

**REQUEST FOR AUTHORIZATION TO IMPLEMENT A  
BACHELOR OF SCIENCE IN DATA SCIENCE  
AT UNIVERSITY OF WISCONSIN (UW-MILWAUKEE)  
PREPARED BY UW-MILWAUKEE**

**ABSTRACT**

The University of Wisconsin-Milwaukee proposes to establish a Bachelor of Science in Data Science (B.S. in Data Science), jointly offered by the College of Letters and Science and the College of Engineering and Applied Science. The development of program responds to the need to prepare students for careers in data science, data analytics, and related fields. Establishing the program will provide students with a solid foundation in statistical methods and programming techniques that are required in this field. Graduates will be better equipped to meet the challenging requirements of the profession for employment in areas that involve extensive data processing and data analysis. The program will be comprised of 120 credits, which will include required UWM general education courses, 24 credits of mandatory preparatory courses, 36 credits of mandatory advanced core courses, elective courses, and a capstone course or an internship at the end of the coursework.

**PROGRAM IDENTIFICATION**

**Institution Name**

University of Wisconsin-Milwaukee

**Title of Proposed Program**

Data Science

**Degree/Major Designations**

Bachelor of Science

**Mode of Delivery**

Single institution

Face-to-face

**Projected Enrollments and Graduates by Year Five**

Table 1 represents enrollment and graduation projections for students entering the program over the next five years. By the end of Year 5, it is expected 70 students will have enrolled in the program and 7 will have graduated. The average student retention rate is estimated at 75% every year, based on the average first-year attrition rate for UW-Milwaukee; this is a conservative estimate, since retention rates tend to be higher after the second year. Some students from closely related majors are expected to switch to the B.S. in Data Science, and transfers from other colleges are also expected, but these numbers are hard to predict, so they are not included in Table 1.

**Table 1: Five-Year Degree Program Enrollment Projections**

Students/Year	2020	2021	2022	2023	2024
New Students	5	10	15	20	20

Continuing Students	0	4	11	19	28
Total Enrollment	5	14	26	39	48
Graduating	0	0	0	2	5

**Tuition Structure**

For students enrolled in the B.S. in Data Science program, standard tuition and fee rates will apply. For the current academic year, residential tuition and segregated fees total \$4,799.21 per semester for a full-time student enrolled in 12-18 credits per semester. Of this amount, \$4,045.56 is attributable to tuition and \$753.65 is attributable to segregated fees. Nonresident tuition and segregated fees total \$10,584.17 per semester for a full-time student enrolled in 12-18 credits per semester. Of this amount, \$9,830.52 is attributable to tuition and \$753.65 is attributable to segregated fees.

Classes at the College of Engineering and Applied Sciences have a differential tuition of \$21.63 per credit.

Some preparatory courses at the College of Letters and Sciences offer online sections, which incur an additional \$275 fee per course.

**Department or Functional Equivalent**

Department of Mathematical Sciences  
 Department of Electrical Engineering and Computer Science

**College, School, or Functional Equivalent**

College of Letters and Sciences  
 College of Engineering and Applied Sciences

**Proposed Month and Year of Implementation**

January 2021

## DESCRIPTION OF PROGRAM

### Overview of the Program

The program will be comprised of 120 credits, which will include required UWM general education courses, 24 credits of mandatory preparatory courses, 36 credits of mandatory advanced core courses, elective courses, and a capstone course or an internship at the end of the coursework.

### Student Learning Outcomes and Program Objectives

The objective of the BS major degree in Data Science is to prepare students for careers in data science, data analytics or related fields. To accomplish this goal, students will gain a solid foundation in statistical methods and programming techniques via a wide range of courses available through the Department of Mathematical Sciences at the College of Letters and Science and the Computer Science Division at the College of Engineering and Applied Sciences.

Upon completion of the program, students will:

- Be able to integrate methods and concepts from mathematics, statistics and computer science to solve data science problems, including data management and extraction of meaning from data.
- Demonstrate critical thinking related to data science problems and concepts.
- Demonstrate oral and written communication skills related to data science.
- Demonstrate awareness of the ethical aspects of data science.

### Program Requirements and Curriculum

For admission to the B.S. in Data Science program, students must meet the general requirements of admission to UW-Milwaukee, including a high school degree with 4 credits in English, 3 credits in Mathematics, 3 credits in Natural Science, 3 credits in History/Social Science, 2 credits in College Prep Electives, and 2 credits in Other Electives. Performance on ACT/SAT tests is considered, as is an application essay.

Table 2 illustrates the program curriculum for the proposed program. The program requirements are comprised of 120 credits, of which there are 24 credits of preparatory courses, 36 credits of advanced core courses, electives, UW-Milwaukee general education requirements, and a mandatory capstone course or internship at the end of the coursework.

The general education requirements of UW-Milwaukee are also listed in Table 2. Some general education requirements are satisfied by the major requirements; for example, English 310 is a designated QL-B course, and Math 231 counts as a general education course in the Natural Sciences for breadth requirement. The UW-Milwaukee foreign language requirement is completed through two years of a single foreign language in high-school, or two semesters of a single foreign language in college. The UW-Milwaukee cultural diversity requirement is completed by taking one course from the Arts, Humanities, or Social Sciences that is designated as satisfying UW-Milwaukee's cultural diversity requirement.

### Table 2: Bachelor of Science in Data Science Program Curriculum General education and breadth courses (approx. 33 credits):

Oral and Written Communication Part A (grade C or better in English 102 or equivalent)	3 credits
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Oral and Written Communication Part B (course designated as OWC-B)	3 credits
Quantitative Literacy Part A (grade C or better in Math 105)	3 credits
Quantitative Literacy Part B (course designated as QL-B)	3 credits
Arts	3 credits
Humanities	6 credits
Natural Sciences (including one lab or field experience)	6 credits
Social Sciences	6 credits
<b>Preparatory courses (24-25 credits):</b>	
<b>Mathematics</b>	
Math 231 (Calculus I)	4 credits
Math 232 (Calculus II)	4 credits
Math 233 (Calculus III)	4 credits
Math 234 (Linear Algebra) or 240 (Matrices)	4 or 3 credits
<b>Computer Science</b>	
CompSci 250 (Introductory Computer Programming)	3 credits
CompSci 251 (Intermediate Computer Programming)	3 credits
<b>Statistics</b>	
MthStat 215 (Elem. Stat.) or 216 (Intr. to Data Science)	3 credits
<b>Core courses (36 credits):</b>	
<b>Statistics</b>	
MthStat 361 (Introduction to Mathematical Statistics I)	3 credits
MthStat 362 (Introd. to Mathematical Statistics II)	3 credits
MthStat 563 (Regression Analysis)	3 credits
MthStat 566 (Computational Statistics)	3 credits
MthStat 568 (Multivariate Statistical Analysis)	3 credits
<b>Computer Science</b>	
CompSci 315 (Introduction to Computer Organization)	3 credits
CompSci 351 (Data Structures and Algorithms)	3 credits
CompSci 422 (Introduction to Artificial Intelligence)	3 credits
CompSci 411 or 425 (Introduction to Data Mining)	3 credits
CompSci 557 (Introduction to Database Systems)	3 credits
<b>Communication and Ethics</b>	
English 310 (Writing, Speaking and Technoscience)	3 credits
CompSci 395 or Philos 237 (Society, Tech. and Ethics)	3 credits
<b>Capstone or Internship (choose one) (1-6 credits):</b>	
MthStat 489 (Internship)	1-6 credits
Math 599 (Capstone Experience)	1 credit
CompSci 595 (Capstone Project)	4 credits
CompSci 599 (Senior Thesis)	3 credits
<b>Elective courses (to reach 120 total credits):</b>	
Recommended are courses with substantial data analysis, data processing, or computational content, such as the following:	
CompSci 317, 411, 423, 425, 444, 459, 469, 535	
MthStat 562, 564, 565	
Math 315, 318, 341, 571	

InfoSt 120, 315, 465, 660, 661

**Total Credits**

120 credits

**Assessment of Outcomes and Objectives**

All majors in the Department of Mathematical Sciences undergo an annual assessment of departmental learning outcomes, which is part of the campus-coordinated assessment exercise required for Higher Learning Commission (HLC) accreditation. In addition, courses in Computer Science are regularly assessed as part of the Accreditation Board for Engineering and Technology (ABET) accreditation process. The B.S. in Data Science, as a dual major offered by both the Department of Mathematical Sciences and the Department of Computer Science and Electrical Engineering, will be part of both assessment exercises. A specific assessment of the learning outcomes and objectives of the B.S. in Data Science program will also be conducted by regularly surveying graduates of the program.

**Diversity**

The B.S. in Data Science program seeks to prepare students from diverse backgrounds for a competitive job market, providing them with technical expertise that is in high demand but in short supply in the current marketplace. This will increase the participation of women and minorities in the STEM-related job market. The program curriculum includes courses that will offer students opportunities and learning activities to engage in diversity with respect to perspectives, theories, practices, and populations different from themselves, particularly some GER courses in the Humanities and the core courses on Ethics and Communication.

The Department of Mathematical Sciences participates in many initiatives designed to foster diversity among students: UW-Milwaukee's STEM-Inspire and WiscAMP programs, which seek to "improve the recruitment, retention, and graduation of underrepresented minorities in STEM majors" (<https://uwm.edu/steminspire/>); the regional M-cubed initiative (<https://uwm.edu/m-cubed/>), which includes southeastern Wisconsin's three primary public educational institutions (Milwaukee Public Schools, Milwaukee Area Technical College, and UW-Milwaukee), urban institutions with a large proportion of minority students, and has as its mission "to increase the retention, graduation, and career success of our students and provide a prepared workforce and citizenry for the Wisconsin economy"; the UW-system Math Initiative (<https://www.wisconsin.edu/math-initiative/>), which seeks to improve the success of students in developmental math courses and in their first credit-bearing math courses; and the Higher Education Regional Alliance (HERA, <https://www.herawisconsin.org/>), a consortium of higher education institutions throughout southeast Wisconsin which is working to improve students' success in college generally, including mathematics. Faculty of the department also organize the Math Circle (<https://uwm.edu/math/math-circle-uwm/>), an outreach effort consisting of weekly sessions of problem solving and mathematical puzzles for students interested in mathematics in grades 5-12.

The Department of Computer Science and Electrical Engineering also participates in diversity-fostering initiatives. It is a founding institution in the BRAID initiative of AnitaB.org (<https://anitab.org/braid-building-recruiting-and-inclusion-for-diversity/>). One of the initiative's commitments is to build joint majors that encourage broader participation. The department also hosts the Girls Who Code Club during the academic year, a program led by computer science

faculty to encourage school girls' interest in computing and all the opportunities it provides (<https://uwm.edu/engineering/our-people/community/girls-who-code-club/>).

### **Projected Time to Degree**

A full-time student taking the standard course load of five three-credit courses per semester will complete the requirements in eight semesters. For this, students will need a mathematics placement level that allows them to begin with pre-calculus or a higher math course. About 30% of entering UW-Milwaukee students achieve this level. Students needing additional math courses should still be able to complete the program in four years by taking coursework during the summer.

### **Program Review**

In accordance with UW-Milwaukee policies and procedures, the program will be reviewed five years after implementation for the first time, and every ten years thereafter.

### **Accreditation**

This program does not require special accreditation. It will be reviewed as part of the campus accreditation process by the Higher Learning Commission.

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## **JUSTIFICATION**

### **Rationale and Relation to Mission**

The UW-Milwaukee Select Mission Statement (<https://uwm.edu/mission/>) states, in part, that “to fulfill its mission as a major urban doctoral university and to meet the diverse needs of Wisconsin’s largest metropolitan area, the University of Wisconsin–Milwaukee must provide a wide array of degree programs [...]. Fulfilling this mission requires the pursuit of these mutually reinforcing academic goals:

- To develop and maintain high quality undergraduate, graduate and continuing education programs appropriate to a major urban doctoral university.
- To attract highly qualified students who demonstrate the potential for intellectual development, innovation, and leadership for their communities.
- To further academic and professional opportunities at all levels for women, minority, part-time, and financially or educationally disadvantaged students.
- To promote public service and research efforts directed toward meeting the social, economic and cultural needs of the state of Wisconsin and its metropolitan areas.
- To provide educational leadership in meeting future social, cultural, and technological challenges.”

The proposed B.S. in Data Science will contribute directly to the mission of UW-Milwaukee by providing students with a thorough academic preparation to meet the challenging demands of the profession, by attracting students with strong STEM potential from diverse socioeconomic backgrounds in southeastern Wisconsin, and by fostering cooperation between UWM and the business community, for example, through the Northwestern Mutual Data Science Institute (<https://innovation.northwesternmutual.com/northwestern-mutual-data-science-institute/>).

### **Institutional Program Array**

The proposed B.S. in Data Science will complement existing programs both at the Department of Mathematical Science and the Department of Electrical Engineering and Computer Science.

The department of Mathematical Sciences currently offers a B.A. in Actuarial Science and B.A./B.S. in Mathematics. The mathematics and statistics courses (Math and MthStat) listed in the proposed B.S. in Data Science curriculum are regularly offered by the department as part of those majors’ curricula. However, the department does not currently offer a specific degree on statistics or data science, which would require a stronger programming coursework.

Similarly, the Department of Electrical Engineering and Computer Science offers B.A./B.S. in Computer Science, and the computer science courses (CompSci) listed in the proposed B.S. in Data Science curriculum are regularly offered by the department as part of those majors’ curricula, but the department does not currently offer a specific degree on statistics or data science, which would require a stronger statistics coursework.

Both departments currently offer a joint B.S. in Applied Mathematics and Computer Science, but this degree is not specifically aimed at the market demands in the fields of data science and data analytics.

The proposed B.S. in Data Science seeks to combine the existing course offers of both departments, and the expertise of their faculty, into a new major that is specifically oriented to data science. Therefore, the proposed program will complement existing programs in both departments.

### **Other Programs in the University of Wisconsin System**

There is currently only one major degree in data science offered at a UW institution, a B.S. in Data Science and Predictive Analytics at UW-River Falls. Two other institutions have recently received approval to plan major degrees in data science: B.A./B.S. in Data Science at UW-Madison and a B.S. in Data Science at UW-Platteville. UW-Stout offers a B.S. in Applied Mathematics and Computer Science that, unlike its homonymous at UW-Milwaukee, it has concentrations with stronger statistics and data science components, so it can be considered a closely related degree. There is also a minor offered by the Department of Computer Science at UW-Whitewater. No other undergraduate degrees in data science are currently offered at the UW system.

This program, then, will not create unnecessary duplication and will fill an unmet market need in the area of southeast Wisconsin.

### **Need as Suggested by Current Student Demand**

Graduation data from the Department of Mathematical Sciences between Spring 2014 and Spring 2018 show that the department granted 48 B.A.s in Actuarial Science, 9 B.A.s or B.S.s in Mathematics with concentration in Applied Mathematics, 1 B.S. in Mathematics with concentration in Statistics, 2 B.S.s in Mathematics with concentration in Computational Mathematics, 8 B.A.s or B.S.s in Mathematics with concentration in Pure Mathematics, and 54 B.A.s or B.S.s in Mathematics without concentration specification (concentrations were discontinued in Fall 2017, so the last figure includes both students interested in pure or applied mathematics.) These data show that a large proportion of undergraduate students in the Department of Mathematical Sciences have shown interest in statistics, actuarial science or applied mathematics in recent years. Therefore, there has been a sustained student demand for applied math and statistics-related programs in recent years.

We expect that the proposed B.S. in Data Science will complement these majors, as well as the majors offered by the Department of Computer Science and Electrical Engineering, increasing the visibility of UW-Milwaukee in this area and giving us the opportunity to recruit students who would otherwise not attend UW-Milwaukee. It must be noted that, in the southeast Wisconsin region, only Marquette University offers a data science major degree; however, Marquette is a private catholic institution with a very different mission and student body than UW-Milwaukee.

### **Need as Suggested by Market Demand**

The job outlook for mathematicians and statisticians in the Occupational Outlook Handbook of the Bureau of Labor Statistics (<https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm>) states that "employment of statisticians is projected to grow 34 percent from 2016 to 2026, much faster than the average for all occupations. Growth is expected to result from more widespread use of statistical analysis to make informed business, healthcare, and policy decisions. In addition, the large increase in available data from the Internet will open



up new areas for analysis. (...) The amount of digitally stored data will increase over the next decade as more people and companies conduct business online and use social media, smartphones, and other mobile devices. As a result, businesses will increasingly need mathematicians to analyze the large amount of information and data collected." The handbook is very specific about data science, stating that "job opportunities are expected to be favorable for those with very strong quantitative and data analysis skills. Computer programming skills will remain important to many employers, as will be keeping up with new statistical methods and programming languages." According to this report there were 37,200 job positions for statisticians in the US in 2016, and this number is expected to grow to 49,800 in 2026.

For the state of Wisconsin, a labor market report generated at WisConomy, the Department of Workforce Development labor database (<https://jobcenterofwisconsin.com/wisconomy/>), shows that the number of job positions in Computer and Mathematical Occupations in the Professional, Scientific, and Technical Services industries is expected to grow from 17,299 in the year 2016 to 20,899 in 2026 (a 20.8% increase), and in the Finance and Insurance industries is expected to grow from 10,424 to 11,703 (a 12.3% increase) in the same period.

The recent creation of the Northwestern Mutual Data Science Institute at UW-Milwaukee and Marquette University also demonstrates the demand for data science programs in the region of southeast Wisconsin.