

THE UNIVERSITY OF NORTH CAROLINA ASHEVILLE

FACULTY SENATE

Senate Document Number SD3124S

Date of Senate Approval 03/07/2024

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Statement of Faculty Senate Action:

**APC Document 25 (MATH): Add a minor in Data Science to be administered by the Department of Mathematics and Statistics**

**Effective Date: Fall 2024**

**1. Add:** On page 240, following the entry for **Minor in Mathematics:**

**Minor in Data Science**

The Data Science minor is designed to introduce students from any discipline to a foundation in data science. The core requirements introduce programming and key concepts from mathematics and statistics used in data science methods, and the upper level courses introduce students to methods and applications in data science. Earning a minor in data science will help prepare students for data-focused careers or postgraduate studies.

**Requirements for the Minor**

The Data Science minor requires a minimum of 24 semester hours, including CSCI 183, one course from CSCI 329, 339 or STAT 329; STAT 185 or 225; MATH 191, 295; and two additional courses chosen from the list of elective courses below. Completion of MATH 291 and 365 may be substituted for MATH 295. Other appropriate courses with a data science emphasis may be approved by the Chair of the Department of Mathematics and Statistics. Students majoring in Mathematics or Computer Science may apply only 15 hours of courses that are used for the major toward a Minor in Data Science.

University-wide minimum requirements for a minor: 1) one-half of the hours required for a minor must be completed in residence at UNC Asheville, to include at least 6 hours at the 300-400 level; 2) students must have a cumulative grade-point-average of at least 2.0 on minor courses taken at UNC Asheville.

**Data Science Electives**

- ASTR 420 Observational Astronomy II (3)
- ATMS 405 Meteorological Statistics (3)
- BUS 367 Introduction to Business Analytics (4)
- CSCI 329 Big Data Analytics (if not counted above) (3)
- CSCI 339 Topics in AI & Machine Learning (if not counted above) (3)
- CSCI 343 Database Management (3)
- ECON 365 Econometrics (4)
- POLS 396 Quantitative Reasoning: Telling Stories with Numbers (4)
- STAT 325 Introduction to Regression Models (3)
- STAT 326 Statistics for Experimenters (3)
- STAT 327 Applied Multivariate Analysis (3)
- STAT 329 Big Data Analytics (if not counted above) (3)
- STAT 425 Introduction to Probability Theory (3)
- STAT 426 Introduction to Mathematical Statistics (3)

**Impact:** We expect that there will be a small impact on resources and staffing with the addition of the minor in Data Science. The minor consists of courses that already exist in the UNC Asheville course catalog, with the exception of MATH 295 and CSCI 339. Multiple sections of STAT 185, CSCI 183, and MATH 191 are typically offered each semester. STAT/CSCI 329: Big Data Analytics is currently offered every other year, and if the minor increases demand for this course in the future, we will submit an APC proposal to update the course catalog to offer this course every year. While Dr. Jimin Lee has been the only faculty member who has taught STAT/CSCI 329, there are faculty in both the Department of Mathematics and Statistics and the Department of Computer Science who have the expertise and interest in teaching this course, and the instructor could potentially alternate between the two departments if it is offered annually. The Department of Mathematics and Statistics and the Department of Computer Science have a history of collaboration with cross-listed courses and will work together to coordinate the frequency and instructor for this course. CSCI 339, Topics in AI and Machine Learning, is a new course that will feature rotating topics related to data science. CSCI 339 is being proposed to replace CSCI 312 (Artificial Intelligence), CSCI 412 (Computer Vision), and special topics courses such as CSCI 373 Data Science, and CSCI 373 Natural Language Processing.

The Department of Mathematics and Statistics will work collaboratively with the Department of Computer Science to establish a new course, MATH 295 Math for Machine Learning. MATH 295 introduces the essential tools of calculus, linear algebra, and probability used in machine learning. The Department of Computer Science intends to require MATH 295 for the computer science major (both concentrations). Further discussion of the impact and rationale for MATH 295 can be found in the APC proposal for MATH 295.

Data science minors will be assigned to advisors in mathematics, statistics, or computer science, and the initial impact should be minimal. There will be a slight increase in workload for the Chair of the Department of Mathematics and Statistics, and this workload should be taken into account in the formula to compute the chair reassigned time and compensation.

Required Courses	Credits
CSCI 183      Intro Programming: Data Science	3
MATH 191      Calculus I	4
MATH 295      Math for Machine Learning (or MATH 291: Calculus III and MATH 365: Linear Algebra I)	4
Choose one: STAT 185      Introductory Statistics STAT 225      Introduction to Calculus-Based Statistics	4
Choose one: STAT/CSCI 329 Big Data Analytics CSCI 339      Topics in AI & Machine Learning	3
Choose two: ASTR 420      Observational Astronomy II (3) ATMS 405      Meteorological Statistics (3) BUS 367      Introduction to Business Analytics (4) CSCI 329      Big Data Analytics (3) CSCI 339      Topics in AI & Machine Learning (if not counted above) (3) CSCI 343      Database Management (3) ECON 365      Econometrics (4) POLS 396      Quantitative Reasoning: Telling Stories with Numbers (4) STAT 325      Intro to Regression Models (3) STAT 326      Stats for Experimenters (3) STAT 327      Applied Multivariate Analysis (3) STAT 329      Big Data Analytics (if not counted above) (3) STAT 425      Intro to Prob Theory (3) STAT 426      Intro to Mathematical Stats (3)	6 - 8

**Rationale:** Almost every industry is being reshaped by the need to adapt to data-driven decision making due to the rapid development of computation, data collection, and storage methods. Data storage, data organization, statistical tests, and machine learning methods are tools used in various fields and industries. As a result, there is an increasing number of job opportunities for students with training in data science. According to [Lightcast](#), the number of data science jobs in the U.S. is expected to increase by 84% between 2020 and 2030; between May 2022 and May 2023 there were 19,801 average monthly postings for data scientists but only 5,238 average monthly hires. To meet this emerging trend and to support our students’ success, we are proposing a data science minor to strengthen students’ computational and statistical skills.

Many mathematics departments at other liberal arts institutions have pivoted to offer data-focused programs and have seen incredible growth in their numbers. In addition, most institutions in the UNC system offer programs in data science (see Table 1). A more data-focused and computational program has the potential to not only provide more job opportunities for students as they enter the workforce, but also strengthen UNC Asheville’s undergraduate enrollment and market position and support the work being done to increase recruitment and retention.

**Table 1: UNC System Undergraduate and Masters Data Science Programs**

<b>Institution</b>	<b>Programs in Data Science</b>
UNC Chapel Hill	Data Science Minor Applied Data Science M.S.
UNC Charlotte	Data Science B.S. Graduate Certificate in Data Science and Business Analytics Data Science and Business Analytics M.S.
UNC Wilmington	Data Science M.S.
Western University	Data Science Graduate Certificate
App State	Data Science Certificate in Computer Science
Fayetteville State University	Data Science Minor Graduate Certificate in Data Science
East Carolina University	Data Science M.S.
Elizabeth City State University	Computer Science - Concentration in Data Science B.S.
NC State	Graduate Certificate Program in Data Science Foundations Foundations of Data Science M.S.
NC A&T State University	Data Science and Engineering M.S.
UNC Greensboro	Computer Science - Concentration in Data Science and Big Data B.S.
Winston-Salem State University	Data Science Minor Graduate Certificate in Data Science

We have an existing set of courses that provide a core foundation in computational and statistical techniques, and a number of courses that can serve as electives. The proposed courses align closely with other data science programs (see Table 2), and utilizes faculty expertise across disciplines to offer a cohesive multidisciplinary program in data science. This minor provides a first step to offering a data science program, with the goal of eventually developing a data science major.

**Table 2: Data Science Minor Requirements at Other Institutions**

<b>Institution</b>	<b>Requirements</b>
UNC Chapel Hill	15-18 hours: One course in data and computational thinking One course in data and statistical thinking One course in data, culture, and society Two electives
Fayetteville State University	15 hours: College Algebra or higher Basic Probability and Statistics Introduction to Data Science Statistical Modeling for Data Science Data Products Development
Winston-Salem State University	18 hours: Introduction to Data Science Applied Data Science Statistics Course (choose one from a list) Choose any three courses from a list
Converse College	19-20 hours: Data Science I and II One course in statistics (from a list of four options) Introduction to computer programming Two electives
Elon University	20 hours: Data Science and Visualization Computer Science I Computer Science II Database Systems Data Mining and Machine Learning

We plan to recruit students from Natural Sciences, Economics, Political Science, and Business. While students in Psychology might be interested in this minor, we expect that psychology students will more likely pursue the Certificate in Applied Social Science Research. The data science minor requires 24-26 credit hours, which is higher than most other minors on campus. However, Table 3 shows courses required in other majors that can count toward the data science minor. We expect computer science majors and mathematics majors in the applied mathematics concentration to be interested in pursuing a data science minor and therefore allow up to 15 credit hours to count toward both the major and minor, which leaves 3 additional courses for these students to obtain the minor.

**Table 3: Data Science Minor Courses that count toward major requirements**

<b>Major</b>	<b>Courses in minor that can count toward major</b>	<b>Credit Hours</b>
Atmospheric Sciences	ATMS 405 MATH 191	7
Biology	MATH 191	4
Business	BUS 367 STAT 185 or 225	8
Chemistry & Biochemistry	MATH 191	4
Computer Science	CSCI 182/183/185 CSCI 329 or 339 MATH 191 MATH 295 Additional CSCI courses can't count toward both the major and minor.	14
Economics	ECON 365 STAT 185 or 225	8
Engineering	MATH 191 STAT 225	8
Environmental Studies	STAT 185	4
Mathematics (Applied)	CSCI 183 MATH 191 MATH 295 (satisfied by MATH 291 and 365) STAT 225 300-400 level STAT courses cannot count toward both the major and minor.	15
Physics	MATH 191	4
Political Science	POLS 396 (elective for major) STAT 185	8

**Student Learning Outcomes:**

Table 4 shows the student learning outcomes for the data science minor and where these objectives are achieved.

**Table 4: Student Learning Outcomes for the data science minor**

<b>Course</b>	<b>Student Learning Outcomes</b> <i>Students completing the minor in data science will demonstrate the ability to:</i>
STAT 185    Introductory Statistics <i>or</i> STAT 225    Introduction to Calculus- Based Statistics	Effectively use statistics to summarize and analyze data.
CSCI 183    Intro Programming: Data Science	Implement introductory programming and data visualization skills for data science applications.
MATH 295    Math for Machine Learning	Understand basic mathematical concepts in machine learning, relating to calculus, linear algebra, and probability, and use computational tools to apply these methods in basic machine learning applications.
STAT/CSCI 329 Big Data Analytics <i>or</i> CSCI 339    Topics in AI & Machine Learning	Understand and implement various advanced data science methods.
Electives	Apply statistical and/or computational methods to discipline-specific examples