BS IN DATA SCIENCE

The B.S. in Data Science is an interdisciplinary program that requires a minimum of 120 hours of coursework and is designed to provide the combination of programming skills, mathematical and statistical expertise, and experience working with big data that is needed for a successful career in data science. The program includes 17-20 credit hours of study in a specific area of concentration that includes working with and applying data science methods to solving real world problems. Students may choose to concentrate in public health data, astrophysics data, or environmental science data; minors in geographic information science and technology, economics, computer science and engineering or physics also constitute concentrations; students interested in other areas should consult with their advisor. Students interested in a concentration in mathematics or statistics should choose the BS in Mathematics with a Concentration in Data Science as their preferred program of study.

Questions regarding the program should be directed to Bill Kalies (william.kalies@utoledo.edu), Interdisciplinary Data Science Program Director and program advisor

Data Science-Astrophysics Concentration, BS

Code	Title	Hours
UToledo Core Curriculum (36 total)		29
Required MATH & PHYS courses provide 7 credit hours		
UToledo Multicultural		6
College of NSM Degree Requirements		
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
NSM 1500	Building a Career in Science and Math	1
One WAC course within the Program (3 cr)		
Required courses for the BS Data Science:		
MATH 1850	Single Variable Calculus I	4
MATH 1860	Single Variable Calculus II	4
MATH 2850	Elementary Multivariable Calculus	4
MATH 1890	Elementary Linear Algebra	3
MATH 3610	Statistical Methods I	3
MATH 3620	Statistical Methods II	3
MATH 4680	Introduction To Theory Of Probability	3
MATH 4690	Introduction To Mathematical Statistics	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
CSET 3300	Database-Driven Web Sites	4
EECS 1030	Introduction to Computer Science and Engineering	3
EECS 1510	Introduction To Object Oriented Programming	4
EECS 4750	Machine Learning	3
DATA 2500	Data Science I	3
DATA 4500	Data Science II	3
GEPL 4110	Geographic Information Systems	3
or EEES 4480	GIS Applications in ENSC	
ECON 3810	Applied Econometrics	3
or ECON 4810	Econometrics Models And Methods I	
ART 2800	Visual Literacy-Data Visualization	3
or DATA 4260	Data Visualization	
PHIL 3160	Data Science Ethics	3
Required courses for the Concentration in Astrophysics Data:		
ASTR 2020	Stars, Galaxies, And The Universe	3
ASTR 3880	Foundations of Astronomy	4
PHYS 2130	Physics For Science And Engineering Majors I	4
PHYS 2135	Physics for Science and Engineering Majors I - Lab	1
PHYS 2140	Physics For Science And Engineering Majors II	4
PHYS 2145	Physics for Science and Engineering Majors II - Lab	1
PHYS 3310	Modern Physics I (WAC)	3
Total Hours		**120**

Data Science-Environmental Data Concentration, BS

Code	Title	Hours
UToledo Core Curriculum (36 total)		29
Required MATH & EEES courses provide 7 credit hours		
UToledo Multicultural		6
College of NSM Degree Requirements		
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
NSM 1500	Building a Career in Science and Math	1
One WAC course within the Program		3
EEES 3900	Literature And Communications In The Environmental Sciences	
Required courses for the BS Data Science:		
MATH 1850	Single Variable Calculus I	4
MATH 1860	Single Variable Calculus II	4
MATH 2850	Elementary Multivariable Calculus	4
MATH 1890	Elementary Linear Algebra	3
MATH 3610	Statistical Methods I	3
MATH 3620	Statistical Methods II	3
MATH 4680	Introduction To Theory Of Probability	3
MATH 4690	Introduction To Mathematical Statistics	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
CSET 3300	Database-Driven Web Sites	4
EECS 1030	Introduction to Computer Science and Engineering	3
EECS 1510	Introduction To Object Oriented Programming	4
EECS 4750	Machine Learning	3
DATA 2500	Data Science I	3
DATA 4500	Data Science II	3
GEPL 4110	Geographic Information Systems	3
or EEES 4480	GIS Applications in ENSC	
ECON 3810	Applied Econometrics	3

or ECON 4810	Econometrics Models And Methods I	
ART 2800	Visual Literacy-Data Visualization	3
or DATA 4260	Data Visualization	
PHIL 3160	Data Science Ethics	3
Required courses for the Environmental Data Concentration:		
EEES 2020	Introduction to the Environment: Energy and Climate	3
EEES 2030	Introduction to the Environment Land-Use and Water	3
or EEES 2200	Climate Change	
Select one of the following course combinations:		4-5
EEES 2100 & EEES 1020	Fundamentals Of Geology and Introductory Geology Laboratory	
EEES 3050 & EEES 3060	General Ecology and General Ecology Laboratory	
EEES 4160	Environmental Data Management and Visualization	3
EEES 4490	Remote Sensing of The Environment	4
Total Hours		**120-121**

Data Science-Individualized Concentration, BS

Code	Title	Hours
UToledo Core Curriculum (36 total)		28
Required MATH courses provide 8 credit hours		
UToledo Multicultural		6
College of NSM Degree Requirements		
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
NSM 1500	Building a Career in Science and Math	1
One WAC course approved by advisor (3 cr)		3
Required courses for the BS Data Science:		
MATH 1850	Single Variable Calculus I	4
MATH 1860	Single Variable Calculus II	4
MATH 2850	Elementary Multivariable Calculus	4
MATH 1890	Elementary Linear Algebra	3
MATH 3610	Statistical Methods I	3
MATH 3620	Statistical Methods II	3
MATH 4680	Introduction To Theory Of Probability	3
MATH 4690	Introduction To Mathematical Statistics	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
CSET 3300	Database-Driven Web Sites	4
EECS 1030	Introduction to Computer Science and Engineering	3
EECS 1510	Introduction To Object Oriented Programming	4
EECS 4750	Machine Learning	3
DATA 2500	Data Science I	3
DATA 4500	Data Science II	3
GEPL 4110	Geographic Information Systems	3
or EEES 4480	GIS Applications in ENSC	
ECON 3810	Applied Econometrics	3
or ECON 4810	Econometrics Models And Methods I	
ART 2800	Visual Literacy-Data Visualization	3
or DATA 4260	Data Visualization	
PHIL 3160	Data Science Ethics	3
Requirement for a related Minor for the Individualized Concentration		18
Refer to the guidelines below for details		
Total Hours		**120**

In areas of study where an existing concentration in the Data Science major is not available, a related minor may be selected in consultation with the student's academic advisor and the approval of the Data Analytics/Data Science Program Oversight Committee to fulfill the concentration requirement of the degree. For minors that are less than 18 credits, additional courses to equal at least 18 credits in the same discipline as the minor must be included. Courses selected within the minor must include at least two courses that focus on the collection, management, and/or analysis of data in the minor. The following minors are already approved as meeting this requirement:

Minor in Geographic Information Science and Technology
Minor in Economics
Minor in Computer Science and Engineering
Minor in Physics

Students interested in a concentration in mathematics or statistics should choose the BS in Mathematics with a Concentration in Data Science as their preferred program of study.

Data Science-Public Health Data Concentration, BS

Code	Title	Hours
UToledo Core Curriculum (36 total)		28
Required MATH courses provide 8 credit hours		
UToledo Multicultural		6
College of NSM Degree Requirements		
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
NSM 1500	Building a Career in Science and Math	1
One WAC course approved by advisor (3 cr)		3
Required courses for the BS Data Science:		
MATH 1850	Single Variable Calculus I	4
MATH 1860	Single Variable Calculus II	4
MATH 2850	Elementary Multivariable Calculus	4
MATH 1890	Elementary Linear Algebra	3
MATH 3610	Statistical Methods I	3
MATH 3620	Statistical Methods II	3
MATH 4680	Introduction To Theory Of Probability	3
MATH 4690	Introduction To Mathematical Statistics	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
CSET 3300	Database-Driven Web Sites	4
EECS 1030	Introduction to Computer Science and Engineering	3
EECS 1510	Introduction To Object Oriented Programming	4
EECS 4750	Machine Learning	3
DATA 2500	Data Science I	3
DATA 4500	Data Science II	3

GEPL 4110	Geographic Information Systems	3
or EEES 4480	GIS Applications in ENSC	
ECON 3810	Applied Econometrics	3
or ECON 4810	Econometrics Models And Methods I	
ART 2800	Visual Literacy-Data Visualization	3
or DATA 4260	Data Visualization	
PHIL 3160	Data Science Ethics	3
Required courses for the Concentration in Public Health Data:		
HEAL 2700	Introduction to Public Health	3
HEAL 2750	Introduction to Epidemiology	3
HEAL 3000	Global Health	3
HEAL 3500	Environmental Health	3
HEAL 3600	Prevention And Control Of Disease	3
HEAL 4800	Public Health Research And Statistics	3
Total Hours		**120**

Data Science-Astrophysics Concentration, BS (p. 3)
Data Science-Environmental Data Concentration, BS (p. 1)
Data Science-Individualized Concentration, BS (p. 4)
Data Science-Public Health Data Concentration, BS (p. 2)

Data Science-Astrophysics Concentration, BS

First Term		**Hours**
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
MATH 1850	Single Variable Calculus I	4
DATA 2500	Data Science I	3
ENGL 1110	College Composition I	3
Arts/Humanities Core		3
	Hours	**14**
Second Term		
MATH 1860	Single Variable Calculus II	4
ENGL 1130	College Composition II: Academic Disciplines And Discourse	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
ASTR 2020	Stars, Galaxies, And The Universe	3
NSM 1500	Building a Career in Science and Math	1
	Hours	**15**
Third Term		
MATH 2850	Elementary Multivariable Calculus	4
MATH 3610	Statistical Methods I	3
PHYS 2130	Physics For Science And Engineering Majors I	4
PHYS 2135	Physics for Science and Engineering Majors I - Lab	1
EECS 1030	Introduction to Computer Science and Engineering	3
	Hours	**15**
Fourth Term		
MATH 1890	Elementary Linear Algebra	3
MATH 3620	Statistical Methods II	3
EECS 1510	Introduction To Object Oriented Programming	4
PHYS 2140	Physics For Science And Engineering Majors II	4
PHYS 2145	Physics for Science and Engineering Majors II - Lab	1
	Hours	**15**
Fifth Term		
MATH 4680	Introduction To Theory Of Probability	3
PHYS 3310	Modern Physics I (WAC)	3
CSET 3300	Database-Driven Web Sites	4
Non#US Diversity		3
Social Science Core		3
	Hours	**16**
Sixth Term		
MATH 4690	Introduction To Mathematical Statistics	3
PHIL 3160	Data Science Ethics	3
ASTR 3880	Foundations of Astronomy	4
Elective		3
Arts/Humanities Core		3
	Hours	**16**
Seventh Term		
GEPL 4110	Geographic Information Systems	3
ECON 4810	Econometrics Models And Methods I	3
Natural Sciences Core		3
ART 2800	Visual Literacy-Data Visualization	3
EECS 4750	Machine Learning	3
	Hours	**15**
Eighth Term		
DATA 4500	Data Science II	3
Social Sciences Core		3
US Diversity		3
Electives		5
	Hours	**14**
	Total Hours	**120**

Data Science-Environmental Data Concentration, BS

First Term		**Hours**
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
MATH 1850	Single Variable Calculus I	4
HHS 2500	Data Science I	3
ENGL 1110	College Composition I	3
Arts/Humanities Core		3
	Hours	**14**
Second Term		
NSM 1500	Building a Career in Science and Math	1

MATH 1860	Single Variable Calculus II	4
ENGL 1130	College Composition II: Academic Disciplines And Discourse	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
Social Sciences Core		3
	Hours	**15**
Third Term		
MATH 2850	Elementary Multivariable Calculus	4
MATH 3610	Statistical Methods I	3
EEES 2100	Fundamentals Of Geology	4
EECS 1030	Introduction to Computer Science and Engineering	3
EEES 1020	Introductory Geology Laboratory	1
	Hours	**15**
Fourth Term		
MATH 1890	Elementary Linear Algebra	3
MATH 3620	Statistical Methods II	3
EECS 1510	Introduction To Object Oriented Programming	4
CSET 3300	Database-Driven Web Sites	4
EEES 2020	Introduction to the Environment: Energy and Climate	3
	Hours	**17**
Fifth Term		
MATH 4680	Introduction To Theory Of Probability	3
EEES 2030	Introduction to the Environment Land-Use and Water	3
Social Sciences Core		3
Non#US Diversity		3
Arts/Humanities Core		3
	Hours	**15**
Sixth Term		
ART 2800	Visual Literacy-Data Visualization	3
MATH 4690	Introduction To Mathematical Statistics	3
PHIL 3160	Data Science Ethics	3
EEES 3900	Literature And Communications In The Environmental Sciences	3
Diversity of US		3
	Hours	**15**
Seventh Term		
GEPL 4110	Geographic Information Systems	3
ECON 4810	Econometrics Models And Methods I	3
EEES 4160	Environmental Data Management and Visualization	3
EEES 4490	Remote Sensing of The Environment	4
EECS 4750	Machine Learning	3
	Hours	**16**
Eighth Term		
HHS 4500	Data Science II	3
Social Sciences Core		3
Elective		3
Natural Science Core		4
	Hours	**13**
	Total Hours	**120**

Data Science-Individualized Concentration, BS

First Year		
First Term		**Hours**
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
MATH 1850	Single Variable Calculus I	4
HHS 2500	Data Science I	3
ENGL 1110	College Composition I	3
Arts/Humanities Core		3
	Hours	**14**
Second Term		
ENGL 1130	College Composition II: Academic Disciplines And Discourse	3
MATH 1860	Single Variable Calculus II	4
CSET 1100	Introduction to Computer Science and Engineering Technology	4
Elective in Concentration/Minor requirement		3
NSM 1500	Building a Career in Science and Math	1
	Hours	**15**
Second Year		
Third Term		
ART 2800	Visual Literacy-Data Visualization	3
MATH 2850	Elementary Multivariable Calculus	4
MATH 3610	Statistical Methods I	3
EECS 1030	Introduction to Computer Science and Engineering	3
Elective		3
	Hours	**16**
Fourth Term		
MATH 1890	Elementary Linear Algebra	3
MATH 3620	Statistical Methods II	3
EECS 1510	Introduction To Object Oriented Programming	4
Natural Sciences Core and Natural Sciences Core Laboratory		4-5
	Hours	**14-15**
Third Year		
Fifth Term		
MATH 4680	Introduction To Theory Of Probability	3
CSET 3300	Database-Driven Web Sites	4
Elective in Concentration/ Minor requirement		3
US Diversity (WAC)		3
Social Sciences Core		3
	Hours	**16**

Sixth Term		
MATH 4690	Introduction To Mathematical Statistics	3
PHIL 3160	Data Science Ethics	3
Elective in Concentration/ Minor requirement		3
Elective		3
Arts/Humanities Core		3
	Hours	**15**
Fourth Year		
Seventh Term		
GEPL 4110	Geographic Information Systems	3
ECON 4810	Econometrics Models And Methods I	3
EECS 4750	Machine Learning	3
Natural Science Core		3
Elective in Concentration/ Minor requirement		3
	Hours	**15**
Eighth Term		
HHS 4500	Data Science II	3
Elective in Concentration/ Minor requirement		3
Social Science Core		3
Non-US Diversity		3
Elective		3
	Hours	**15**
	Total Hours	**120-121**

Data Science-Public Health Data Concentration, BS

First Term		**Hours**
NSM 1000	Foundations of Academic Success for Science and Math Majors	1
MATH 1850	Single Variable Calculus I	4
HHS 2500	Data Science I	3
ENGL 1110	College Composition I	3
Arts/Humanities Core		3
	Hours	**14**
Second Term		
MATH 1860	Single Variable Calculus II	4
ENGL 1130	College Composition II: Academic Disciplines And Discourse	3
CSET 1100	Introduction to Computer Science and Engineering Technology	4
Social Sciences Core		3
NSM 1500	Building a Career in Science and Math	1
	Hours	**15**
Third Term		
MATH 2850	Elementary Multivariable Calculus	4
MATH 3610	Statistical Methods I	3
Natural Sciences Core & Natural Sciences Core Laboratory		4-5
EECS 1030	Introduction to Computer Science and Engineering	3
	Hours	**14-15**
Fourth Term		
MATH 1890	Elementary Linear Algebra	3
MATH 3620	Statistical Methods II	3
EECS 1510	Introduction To Object Oriented Programming	4
CSET 3300	Database-Driven Web Sites	4
HEAL 2700	Introduction to Public Health	3
	Hours	**17**
Fifth Term		
MATH 4680	Introduction To Theory Of Probability	3
ART 2800	Visual Literacy-Data Visualization	3
HEAL 3000	Global Health	3
HEAL 2750	Introduction to Epidemiology	3
US Diversity (WAC)		3
	Hours	**15**
Sixth Term		
MATH 4690	Introduction To Mathematical Statistics	3
PHIL 3160	Data Science Ethics	3
Diversity of US		3
HEAL 3500	Environmental Health	3
Elective		3
	Hours	**15**
Seventh Term		
GEPL 4110	Geographic Information Systems	3
HEAL 3600	Prevention And Control Of Disease	3
ECON 4810	Econometrics Models And Methods I	3
EECS 4750	Machine Learning	3
Natural Sciences Core		3-4
	Hours	**15-16**
Eighth Term		
HHS 4500	Data Science II	3
HEAL 4800	Public Health Research And Statistics	3
Social Sciences Core		3
Arts/Humanities Core		3
Non-US Diversity		3
	Hours	**15**
	Total Hours	**120-122**

- PLO 1. Students will be able to explain and apply mathematical, statistical and computational principles to different data types collected from natural phenomena and human activities.
- PLO 2. Students will construct databases from data sets, manipulate and use them to extract meaningful answers to questions of interest in the natural sciences, human health or well-being.
- PLO 3. Students will be able to select and apply the appropriate computational algorithms, statistical software packages, and programming skills that are based on the evaluation of a specific data set and problem under investigation.
- PLO 4. Students will be able to describe current issues in a disciplinary area in the natural sciences, human health or well-being

that large data can provide insight into and apply the appropriate data analytics tools to their investigation.

- PLO 5. Students will describe and evaluate various social and ethical issues related to the collection, analysis and applications of data.
- PLO 6. Students will effectively communicate their work and results through written and/or oral presentations.

Honors in Data Science is available to students pursuing both a B.S. degree in Data Science and Honors through the Jesup Scott Honors College. To receive an undergraduate degree with Honors in Data Science, all requirements for the B.S. degree must be met, including at least 12 credit hours of Honors coursework in the major, with at least two Honors courses in the selected Data Science concentration. In addition, a project leading to a thesis under the direction of a research-active faculty member in the major or concentration in the major must be completed. Students are required to submit a written Honors Thesis to the program advisor before completion of their senior year.