
|--|------------------------------------|----|
| DS 330 <sup>*</sup>                    | 3 ENGL 202C <sup>‡</sup>           | 3  |
| SRA 231, IST 442, SODA 308, or IST 445 | 3 Option List A Course             | 3  |
| General Education Selection (GA)       | 3 General Education Selection (GH) | 3  |
|  | 15                                 | 15 |

**Fourth Year**

| Fall                              | Credits Spring                        | Credits |
|-----------------------------------|---------------------------------------|---------|
| IST 337, 441, DS 402, or IST 462  | 3 DS 440 <sup>*</sup>                 | 3       |
| DS 410 <sup>*</sup>               | 3 Option List B Course                | 3       |
| Option List B Course              | 3 General Education Selection (GN)    | 3       |
| Option List A Course              | 3 General Education Selection (GS)    | 3       |
| Elective                          | 2 Elective                            | 3       |
| General Education Selection (GHW) | 1.5 General Education Selection (GHW) | 1.5     |
|                                   | 15.5                                  | 16.5    |

Total Credits 124

- \* 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/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

**Advising Note:**

- 1 credit of IST 495 is required. A grade of C or better must be earned in this course.

**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 Information Sciences and Technology

OFFICE OF THE ASSOCIATE DEAN FOR GRADUATE AND UNDERGRADUATE STUDIES

E397F Westgate Building

University Park, PA 16802

814-863-3450

[programs@ist.psu.edu](mailto:programs@ist.psu.edu)

[https://ist.psu.edu/directory/office/grad\\_undergrad\\_studies](https://ist.psu.edu/directory/office/grad_undergrad_studies)

#### College of Engineering

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

W209 Westgate Building

University Park, PA 16802

814-865-9505

[arc88@psu.edu](mailto:arc88@psu.edu)

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#### Eberly College of Science

DEPARTMENT OF STATISTICS

326 Thomas Building

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814-865-1348

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<http://stat.psu.edu/about-us/contact-us>