**Agendum**
**Oakland University**
**Board of Trustees Formal Session**
**February 7, 2025**

## BACHELOR OF SCIENCE DEGREE IN APPLIED DATA SCIENCE
**A Recommendation**

1. **Division and Department:** Academic Affairs, College of Arts and Sciences, Department of Mathematics and Statistics.

2. **Introduction:** Oakland University proposes a new Bachelor of Science (BS) degree in Applied Data Science. This program builds upon the strengths of existing coursework, research activities, and degree programs in the Department of Mathematics and Statistics, as well as those within the College of Arts and Sciences, the School of Engineering and Computer Science, the School of Health Sciences, and the School of Business Administration. The BS in Applied Data Science provides students with a solid understanding of all three pillars of data science: mathematics and statistics, computer science, and specific application areas. A key feature of this program is its flexibility, offering students the opportunity to take electives in applied quantitative analysis or methods and one or two application areas such as geoinformatics, healthcare, business, computer science or engineering. This enables students to tailor their education to their specific interests and career goals. This comprehensive and flexible approach ensures that graduates are well-equipped to tackle real-world data-driven challenges, pursue advanced studies or careers in the industry, and eventually meet the growing demand for data science professionals in Michigan and across the nation.

3. **Previous Board Action:** None.

4. **Budget Implications:** The program will primarily be funded through undergraduate tuition. It is expected to generate a net income for the University beginning in its first year of operation. By the fifth year, tuition revenue is anticipated to stabilize with 27 students enrolled. Salary expenses will cover one full-time faculty member and one part-time faculty member. Operating expenses will include costs for marketing and library resources to support the new program. The proforma budget is provided as Attachment B. The budget impact of this program is minimal, as it leverages existing coursework and expertise within the College of Arts and Sciences, the School of Engineering and Computer Science, the School of Health Sciences, and the School of Business Administration.

**5. Educational Implications:** The proposed program will introduce two new courses focused on general processes and methods for visualizing, transforming, and analyzing data, as well as on methods for implementing these techniques using statistical software. Additionally, three new courses will be offered, addressing modeling and analyzing data from specific application areas or key programming languages with data science applications. The first two courses will be required for the program, while the remaining three will be electives.

**6. Personnel Implications:** To manage the anticipated teaching load resulting from the introduction of new courses, the program will require the hiring of a full-time faculty member at the assistant professor level starting in the second year of its operation. Additionally, a director responsible for overseeing recruitment and retention of students, curriculum updates, and industrial outreach will be appointed from the existing faculty in the third year of the program. A part-time faculty member will be hired concurrently with the director to help manage course releases for the director and to teach necessary introductory-level courses, enabling other full-time faculty to focus on upper-level courses related to the program.

**7. University Reviews/Approvals:** The proposed program has been reviewed by the College of Arts and Sciences Faculty Assembly, the University Committee on Undergraduate Education, the Oakland University Senate, and the Executive Vice President for Academic Affairs and Provost.

**8. Recommendation:**

WHEREAS, the BS in Applied Data Science degree program is consistent with the objectives contained in Oakland University's Institutional Priorities; and

WHEREAS, the BS in Applied Data Science degree program will build on the academic and research strengths of the College of Arts and Sciences and provide new educational and community engagement opportunities; now, therefore, be it

RESOLVED, that the Board of Trustees authorizes the College of Arts and Sciences to offer the BS in Applied Data Science; and, be it further

RESOLVED, that the Executive Vice President for Academic Affairs and Provost will complete annual reviews of the BS in Applied Data Science degree program to evaluate academic quality and fiscal viability to determine whether the program should continue.

**9. Attachments:**

A. Proposal for the BS in Applied Data Science degree program.
B. Proforma budget for the BS in Applied Data Science degree program.

Submitted to the President
on 1/28/25, 2025 by

Kevin J. Corcoran, Ph.D.
Interim Executive Vice President for
Academic Affairs and Provost

Recommended on 1/30, 2025
to the Board for Approval by

Ora Hirsch Pescovitz, M.D.
President

Reviewed by

Joshua D. Merchant, Ph.D.
Chief of Staff and
Secretary to the Board of Trustees

# Proposal for a B.S. in Applied Data Science

## Department of Mathematics and Statistics

## College of Arts and Sciences

## Oakland University

Approved unanimously by the full-time tenured and tenure-track faculty of the Department of Mathematics and Statistics at the meeting of March 14, 2023.

New Program Proposal

# Applied Data Science, B.S.

**Requested Implementation Term: Fall 2025**

Department of Mathematics and Statistics

College of Arts and Sciences (CAS)

## School or College Governance

I, Dean Carey certify that the Bachelor of Science in Applied Data Science has been reviewed by the appropriate school/college and department committees and that implementation of the proposed degree program is recommended.

| Dean of the College (signature) | 12/6/2024 | Elaine Carey |
|---|---|---|
| | Date | Dean of the College (print) |

**Department of Mathematics & Statistics**
Approval on: March 14, 2023

| Chairperson of the Department (signature) | 12/6/2024 | Anna Spagnuolo |
|---|---|---|
| | Date | Chairperson of the Department (print) |

**CAS Undergraduate Committee on Instruction**
Approved on: April 13, 2023

**CAS Assembly**
Approved on:

## University Governance

**University Committee on Undergraduate Instruction (UCUI)**
Approved on: October 3, 2023

**University Senate**
Approved on:

**Board of Trustees**
Approved on:

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## Summary

The Occupational Outlook Handbook of the U.S. Bureau of Labor Statistics states that: "*Employment growth for data scientists is expected to stem from an increased demand for data-driven decisions. The volume of data available and the potential uses for that data will increase over the projections decade. As a result, organizations will likely need more data scientists to mine and analyze the large amounts of information and data collected. Data scientists' analysis will help organizations to make informed decisions and improve their business processes, to design and develop new products, and to better market their products.*"

Vast amounts of data in various formats are collected nowadays in industry, business, government, healthcare, and other areas. Extracting useful information from these data sets requires a new approach based on quantitative methods and computing tools. Data scientists use such methods and tools to generate knowledge and insights from data. The career prospects of data scientists are very good, with a much faster than average job growth outlook over the course of the current decade.

A growing number of universities in Michigan offer B.S. data science programs to graduate data scientists who can respond to the needs of the local, state and national economies. Generally, these programs consist of a set of required and elective courses in mathematics, statistics and computer science, which are necessary for students to be successful in jobs in data science. In addition, these programs offer electives in application areas. The program proposed by the Department of Mathematics and Statistics at Oakland University meets these data science education guidelines. In addition, it provides a distinctive focus on enhancing students' comprehension of applied quantitative analysis and methodologies while developing their skills in specialized application areas, including geoinformatics, healthcare, business, and beyond.

# I. Rationale

## A. Data Science Overview

In the modern era, data is being generated at an unprecedented pace: it was estimated that 2.5 quintillion bytes of data is created each day[1]. Fueled by the increase in complex and rich data in the modern era, data science, defined as the science of "planning for, acquisition, management, analysis of, and inference from data" [2], is experiencing unexpected and rapid growth. A typical data analysis project involves initiating a domain-specific problem, collecting and cleaning data, exploring patterns, developing and evaluating a model, deploying it, communicating results, and iteratively refining the process based on feedback. Throughout the workflow, data scientists must leverage statistical, mathematical, and computational knowledge, along with domain-specific expertise, to guide analytic decisions and interpretations. This workflow also highlights the true interdisciplinary nature of data science, as illustrated in the following diagram, which requires proficiency not only in mathematics, statistics, and computer science but also in a specific underlying domain. This unique feature sets data science apart from traditional professions that require expertise in one or two of the previously mentioned areas and provides a rationale for developing an independent data science program to train students who can address challenges arising from acquiring knowledge from modern, complex data.

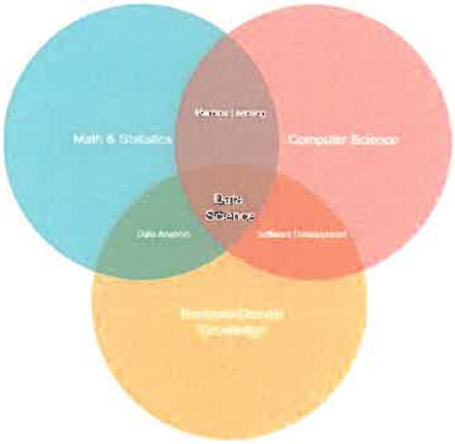



Figure 1. What is Data Science?

[1] https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/#5de87a5060ba (Accessed Feb 4, 2023. How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read.)

[2] http://www.nsf.gov/attachments/130849/public/Stodden-StatsNSF.pdf (Accessed Feb 4, 2023. Data Science at NSF.)

**B. Promote the mission of the university**

The Oakland University Mission Statement is as follows:

> Oakland University cultivates the full potential and inclusive community. As a public doctoral institution, we impact Michigan and the world through education, research, scholarship, and creative activity.

In a world that is becoming increasingly data-driven, the proposed program aligns well with the University's mission to cultivate the full potential of an inclusive community. By offering a comprehensive curriculum in data science, the program aims to graduate students equipped with the necessary quantitative and computational skills. These graduates are poised to make contributions to meet the demands of the local, state, and national economies. In addition, this data science program not only prepares students for successful careers but also positions them to play a vital role in advancing knowledge, innovation, and economic growth at various levels of society.

Additionally, the proposed B.S. in Applied Data Science program may attract underrepresented minority students for its dynamic and interdisciplinary nature, offering a platform to address real-world challenges impacting their communities. The potential for lucrative career paths and initiatives promoting diversity and mentorship within data science programs can enhance inclusivity, making the field appealing to underrepresented individuals seeking both professional and societal impact.

The Department of Mathematics and Statistics has already established a mechanism, the Oakland University Math Corps Summer Camp, as an outreach program designed for middle and high school students residing primarily in Pontiac, Michigan, aimed at fostering diversity within OU's student body. This program immerses a varied student group in a daytime camp on the university campus, fostering a sense of belonging by bringing them into contact with faculty and staff. The camp has already inspired students to express interest in diverse degree programs at Oakland University, and with the proposed applied data science program, participants will have an additional pathway to explore within the university's offerings.

**C. Program need**

According to the Occupational Outlook Handbook of the U.S. Bureau of Labor Statistics[3], "data scientists use analytical tools and techniques to extract meaningful insights from data", their 2022 median pay was $103,500 per year and the data science job growth outlook for 2022-32 is 35% (much faster than average). The strong interest in data science careers is supported by the large number of job postings. For example, there were 168,900 jobs openings for data scientists in 2022. More recently, there were 106,051 jobs related to data science posted nationwide within the last 30 days on ZipRecruiter[4], of which 810 in the state of Michigan. Therefore, there is a need for data scientists at national and state levels, and an opportunity for universities to provide the necessary education.

The Occupational Outlook Handbook of the U.S. Bureau of Labor Statistics[5] outlines some education guidelines for future data scientists as follows: "*Data scientists typically need at least a bachelor's degree, but some jobs require a master's or doctoral degree. Common fields of degree include mathematics, statistics, computer science, business, and engineering. Because data science involves the use of algorithms and statistical techniques, students need extensive study in mathematics and statistics" and "courses in computer science are important in addition to math and statistics. Students must learn data-oriented programming languages as well as statistical, database, and other software for presenting analyses.*"

This statement reveals the importance of mathematics and statistics in the new field of data science, as emphasized by the U.S. Bureau of Labor Statistics (BLS). Indeed, the most prestigious organizations in statistics (American Statistical Association - ASA) and applied mathematics (Society for Industrial and Applied Mathematics - SIAM) have recently introduced two research journals in data science: (1). Statistical Analysis and Data Mining: The ASA Data Science Journal; and (2). SIAM Journal on Mathematics of Data Science. These additions reflect the acknowledgement of both organizations and the BLS of the present and future role of mathematics and statistics in developing robust methods and models for data science. Moreover, the above statement on BLS's website reveals the interdisciplinary approach to data science driven primarily by mathematics, statistics, and computer science. As the statement above

[3] https://www.bls.gov/ooh/math/data-scientists.htm#tab-1 (Accessed Oct 1, 2023)
[4] https://www.ziprecruiter.com (Accessed Feb 4, 2023. It includes all job titles related to data science.)
[5] https://www.bls.gov/ooh/math/data-scientists.htm#tab-4 (Accessed Oct 1, 2023)

stresses the importance of mathematics and statistics in data science, we plan to offer a program that follows this interdisciplinary approach, while emphasizing the applied quantitative mathematical and statistical aspects which are foundational to data science.

**D. Career options**

The career prospects for data scientists are described as follows by the Occupational Outlook Handbook of the U.S. Bureau of Labor Statistics[6]: "*Employment growth for data scientists is expected to stem from an increased demand for data-driven decisions. The volume of data available and the potential uses for that data will increase over the projections decade. As a result, organizations will likely need more data scientists to mine and analyze the large amounts of information and data collected. Data scientists' analysis will help organizations to make informed decisions and improve their business processes, to design and develop new products, and to better market their products.*"

Therefore, data scientists have a wide range of career options in industry, business, government, healthcare, etc. In addition, students finishing a B.S. data science program have very good prospects for graduate studies in data science, statistics, mathematics, computer science, business, and others.

**E. Goals and objectives**

The program is designed for students with good mathematical, statistical, and programming skills who want to apply them to various fields. It will prepare students for high paying entry jobs in industry, healthcare, business, government, etc. The particular emphasis of the program on applied aspects of data science as outlined in the program curriculum will offer students additional opportunities within specific domain areas, enhancing their readiness for targeted roles in their chosen field.

**F. Current Data Science Programs in Michigan**

A growing number of public universities in Michigan offer bachelor's degrees in data science. Their course requirements are given in Appendix B.

[6] https://www.bls.gov/ooh/math/data-scientists.htm#tab-6 (Accessed Oct 1, 2023)

- Central Michigan University offers a B.S. degree in Data Science in the Department of Statistics, Actuarial and Data Sciences.
- Eastern Michigan University offers a B.S. degree in Data Science and Analytics in the College of Arts and Sciences (CAS), an interdisciplinary program between the Department of Mathematics and Statistics (in the CAS), the Department of Computer Science (in the CAS) and the Department of Computer Information Systems in the College of Business.
- The University of Michigan-Dearborn offers a B.S. degree in Data Science, in the Computer and Information Science Department.
- The Department of Statistics at Western Michigan University offers a B.S. degree in Data Science as a joint degree between the Department of Statistics and the Department of Computer Science.
- The Department of Mathematics and Computer Science at Northern Michigan University offers a B.S. degree in Data Science.
- The School of Computer Science and Mathematics at Lake Superior State University offers a B.S. degree in Data Science.
- The College of Innovation and Technology at University of Michigan, Flint offers a (fully online) B.S. degree in Data Science.
- The College of Computing at Michigan Technological University offers a B.S. degree in Data Science.

Five of the above programs (those at CMU, NMU, LSSU, UM Flint and Michigan Tech) started in the past two years, which speaks greatly to the urgency for Oakland University to offer this degree.

- The University of Michigan in Ann Arbor offers a multidisciplinary undergraduate major, co-located in the College of Literature, Science, and the Arts (LSA) and the College of Engineering (CoE). It is jointly managed by the Department of Statistics in the LSA and the Division of Computer Science and Engineering (CSE) in CoE. Students in the LSA program receive a B.S. degree with a Data Science major and the students from CoE receive a B.S.E. degree in Data Science.

- Michigan State University offers two separate data science programs sharing some of the courses: the B.S. degree in Data Science in the Department of Computational Mathematics, Science and Engineering (in the College of Natural Science), and the B.S. Computational Data Science in the Department of Computer Science and Engineering (College of Engineering).

Both the University of Michigan in Ann Arbor and Michigan State University have diverse data science degrees in that they are offered in two different colleges. This diversification likely resulted in a larger student enrollment in each program. Specifically, students who want a degree from either college have the ability to obtain a data science degree. This model of offering the degree in different units may also be appropriate for Oakland University as it might play a role in increasing enrollment.

As of Fall 2023, there were ten MI public universities that offer B.S. degrees in data science, based on public information from their websites. In eight of them, a Mathematics and/or Statistics department participates formally, either jointly with other departments or separately as a single department. This aligns well with the educational guidelines of the U.S. Bureau of Labor Statistics regarding the role of mathematics and statistics in data science. A B.S. degree in data science offered by the Department of Mathematics and Statistics at Oakland University follows this model. The support letters included in Appendix H emphasize the importance of our proposed program.

The number of required credits varies by university program, but it is generally between 120 and 128. A common theme is that all programs require a combination of basic courses necessary in data science, from mathematics, statistics, and computer science. Later in the programs, students take more advanced data science courses from mathematics, statistics, computer science and/or application areas.

The proposed program shares similarities with existing programs, integrating a comprehensive mix of required courses in statistics, mathematics, and computer science. However, it distinguishes itself with notable advantages over comparable programs offered within Oakland University and other Michigan universities:

(1). It sets itself apart by placing a unique emphasis on cultivating an advanced understanding of applied quantitative analysis and methods through specific applied mathematics and applied statistics courses related to data science. This focus allows students not only to deepen their comprehension of various data science models but also positions them well for the pursuit of advanced degrees in the field.

(2). The program offers a distinctive edge through a well-rounded set of required elective courses in specific application areas. These courses, spanning geoinformatics, healthcare, business, and more, provide students with a practical toolkit tailored to the demands of diverse industries. This emphasis on applied aspects not only aligns with the interdisciplinary nature of data science but also enhances students' practical skills and employability.

(3). The program's positioning within the College of Arts and Sciences (CAS) is advantageous for students pursuing other majors within CAS. By sharing general education course requirements, the program facilitates a path for CAS majors to claim a minor in data science. Establishing a minor in Applied Data Science in the Department of Mathematics and Statistics is an initiative that will be undertaken once the major is established. This streamlined approach not only encourages broader enrollments but also fosters a collaborative academic environment where students from diverse majors can benefit from the interdisciplinary nature of data science education.

(4). The program leverages Oakland University's strategic location in metropolitan Detroit, providing students with internship opportunities and connecting them with the region's data science industry. This location advantage is reinforced by inviting local data scientists to the Industrial Advisory Committee, enhancing the program's relevance and students' potential for securing internships and future careers. In fact, our Industrial Advisory Committee members have a history of providing internships and monetary support to our graduate students.

## II. Academic Unit

### A. How goals of School/College/Dept are served

The teaching mission of the Department of Mathematics and Statistics at Oakland University states, "*The Department is committed to offering excellent undergraduate degree programs and concentrations in the mathematical sciences to fit the specific career needs of Oakland students,*

*whether these be in government, industry, teaching, or the pursuit of higher education in the mathematical sciences or in other areas that require a high level of mathematical or statistical competence. Toward this end, the Department cooperates fully with other units in the development of programs...*"

The proposed program in data science offered by the Department will meet the needs of students who are interested in a modern, interdisciplinary program that cuts across several disciplines and is directly applicable to solve problems involving complex and large amounts of data necessary in the world today. The Department will cooperate with the Computer Science and Engineering Department in the School of Engineering and Computer Science as well as other departments in developing this program.

**B. Staff support**

The Department of Mathematics and Statistics has full-time faculty with the appropriate expertise required to offer this program. However, the addition of a new tenure-track faculty member with expertise in the applied mathematics aspects of data science, would be highly beneficial. This addition is crucial for the Department to sustain its offerings of existing and new courses.

We also request the creation of a director position to begin in the third year following the initiation of the proposed data science program. The director's position will be assigned to an existing full-time faculty member. The director will take on various responsibilities, including the recruitment of new students, retention of existing students (which includes advising), management of student internships, outreach to industry or external collaborators to seek advice on curriculum offerings, and the generation of internship or full-time job offers for students.

In comparison to traditional degree programs that focus on a single discipline, students majoring in the proposed data science program, as mentioned earlier, must develop skills in multiple discipline areas. This complexity in terms of course sequence and timing underscore the significance of effective advising for the success of students in the proposed data science program. Furthermore, given the rapid evolution of the data science field, continuous adjustments to the curriculum are essential. Periodically connecting with industry collaborators to seek advice on course offerings ensures that students receive training relevant to the dynamic demands of the field.

Additionally, the third pillar of data science is application areas. Proficiency in this pillar can be achieved not only through coursework but also through internships, providing students with the opportunity to apply their skills to analyze real-life data and make informed decisions and to help students gain practical experience that may be useful later in securing full-time employment. A director can play a crucial role in assisting students in securing and succeeding in internships with industry partners or case studies from external collaborators, as exemplified by the Data Mine program at Purdue (as mentioned in Section III.D). The suggestion to establish such a director's position is also inspired by the actuarial science program managed by DMS, where a director is in place to assume similar responsibilities and ensure program sustainability. Compensation for the director's position could be provided as a course release.

### C. Faculty qualifications

The Department currently has 28 (including two visitors) full-time faculty members, having various teaching and research interests in mathematics and statistics. In fact, some faculty in the Department publish their research in journals related to data science. All full-time faculty have the expertise to teach many courses listed in the data science program, and many faculty have the expertise to teach the advanced courses. Short biographical sketches of permanent full-time faculty are included in Appendix A.

## III. Program Plan

### A. Admission requirements

There are no admission criteria to take this major. However, students are required to earn a grade of C or higher in all required courses.

### B. Degree requirements

Specific degree requirements of the proposed degree program are detailed in Appendix B. The program comprises a set of required courses, totaling 82 credits. The remaining courses fulfills additional prerequisites, Oakland University's general education requirements, and the College of Arts and Sciences exploratory requirement. The latter is met through a minor in Mathematics or Applied Statistics, as a small subset of required courses in the curriculum. The list of the required courses is provided below:

1. Foundational Courses (20 credits):

   Mathematical Foundation:

   - MTH 1554 - Calculus I (4)
   - MTH 1555 - Calculus II (4)
   - MTH 2775 - Linear Algebra (4)

   Programming Foundation:

   - CSI 1320 - Introduction to Python Programming and Unix (4)

   Statistical Foundation:

   STA 2226 - Applied Probability and Statistics (4)

2. Program Core Courses (20 credits):
   - APM 2663 - Discrete Mathematics (4)
   - CSI 2300 - Object Oriented Programming (4)
   - CSI 2310 - Data Structures (4)
   - STA 4002 - Applied Linear Models I (4)

     or

     MTH 2554 - Multivariable Calculus (4)
   - STA 4111 - Statistical Methods in Data Science (4)

3. Additional Required Courses (12 credits):
   - STA 4006[7] - Statistical Computing (4)
   - STA 4840 - Introduction to R for Data Science (4)
   - CSI 3450 - Database Design and Implementation (4)

4. Program Specific Electives (30 credits)

   - Four elective courses from **applied quantitative analysis or methods** (16 credits)
   - A minimum of 14 credits from one or a mixture of two **application areas** selected from geoinformatics, healthcare, business, computer science or engineering

[7] Potentially cross-listed with an existing graduate course.

The required courses are a blend of fundamental data science courses offered by both the Department of Mathematics and Statistics, and the Department of Computer Science and Engineering. The four elective courses from applied quantitative analysis and methods, as listed in Appendix B offer a larger and more balanced variety of such courses related to data science, both in applied mathematics and applied statistics, when compared with other data science B.S. programs in the state. These courses cover applied quantitative topics directly related to data science, such as statistical modeling and analysis, SAS programming with statistics applications, stochastic processes, time series and analysis of stocks data, graphs and networks, mathematical modeling in biology, numerical methods, operations research, and optimization. The electives in the application areas, as listed in Appendix B, offer students an introductory expertise on some applications of data science, such as geographic information systems and satellite imagery, genetics and bioinformatics, economy and financial markets, artificial intelligence and cloud computing, or engineering risk and economic analysis. We would like to note that the list of electives for application areas is expected to expand as the proposed program matures and fosters more collaborations with other units at OU. Another important group consists of courses that satisfy Oakland University's general education requirement and the College of Arts and Sciences exploratory requirement. Examples of such courses are included in the complete sample curriculum for the proposed program in Appendix C. In the proposed program curriculum, STA 4111 will serve as a capstone course to further assess and develop students' critical thinking and communication skills.

All courses in the proposed program are existing courses except for two required course STA 4111, STA 4840, and three elective courses. STA 4006 currently not in the undergraduate catalog will be created as a cross-listed course with the existing STA 5006. An overview of the new courses in the Department of Mathematics and Statistics is given in Appendix D.

The design of our curriculum reflects the seven focus areas of a data science curriculum mentioned in the 2017 paper[8] written by De Veaux etc. and the 2018 National Academies of Sciences, Engineering, and Medicine's report[9] entitled "Envisioning the Data Science Discipline:

[8] De Veaux, R., M. Agarwal, M. Averett, B. Baumer, A. Bray, T. Bressoud, L. Bryant, et al. 2017, Curriculum guidelines for undergraduate programs in data science, Annual Review of Statistics and Its Applications 4: 15-30.
[9] National Academies of Sciences, Engineering, and Medicine, Envisioning the Data Science Discipline: The Undergraduate Perspective: Interim Report (2018), DOI 10.17226/24886

The Undergraduate Perspective". These focus areas are (1) mathematical foundations, (2) computing skills, (3) statistical thinking, (4) computational thinking, (5) data description and curation, (6) data modeling, and (7) communication, reproducibility, and ethics.

Students establish their mathematical foundations and computing skills through foundational courses. Subsequently, they cultivate their statistical thinking and computational skills in the core courses of the program. Emphasis on data description and curation, as well as data modeling, will be placed in the additional required courses. The seventh skill, encompassing communication, reproducibility, and ethics, will be integrated into certain project-based courses within the curriculum, including STA 4111, as well as select courses from the application area electives, offering a comprehensive capstone experience for the students.

The emphasis on the applied aspects of the proposed program is reflected in its curriculum design. (1). Through required courses, students will gain exposure to two important programming languages in the field of data science, namely R and Python. This exposure is intended to provide them with a solid foundation in these essential languages. Additionally, they can further enhance their skills in other essential languages, such as SAS, by taking electives. This flexibility enables students to tailor their education to their specific interests and career goals. (2). An integral aspect of our proposed program is that our curriculum requires students to take electives from application areas. These courses enable students to acquire crucial domain-specific knowledge, providing valuable context and insights into the unique aspects of a particular industry or field. While statistical and computational skills form the foundation, domain expertise enhances the ability to formulate meaningful questions, interpret results, and create models that align with real-world complexities. Moreover, domain knowledge aids effective communication with stakeholders, translating technical findings into actionable insights that address specific goals and challenges. Graduates should be adept at applying domain-specific knowledge to their daily responsibilities upon securing employment.

**C. Intended program length**

The program is intended to be completed in four years.

**D. Intra- and Inter-Institutional Collaboration**

With the interdisciplinary nature of data science, the proposed data science program has great potential to foster new intra- and inter-institutional collaborations.

(1). As indicated by the support letters that we have gathered from the heads of the following internal units, various forms of potential collaborations can be established within OU:

- School of Engineering and Computer Science
- Center for Data Science and Big Data Analytics
- Department of Computer Science and Engineering
- Department of Philosophy

Firstly, we will continue our long history of collaboration with the Department of Computer Science and Engineering (CSE), now in the area of data science, as the attached support letter indicates. Some required and elective CSI courses taught by faculty in the Department of CSE are included in the proposed Applied Data Science program. The Department of CSE recently received approval for its B.S. degree in Data Science. Both programs include quantitative and computing elements and share some courses. By sharing courses between the proposed data science program by DMS and the one by CSE, we aim to streamline resource utilization and maximize cost efficiency. This collaborative approach allows us to leverage existing expertise and infrastructure, avoiding redundant investments in course development and instructional resources. We believe both Data Science programs can coexist at OU and will provide detailed reasons in the following subsection. As a matter of fact, the School of Engineering and Computer Science (SECS) is in support of our proposed applied data science program, as evidenced in Dean Chamra's letter of support: "The continuation of this collaborative tradition through the proposed Applied Data Science program is both commendable and strategic.".

Secondly, we intend to provide data science minors to students majoring in various departments within the College of Arts and Sciences. By enrolling in fundamental mathematics and statistics courses, along with computer programming courses, and completing courses in the specified application areas (as mentioned earlier, this list is expected to expand in the future), these students can claim a minor in data science. This will enable them to apply the acquired

skills to extract knowledge from data, addressing challenges within their respective fields of study.

Thirdly, DMS is actively engaged and informed about the collaborative initiatives across multiple schools aimed at establishing a master's program in data science at OU. By providing a comprehensive foundation and specialized coursework, the proposed undergraduate data science program ensures that students are well-prepared to pursue a graduate degree in data science at OU in the future. This strategic alignment between the undergraduate and prospective master's programs enhances the educational experience in the field of data science at OU.

Last but not least, it is noteworthy that the proposed program aligns well with the goals of the Center for Data Science and Big Data Analytics to promote data literacy at an advanced level and generate collaborative and fundamental research. The DMS will collaborate closely with the Center for Data Science and Big Data Analytics to offer students enrolled in the proposed major opportunities for activities such as undergraduate research and capstone projects. These activities are designed to provide valuable experiences for the students.

(2). External partners:

Interdisciplinary in nature, the proposed data science program has garnered strong support from external local and national partners. Support letters from the following personnel at external institutions and organizations are included in Appendix H. We elaborate the potential opportunities and resources offered by these external partners below.

- Dr. Mark Daniel Ward, *Professor of Statistics* and *Director of The Data Mine* at Purdue University
- Dr. Lili Zhao, *Director of Biostatistics and Health Informatics* at Beaumont Health, Research Institute and *Adjunct Research Professor* at Department of Biostatistics, University of Michigan, Ann Arbor
- Dr. David Gorsich, *Chief Scientist*, U.S. Army Ground Systems, U.S. Army Futures Command, Warren MI
- Charles W. Wampler, *Sr. Technical Fellow*, GM Global R&D Center, Battery Cell Systems Research
- Ian Bradbury, *President & CEO*, Peaker Services, Inc.

- Dr. Jeffery Tew, *Chief Scientist and Executive Director*, Tata Consultancy Services, North America Innovation Labs

The Data Mine is a campus-wide initiative at Purdue University that trains students in valuable data science skills for the industry, involving projects with Corporate Partners. The program's scale is significant, with an anticipated 1700 participating students for the academic year 2023-2024, and a total of 80 teams successfully completing projects with Corporate Partners in the academic year 2022-2023. Dr. Mark Daniel Ward, the director of the Data Mine program, supports the proposed data science program. He also wrote, "Here at Purdue, if it would be helpful, we could support this initiative with some new Corporate Partners, and also by sharing our curricular materials (we have perhaps more than 2000 pages of materials and perhaps more than 1000 videos to accompany the material) and computational resources."

Dr. Lili Zhao, the Director of Biostatistics and Health Informatics at the Beaumont Health Research Institute, also expresses enthusiastic support for the proposed program. Recognizing the need to analyze large datasets from Beaumont Health, Dr. Zhao offers internship and full-time job opportunities for students enrolled in the program.

Support letters from other industrial partners echo a similar theme, acknowledging the importance of data analytical skills across various industries, including human-autonomy interaction, intelligent power systems, virtual experiments, robotics, engineering, automotive, transportation, and retail.

The DMS is committed to collaborative efforts with these external stakeholders, seeking their advice on curriculum development, offering capstone projects to students, and facilitating internship and full-time job opportunities for program participants.

**E. Plan for transfer credits**

Courses from other institutions will be transferred to the new program if they are determined to be equivalent to the corresponding OU courses. The evaluation is done by the DMS Chief Undergraduate Adviser in consultation with faculty having experience in these courses.

**F. Impact on existing resources**

The Department of Mathematics and Statistics currently offers four programs leading to a bachelor's degree: a Bachelor of Science in Actuarial Science, a Bachelor of Science in Mathematics, a Bachelor of Arts in Mathematics, and a Bachelor of Science in Applied Statistics. The B.S. program in Actuarial Science prepares students for careers as actuaries, utilizing mathematics, economics, statistics, and finance to assess risk and uncertainty. The B.S. program in Mathematics caters to undergraduates intending to pursue graduate studies in mathematics or work as mathematicians in industry and business. The B.A. program accommodates all other mathematics students, including those in the Secondary Teacher Education Program. The B.S. program in Applied Statistics primarily serves individuals aspiring to work as statisticians in industry and business. All four programs are accredited by the North Central Association of Colleges and Schools (NCA). Fall enrollments across all undergraduate majors in the Department for the last two years were 92 and 81, respectively, which are stabilized after the pandemic.

In terms of the impact of the proposed applied data science program on existing resources, we anticipate minimal impact for the following reasons:

(1). As mentioned earlier in the curriculum section, the proposed data science program only necessitates the addition of two new core courses and three new elective courses. All other courses in the curriculum of the proposed program already exist.

(2). We expect that the proposed data science program will contribute to the expansion of major enrollments in the DMS and CAS. The current degree programs offered by DMS are tailored for students interested in mathematics or statistics. The proposed data science program, on the other hand, will specifically attract students who prefer integrating mathematics and statistics with programming and computer science, applying these skills in various areas. As illustrated in Table 1 below, the enrollment of a new data science program offered by the Department of Statistics at Western Michigan University increased from 10 to 26 within the first few years of its initiation. We believe it will have a similar effect here at OU, encouraging a distinct group of students to enroll.

(3). The proposed applied data science program COMPLEMENTS the one managed by the Department of Computer Science and Engineering. As highlighted in the initial subsection of the proposal, data science is interdisciplinary, intersecting with three pillars for developing

students' skills: mathematics and statistics, computer science, and a specific domain for applying their skills to solve real-world problems. The applied data science program proposed by DMS differs from the one managed by the Department of Computer Science and Engineering in two of these three pillars of data science:

(i) Students acquire a more robust understanding of mathematics and statistics by completing the four elective courses in applied quantitative analysis and methods;

(ii) The number of credits required for the third pillar, the underlying domain, differs. The program managed by the Department of Computer Science and Engineering also includes application areas; however, it is limited to only two courses, i.e., 6-8 credits out of 128 credits. In contrast, the Applied Data Science program proposed by DMS includes 14 credits of application areas courses out of 124.

Requiring more credits in the application areas reflects the applied nature of the Applied Data Science program proposed by the Department of Mathematics and Statistics. It can help students develop a deeper understanding of the underlying field to produce meaningful projections and interpretations of the analysis and models built, thus increasing students' marketability in their chosen application field.

Given the rapid evolution of fields where data science skills can be applied to analyze real-world problems, and for the reasons stated here, the proposed Applied Data Science program complements the one managed by the School of Engineering and Computer Science.

As a matter of fact, there is strong evidence why this two-degree program model would work:

a) The University of Michigan in Ann Arbor offers two BS data science programs:

- B.S. Data Science through the Department of Statistics in the College of Literature, Science, and the Arts (LSA).

- B.S.E. Data Science through the Division of Computer Science and Engineering (CSE) in the College of Engineering (CoE).

b) Michigan State University offers two BS data science programs:

- B.S. Data Science through the Department of Computational Mathematics, Science and Engineering in the College of Natural Science (CNS).

- B.S. Computational Data Science through the Department of Computer Science and Engineering in the College of Engineering.

c) Oakland University offers two BS actuarial science programs:

- B.S. Actuarial Science through the Department of Mathematics and Statistics in the College of Arts and Sciences.

- B.S. Business Actuarial Science through the School of Business Administration.

In each of these three examples, the dual-programs overlap substantially while also providing different emphasis; their students are not confused and appreciate the opportunity to get such a degree through two different colleges/schools. As illustrated in Table 1 below, the dual programs at University of Michigan, Ann Arbor and at Michigan State University both attracted more students year over year since their initiation. Notably, the program offered by College of Literature, Science, and the Arts or College of Natural Science consistently attracted more students than the one offered by the College of Engineering. Based on the above precedence, we believe two BS data science degrees at OU can coexist and the students will be mature enough to distinguish between them. Furthermore, advising will be available to them. To decrease even further the chance of confusion, we will create a comparison chart between the two data science programs, similar to one created at MSU[10].

## IV. Curriculum Overview

### A. Accreditation

The accrediting agency is the North Central Association of Colleges and Schools.

### B. Total Number of Credits

The program requires a minimum of 124 credits. There will be two required new courses (STA 4111 and STA 4840, each 4 credits), three new courses in the applied quantitative elective category (STA 4007, APM 4560 and APM 4350, each 4 credits), and three new courses in the Application area elective category (CSI 2810, CSI 3820 and CSI 4820, of 4 , 3, 4 credits, respectively). In addition, some STA courses will be cross-listed with existing graduate courses.

[10] https://cmse.msu.edu/_assets/files/academics/undergrad_program/bsds/MSU_DataScienceDegreeComparison_13Sept2021.pdf

**C. Plan of Study**

Included in Appendix C.

**D. Course Descriptions**

Included in Appendix D.

**E. Academic Progress**

The new program will follow OU policies on progress, probation and dismissal, as stated in the Undergraduate Catalog.

**F. Academic Oversight**

The Committee on Undergraduate Programs (CUP) in the Department will coordinate the program. Beginning in the third year after the program's initiation, the Chair will appoint a faculty member as the Director of the Data Science program. The appointed Director will also become a member of CUP, assuming the role of overseeing the program.

**G. Interdisciplinary Programs**

The academic home of this program will be the Department of Mathematics and Statistics, in the College of Arts and Sciences. The department will collaborate with other units on campus as described in section III.D.

**H. Primary Target Audience**

The program is addressed to those categories of students typically enrolled in B.S. programs at Oakland University.

**I. Source of Students**

As mentioned earlier in this document, we anticipate that the proposed program will attract new students who are interested in mathematics and statistics but also seek to acquire computer skills for solving real-world data-related problems. Additionally, it is expected to appeal to those interested in specific domains of knowledge such as geology, biology-related healthcare, and business, who wish to utilize data for addressing real-world challenges.

To gauge the potential interest and willingness of target students to enroll in a data science program, the Department of Mathematics and Statistics conducted a survey in Fall 2022. The survey targeted students enrolled in 1000- and 2000-level MTH, APM, or STA courses with high enrollments taken by students in a variety of majors, as well as a selection of 4000-level courses taken by students majoring in mathematics or statistics. The survey form and our analysis of their responses are included in Appendix C.

When asked about their interest in the program with the question, "Would such a program interest you, or would it have interested you had it been available when you enrolled at Oakland University?", more than 60% of respondents majoring in Business, Engineering, mathematics-related fields, or those who were undecided indicated potential interest in such a program. Regarding the question, "Would you consider majoring in data science?", at least 25% of students majoring in business, engineering, mathematics-related fields, or those undecided responded affirmatively, with students who had not yet decided on their majors representing the highest proportion at 42%.

Notably, in Fall 2022, there were 227 undecided major students at OU. If a proportional 96 (42%) of these students were to consider majoring in a data science program, even if evenly split between the DMS and CSE data science programs, there would still be 48 undecided major students who would consider the proposed program. Similarly, in Fall 2022, when the survey was conducted, there were a total of 92 students enrolled in all undergraduate Math-Stat majors. Proportionally, 34 (37%) of them would consider majoring in the proposed program. The results of this survey along with other metrics are utilized to generate the expected enrollment numbers, as mentioned in the section below.

**J. Recruitment Plan**

The proposed major will be promoted through brochures and flyers distributed to prospective and admitted OU students during open house events and advising functions. Additionally, outreach will extend to other universities and local high schools through social media channels. We will collaborate closely with the recently appointed Director of Communications and Marketing at CAS, Mr. Dave Pemberton, to enhance the program's visibility on various marketing platforms. Furthermore, we intend to promote the proposed program at Math Corps with the aim of attracting a more diverse group of students into the program.

## K. Planned enrollment

Table 1 shows Fall Semester enrollments in B.S. degree programs in data science at Michigan public universities offering at least one degree through a mathematics and/or statistics department. Such data are publicly available on universities' websites. In addition, department chairs in mathematics and/or statistics at universities comparable to Oakland with such comparable degrees were contacted informally and asked to comment on their current enrollment and, more broadly, on their programs.

Table 1. Fall enrollment in B.S. data science programs at MI public universities offering at least one such degree through a Mathematics and/or Statistics department.

| Year | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|
| Univ of Michigan - Ann Arbor[11] (Literature, Science, Arts) | 43 | 76 | 95 | 123 | 130 | 156 | 182 | 190 |
| Univ of Michigan - Ann Arbor (College of Engineering) | 24 | 55 | 70 | 85 | 102 | 114 | 80 | 100 |
| Michigan State University[12] (College of Natural Science) | | | | 19 | 82 | 117 | 157 | 198 |
| Michigan State University (College of Engineering) | | | | 12 | 35 | 29 | 35 | 40 |
| Western Michigan University[13] (Statistics Department) | 10 | 18 | 20 | 22 | 24 | 25 | 26 | 28 |
| Central Michigan University (Statistics Department) | | | | | | | 6 | |

Western Michigan University and Central Michigan University both enroll approximately 6 new students per year in their data science programs. This amounts to about 25 students every year across academic levels at Western Michigan University, while Central Michigan University started their program in Fall 2022 and should reach similar enrollment levels within a few years. Our survey data analysis presented in Appendix C shows that such an enrollment level could be achieved, because there is currently a comparable number of students who would consider being in the proposed data science degree program.

The University of Michigan - Ann Arbor and Michigan State University offer B.S. degrees in data science through two different colleges/departments. The two data science programs show strong enrollments, with higher enrollment in the program offered through a

[11] https://ro.umich.edu/reports/enrollment (Accessed Feb 3, 2023)
[12] https://reg.msu.edu/roinfo/EnrTermEndRpts.aspx (Accessed Feb 3, 2023)
[13] https://wmich.edu/institutionalresearch/interactivedashboards/enrollment/data (Accessed Feb 3, 2023)

statistics or mathematics department. We believe both universities are able to attract more students overall because they diversified their data science degrees to two different colleges.

Furthermore, the number of graduates from the actuarial science (AS) program, managed by DMS, offers insights into the potential enrollment for the proposed data science program. The AS program was introduced in the 2010-2011 OU Undergraduate catalog, and by the 2012-2013 academic year, the program had already graduated five students. In fact, the average number of graduates per academic year for the first four years, when graduates were recorded, exceeded seven students annually.

Based on the enrollments of a comparable program at another university in the state, the actuarial science program at OU and the results of the interest survey conducted at OU as mentioned above, we have made relatively conservative estimates of the total expected enrollments during the first four years of the program's initiation. The budget implications of the proposed program, based on these enrollment numbers, are detailed in Section VI below.

Table 2. Projected enrollments of the proposed data science program during the first four years of its initiation.

| | Year 1 | Year 2 | Year 3 | Year 4 |
|---|---|---|---|---|
| Worst | 4 | 8 | 13 | 18 |
| Likely | 6 | 12 | 19 | 26 |
| Best | 8 | 16 | 26 | 36 |

**L. Advising Students**

Freshman students are required to work with the First Year Advising Center during their first year, and they are introduced to the First Year Advising Center during orientation. This provides assistance in placement into courses and making a four-year plan draft. Starting with the second year all students are expected to see the Department of Mathematics and Statistics Chief Undergraduate Adviser who assists the students in making adjustments in their four year plans, if needed. The students are also expected to visit the College of Arts and Sciences Advising Center to go over other aspects of their university experience (including General Education). A special service performed by the University is to run a degree evaluation on all students who apply to graduate, and they are notified if the degree evaluation program identifies any deficiencies. Such students then visit the academic advisor to check if the detected deficiencies are "false negatives" or are other aspects they need to attend to.

### M. Retention Plan

DMS is committed to student success and makes a sustained effort to retain students enrolled in its programs. Support for students at all levels includes access to faculty, Academic Success Center (formerly Tutoring Center) and Supplemental Instruction. Several department faculty and graduate assistants devote time to the Department's Math Help Center to help students at all levels. In addition, the following are efforts made by the Department to attract and retain talented undergraduate students: end-of-term commendation letters, departmental honors, Louis R. Bragg Graduating Senior Award, Deming Scholarship, Jon Froemke Memorial Fellowship, Distinguished Alumni Award.

## V. Off-Campus or Online Information

### A. Location

The program will be offered on the main campus, using an in-person instruction method.

### B. Assessment of quality

There are no off-campus sites or online components of the proposed program requiring assessment.

## VI. Needs and Costs

### A. New resources needed

One new tenure-track faculty position is needed. The rationale behind the request for a new tenure-track faculty position is that DMS's current faculty resources are already stretched thin. The department currently relies on employing two visiting assistant professors to cover courses that are ideally meant to be taught by faculty with doctoral degrees. Additionally, a former Visiting Assistant Professor who exhausted his maximum allowed (4) years in that role is currently hired as a Special Lecturer (in Winter 2024) so that our MTH 1555 (Calculus II) course could be staffed with a qualified instructor. Introducing the new data science program would further strain the existing faculty's workload, potentially impacting the quality of their service, research, and teaching.

In addition, to ensure the smooth functioning of the new program, a Director position will be needed starting with the third year when the program is expected to grow more substantially.

One part-time instructor will also be needed to teach introductory-level courses. The part-time position will begin in the third year of the program, when advanced courses will start to be scheduled and taught by full-time faculty. The program will entail some spending on marketing and advertisement.

**B. Existing sources to be reallocated**

Most existing courses in the proposed program are offered commonly with other programs, therefore resources to teach such courses already exist. The few new courses proposed will be taught by both the current and new full-time faculty.

**C. 5-Year Budget and revenue**

The pro forma budget is submitted separately. It shows the most likely, the best, and the worst scenarios. The budget is structured as follows:

*Tuition rate*: The lowest CAS tuition rate for resident students has been considered.

*Estimated new students to the program*: We anticipate about 6-7 new students per year, for a total of around 26 students enrolled in the program by the end of the fourth year.

*Tenure-track Faculty*: The new tenure-track faculty will teach upper-level courses in the new program as well as the existing programs. If there is a need, the new faculty will also teach lower-level courses. In the first year of the program's initiation, the Department will conduct a nationwide search for this new tenure-track faculty member. As a result, the salary for this new tenure-track faculty is not accounted for in the Year 1 budget of the proposed program.

*Program Director*: The program Director will oversee all aspects of the new program and will report to the Committee of Undergraduate Programs. The program director will be selected from the faculty present at DMS during Year 3 after the initiation of the new program, with compensation potentially provided in the form of a course release, either one per academic year or one per semester, depending on the number of major students.

*Part-time Faculty*: Full-time faculty in the department teach both low-level and upper-level courses. Full-time faculty will teach the new, upper-level data science courses. The part-time faculty will help with teaching low-level courses.

*Library*: The budget includes new and continuing library subscriptions needed for the proposed program.

*Recruitment and advertising*: We expect that only a minimal amount will be necessary for advertising the new program.

Our evaluation as shown in the table below projects that the proposed program will most likely generate income starting with the first year. Please note that this budget analysis does not incorporate the potential tuition revenue generated by students who pursue a minor in data science. Consequently, we anticipate that the net income of the proposed program will exceed the figures presented in Table 3 below.

Table 3. Projected Performa on the Budget of The Proposed Program During The First Five Years of Its Implementation

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Est. New Students to Program | 6 | 6 | 7 | 7 | 7 |
| Net Tuition Revenue | $67,360 | $136,230 | $221,836 | $305,976 | $318,191 |
| Total Compensation | $0 | $102,746 | $132,837 | $136,158 | $139,562 |
| Total Operating Expenses | $14,774 | $15,751 | $16,827 | $16,009 | $17,310 |
| **Net Income (Loss)** | **$52,586** | **$17,733** | **$72,171** | **$153,627** | **$161,319** |

**D. Library needs**

Appendix F includes a library report on collections evaluation and the corresponding budget, submitted by Professors Helen Levenson and James E. Van Loon from the Oakland University Libraries.

**E. UCM Assessment Plan**

OU Communications and Marketing will assist with the marketing campaign. Their report is included in Appendix I below.

**F. Classroom, Laboratory, Space needs**

No additional space is required.

**G. Equipment Needs**

Advanced software is used in the instruction of the new program. Python and R are free, open-source software. The new elective course STA 4007 – SAS Programming with Statistics

Applications - requires SAS, which is a licensed software. SAS is currently available in the Department. In addition, SAS provides a free version for use in the academic community, which can be used to teach STA 4007. Therefore, no new licensed software subscription is needed.

## Appendix A: Abbreviated Faculty Vitae

Kevin T. Andrews, Professor
Ph.D. University of Illinois
Areas of Interest: Applicable Analysis, Functional Analysis, Operator Theory

Aycil Cesmelioglu, Associate Professor
Ph.D. Rice University
Areas of Interest: Numerical Analysis of Partial Differential Equations, Discontinuous Galerkin (DG) methods, hybridizable DG (HDG) methods, finite element methods (FEM), fluid flow and multiphysics problems

Eddie Cheng, Distinguished Professor
Ph.D. University of Waterloo (Canada)
Recipient of 2007 Mathematical Association of America (Michigan Section) Distinguished Teaching Award
Recipient of 2009 Professor of the Year Award, Presidents Council, State Universities of Michigan
Recipient of the Michigan Mathematics Prize Competition Service Award (2011)
Areas of Interest: Combinatorial Optimization, Linear and Integer Programming, Network Analysis

Dorin Drignei, Professor
Ph.D. Iowa State University
Areas of Interest: Design and Analysis of Computer Experiments, Statistical Applications, Data Science

Tamas Horvath, Assistant Professor
Ph.D. Eötvös Loránd University (Hungary)
Areas of Interest: Numerical Analysis of Partial Differential Equations, Hybridizable Discontinuous Galerkin (HDG) methods, Space-time HDG methods, Adjoint-based Error Estimation and Optimization

Jun Hu, Assistant Professor
Ph.D. University of Connecticut
Areas of Interest: Sequential Analysis, Sampling Strategies, U-Statistics, Applications in Agriculture, Economics, Environmental Health and Tourism

Ravindra Khattree, Distinguished Professor
Ph.D. University of Pittsburgh
Co-Director, Center for Data Science and Big Data Analytics (CDaS)
Member, Center for Biomedical Research(CBR)
Winner of Young Statistician Award, International Indian Statistical Association (2002)
Fellow of the American Statistical Association (inducted 2003)
Elected Member of International Statistical Institute (elected in 2004)
Recipient of 2008 Oakland University Research Excellence Award

Areas of Interest: Multivariate Analysis, Experimental Designs, Statistical Quality Control, Biostatistics, Classification Problems, Bioequivalence

Serge Kruk, Associate Professor
Ph.D. University of Waterloo (Canada)
Areas of Interest: Optimization, Constraint Programming, Numerical Analysis

Li Li, Professor
Ph.D. SUNY-Stony Brook
Areas of Interest: Algebraic Geometry, Algebraic Combinatorics, Cluster Algebras

László Lipták, Professor
Ph.D. Yale University
Areas of Interest: Combinatorics, Alpha-critical Graphs, Stable-set Polytope, Lovasz-Schrijver Operator, 0-1 Optimization, Interconnection Networks

Yongjin Lu, Associate Professor
Ph.D. University of Virginia
Areas of Interest: Partial differential equations (PDE) and related control theory; long-time behavior of solutions; fluid-structure interaction; computer vision algorithm frameworks

Lucian Mazza, Assistant Professor
Ph.D. West Virginia University
Area of Interest: Graph Theory

JD Nir, Assistant Professor
Ph.D. University of Nebraska-Lincoln
Area of Interest: Combinatorics, Graph Theory

Theophilus Ogunyemi, Associate Professor
Ph.D. Kansas State University
Areas of Interest: Bayesian Inference, Statistical Design Theory, Applied Statistics

Subbaiah Perla, Professor
Ph.D. University of Rochester
Areas of Interest: Multivariate Statistical Methods, Quality Control, Reliability

Harvey Qu, Professor
Ph.D. University of Michigan-Ann Arbor
Areas of Interest: Design of Experiment, Computer Experiments, Industrial Statistics

Darrell Schmidt, Professor
Ph.D. Montana State University
Recipient of 1999 Oakland University Teaching Excellence Award
Recipient of 2012 Oakland University College of Arts and Sciences Faculty Engagement Award

Areas of Interest: L1-approximation, Constrained Approximation, Numerical Solution of Integral Equations, Delay Differential Equations

Tony Shaska, Associate Professor
Ph.D. University of Florida
Areas of Interest: Computational Algebraic Geometry, Galois Theory, Algebraic Curves and Their Applications

Peter Shi, Associate Professor
Ph.D. University of Delaware
Areas of Interest: P.D.E., Solid Mechanics, Numerical Analysis, Mathematical Modeling

Meir Shillor, Distinguished Professor
Ph.D. Hebrew University (Israel)
Recipient of 2002 Oakland University Research Excellence Award
Areas of Interests: Applications of Variational Inequalities and Partial Differential Equations to Models of Industrial Processes, especially to frictional contact, adhesion, material damage, and wear; Stefan problems and phase transitions; Dynamical systems and their applications to population dynamics and epidemiology

Hon Yiu (Henry) So, Assistant Professor
Ph.D. McMaster University (Canada)
Areas of Interest: Reliability Analysis, Survey Sampling, Distributional Theory, Missing Data, Misclassification, Biostatistics, Machine Learning, Statistical Computation.

Giselle Sosa Jones, Assistant Professor
Ph.D. University of Waterloo (Canada)
Areas of Interest: Numerical Analysis and Scientific Computing

Anna Maria Spagnuolo, Professor and Chairperson
Ph.D. Purdue University
Recipient of 2023 Distinguished Professor of the Year Award, the Michigan Association of State Universities
Areas of Interests: Fluid Flow in Porous Media, Numerical Analysis, Modeling, Computation, Mathematical Biology, Computation of Disease Processes

Matthew Toeniskoetter, Assistant Professor
Ph.D. Purdue University
Areas of Interest: Commutative Algebra, Multiplicative Ideal Theory, Valuation Theory

Nghia Tran, Associate Professor
Ph.D. Wayne State University
Recipient of 2019 Oakland University New Investigator Research Excellence Award
Areas of Interest: Optimization, Mathematical Programming, Variational Analysis

Stuart S. Wang, Professor, on leave
Ph.D. Cornell University
Areas of Interest: Jacobian Conjecture, Automorphisms of Polynomial Rings, Separable Algebras

Wen Zhang, Professor
Ph.D. Southern Methodist University
Areas of Interest: Scientific Computation, Numerical ODEs and PDEs, Applied Ordinary and Partial Differential Equations, Applications in Biology, Materials Science and Mechanics.

## Appendix B: Degree Requirements

**Proposed B.S. in Applied Data Science:**

**Required courses (52 credits)**

- Mathematical Foundation:
  - MTH 1554 - Calculus I (4)
  - MTH 1555 - Calculus II (4)
  - MTH 2775 - Linear Algebra (4)

- Programming Foundation:
  - CSI 1320 - Introduction to Python Programming and Unix (4)

- Statistical Foundation:
  - STA 2226 - Applied Probability and Statistics (4)
- Program Core Courses:
  - APM 2663 - Discrete Mathematics (4)
  - CSI 2300 - Object Oriented Programming (4)
  - CSI 2310 - Data Structures (4)
  - STA 4002 - Applied Linear Models I (4) Or
    MTH 2554 - Multivariable Calculus (4)
  - STA 4111 - Statistical Methods in Data Science (4)
- Additional Required Courses:
  - STA 4006[14] - Statistical Computing (4)
  - STA 4840 - Introduction to R for Data Science (4)
  - CSI 3450 - Database Design and Implementation (4)

**Applied quantitative electives (16 credits)**

- Applied statistics electives

  - STA 4003 - Applied Linear Models II (4)
  - STA 4007 - SAS Programming with Statistics Applications (4)
  - STA 4113 - Introduction to Mathematical Statistics I (4)
  - STA 4114 - Introduction to Mathematical Statistics II (4)
  - STA 4221[14] - Multivariate Statistical Methods (4)
  - STA 4228[14] - Reliability and Life Data Analysis I (4)
  - STA 4224 - Analysis of Categorical Data (4)
  - STA 4225 - Elements of Stochastic Processes (4)
  - STA 4226 - Nonparametric Methods (4)
  - STA 4229[14] - Statistical Methods in Sample Surveys (4)
  - STA 4330 - Time Series I (4)

[14] Potentially cross-listed with an existing graduate course.

- STA 4331[14] - Bayesian Data Analysis (4)

- Applied mathematics electives

  - APM 2555 - Introduction to Differential Equations with Matrix Algebra (4)
  - APM 3610 - Design and Analysis of Algorithm (4)
  - APM 3332 - Applied Matrix Theory (4)
  - APM 4333 - Numerical Methods (4)
  - APM 4334 - Applied Numerical Methods: Matrix Methods (4)
  - APM 4350 - Technical Analysis of Stocks Trading Data (4)
  - APM 4560 - Mathematical Models in Biology (4)
  - APM 4663 - Applied Mathematics: Discrete Methods I (4)
  - MOR 2442 - Elementary Models in Operations Research (4)
  - MOR 4554 - Linear and Integer Optimization (4)
  - MOR 4555 - Nonlinear Optimizations (4)

Other courses, if approved by the program coordinator

**Application area electives (minimum 14 credits)**

*Geoinformatics:*

- AN 3800 - Introduction to Geographic Information Systems (4)
- AN 3802 - Remote Sensing (RS) Using Aerial and Satellite Imagery (4)
- ENV 4520 - Geographic Information System Analysis for Sustainability (4)

*Healthcare:*

- BIO 1200 - Biology I (4)
- BIO 3400 - Genetics (4)
- BIO 4412 - Functional Genomics and Bioinformatics (4)
- HS 2000 - Introduction to Health and Health Behaviors (3)
- NTR 3300 - Organizational Behavior and Health Care Systems (3)
- WHP 2800 - Introduction to Health Literacy (4)
- WHP 3500 - Health Program Implementation (4)
- WHP 4850 - Population Health, Health Policy, and Healthcare Delivery (4)

*Computer science:*

- CSI 2810 - Introduction to Data Science in Python (4)
- CSI 3820 - Data Visualization (3)
- CSI 4130 - Artificial Intelligence (4)
- CSI 4170 - Machine Learning (4)
- CSI 4810 - Information Retrieval and Knowledge Discovery (4)
- CSI 4820 - Big Data Analysis with Cloud Computing (4)

*Business:*

- ECN 1600 - Introduction to the Global Economy (4)
- ECN 3210 - Financial Markets and Economy (3)
- MKT 3020 - Marketing (3)
- MKT 4100 - Digital Marketing (3)
- MIS 3130 - Information and Data Management (3)

- MIS 4460 - Business Analytics (3)
- MIS 4470 - Practical Computing for Data Analytics (3)

*Engineering:*

- EGR 2600 - Introduction to Industrial and Systems Engineering (4)
- ISE 3318 - Engineering Statistics and Economic Analysis (4)
- ISE 3330 - Engineering Operations Research (3)
- ISE 4435 - Data Analytics (4)
- ISE 4456 - Engineering Risk Analysis (4)

*Mixed:*

- Mix of courses from at least two of the above tracks

Other courses, if approved by the program coordinator

**Other requirements:** General education, other prerequisite courses (the rest of credit hours).

## Degree Requirements for Majors in Data Science at Other Michigan Public Universities

**Central Michigan University**

Responsibility and Ethics (2 hours)
CPS 301 Social Issues of Computing and Professional Practice (1)
DAS 260 Data Integrity and Ethics (1)

Mathematical Foundations I (8 hours)
MTH 132 Calculus I (4)
MTH 133 Calculus II (4)

Mathematical Foundations II (3 hours)
Select one of the following:
MTH 223 Linear Algebra and Matrix Theory (3)
MTH 232 Linear Algebra and Differential Equations (3)

Computational Foundations (9 hours)
CPS 180 Principles of Computer Programming (3)
CPS 285 Programming for Data Science (3)
ITC 341 Introduction to Databases and Applications (3)

Statistical Foundations (9 hours)
STA 382QR Elementary Statistical Analysis (3)
STA 580 Applied Statistical Methods I (3)
STA 581 Probability and Statistics for Data Science (3)

Data Science Core Courses (18 hours)
DAS 150QR Introduction to Data Science (3)
DAS 251 Data Visualizations and Programming using Tableau (1)
DAS 252 Data Visualization and Programming using R/RStudio (1)
DAS 253 Data Visualization and Programming using SAS (1)
DAS 350 Exploratory Data Analytics (3)
DAS 450 Applied Analytics I (3)
DAS 460 Applied Analytics II (3)
DAS 495 Capstone/Practicum (3)

Electives (6 hours)
Select from the following:
CPS 525 Introduction to Text Mining (3)
CPS 580 Supervised Machine Learning (3)
ITC 441 Database and Virtual Data Server Administration (3)
STA 575 Statistical Programming for Data Management and Analysis (3)
STA 582 Experimental Designs (3)
STA 583 Nonparametric Statistics (3)
STA 589 Time Series Forecasting (3)
STA 591 Data Mining Techniques I (3)
STA 595 Introduction to Bayesian Statistics (3)

Total: 55 hours in the major

**Eastern Michigan University**

Required Courses: 61-62 hours
COSC 111 Introduction to Programming (3)
COSC 112 Introduction to Programming Online Lab (1)
COSC 146 Applied Programming and Scripting (3)
COSC 211 Programming Data Structures (3)
COSC 212 Programming Data Structures Online Lab (1)
COSC 311 Algorithms and Data Structures (4)
COSC 381 Software Engineering Solutions (4)
COSC 472 Big Data I (4)
COSC 481W Software Engineering and Senior Project (3)
IS 385 Data Warehousing (3)
IS 410 Data Mining (3)
MATH 120 Calculus I (4)
MATH 121 Calculus II (4)
MATH 122 Elementary Linear Algebra (3)
DS 265 Business Statistics I (3) Or STAT 360 Statistical Methods (3)
DS 465 Applied Linear Statistical Models (3) Or STAT 461 Linear Regression Analysis (3)
COSC 231 Internet-based Computing (3) Or IS 247 Introduction to Web Application Development (3)
IA 212 Open Systems Platform and Network Administration (3) Or IS 416 System Software Administration (3)
COB 200L4 Introduction to Business (3) Or IS 350 Enterprise Resource Planning and Architecture (3)
COSC 471 Database Principles (4) Or IS 380 Data and Information Management (3)

Theory Concentration: 13-15 hours from
COSC 221 Computer Organization I (3)
COSC 423 Computer Operating Systems (4)
COSC 439 Computing Network Principles (4)
MATH 223 Multivariable Calculus (4)
MATH 419W Introduction to Stochastic Mathematical Modeling (3)
STAT 370 Probability and Statistics I (3)

Web Analytics Concentration: 12 hours
IS 310 Social Media for Business (3)
IS 405 Web Content Mining (3)
IS 422 Social Media Network Analysis (3)
MKTG 339 Google Analytics and Landing Page Optimization (3)

Advanced Data Analysis Concentration: 12-14 hours from
COSC 462 Introduction to Information Retrieval (4)
COSC 473 Big Data II (4)
MATH 419W Introduction to Stochastic Mathematical Modeling (3)
STAT 462 Design and Analysis of Experiments (3)
STAT 468 Introduction to Biostatistics (3)
STAT 474W Applied Statistics (3)

Total: 73-77 hours in the major

**Lake Superior State University**

Core courses:
LIBR 102 Introduction to Information Science and College Success 2
EVRN 131 Introduction to GIS and GPS 3
CSCI 105 Introduction to Computer Programming 3
CSCI 115 Introduction to Data Science 3
CSCI 121 Principles of Programming 4
CSCI 201 Data Structures and Algorithms 4
CSCI 211 Database Applications 3
CSCI 265 Introduction to Artificial Intelligence 3
CSCI 342 Advanced Programming Techniques 4
CSCI 411 Data Analytics 3
MATH 151 Calculus I 4
MATH 261 Introduction to Numerical Methods 3
MATH 305 Linear Algebra 3

Concentrations:
Bioinformatics
Business Analytics
Chemistry Informatics
Geosystems Modelling
Health Informatics
Robotics
Spatial Analytics

**Michigan State University**

***MSU- BS Data Science (Computational Mathematics, Science and Engineering)***
Requirements for the major:

| | | | | |
|---|---|---|---|---|
| a. | Chemistry courses (8 or 10 credits) | | | |
| b. | Physics courses (8 to 10 credits): | | | |
| c. | One course from each of the following groups (14 or 15 credits): | | | |
| (1) | LB | 118 | Calculus I | 4 |
| | MTH | 132 | Calculus I | 3 |
| | MTH | 152H | Honors Calculus I | 3 |
| (2) | LB | 119 | Calculus II | 4 |
| | MTH | 133 | Calculus II | 4 |
| | MTH | 153H | Honors Calculus II | 4 |
| (3) | LB | 220 | Calculus III | 4 |
| | MTH | 234 | Multivariable Calculus | 4 |
| | MTH | 254H | Honors Multivariable Calculus | 4 |
| (4) | MTH | 314 | Matrix Algebra with Computational Applications | 3 |
| d. | One of the following groups (4 or 6 credits): | | | |
| (1) | STT | 380 | Probability and Statistics for Data Science | 4 |
| (2) | STT | 441 | Probability and Statistics I: Probability | 3 |

STT 442 Probability and Statistics I: Statistics 3
e. All of the following courses (31 credits):
CMSE 201 Introduction to Computational Modeling and Data Analysis 4
CMSE 202 Computational Modeling Tools and Techniques 4
CMSE 381 Fundamentals of Data Science Methods 4
CMSE 382 Optimization Methods in Data Science 4
CMSE 495 Experiential Learning in Data Science 4
CSE 232 Introduction to Programming II 4
CSE 331 Algorithms and Data Structures 3
STT 180 Introduction to Data Science 4
f. A minimum of 12 credits of approved 400-level courses or above. The following courses are eligible to fulfill this requirement. Other may be substituted with advisor approval.
CMSE 401 Methods for Parallel Computing 4
CMSE 402 Data Visualization Principles and Techniques 3
CMSE 410 Computational Biology and Bioinformatics 3
CMSE 411 Computational Medicine 3
CMSE 492 Special Topics in Data Science 1 to 4
CSE 402 Biometrics and Pattern Recognition 3
CSE 404 Introduction to Machine Learning 3
CSE 440 Introduction to Artificial Intelligence 3
CSE 480 Database Systems 3
CSE 482 Big Data Analysis 3
MTH 468 Predictive Analytics 3
STT 464 Statistics for Biologists 3
STT 465 Bayesian Statistical Methods 3

***MSU - Computational Data Science (Computer Science and Engineering)***
Requirements for the major:
a. Bioscience (4 to 6 credits)
b. All of the following courses (44 credits):
CMSE 201 Introduction to Computational Modeling and Data Analysis 4
CMSE 381 Fundamentals of Data Science Methods 4
CMSE 382 Optimization Methods in Data Science 4
CMSE 495 Experiential Learning in Data Science (W) 4
CSE 232 Introduction to Programming II 4
CSE 300 Social, Ethical, and Professional Issues in Computer Science 1
CSE 331 Algorithms and Data Structures 3
CSE 404 Introduction to Machine Learning 3
CSE 482 Big Data Analysis 3
CSE 480 Database Systems 3
MTH 314 Matrix Algebra with Computational Applications 3
STT 180 Introduction to Data Science 4
STT 380 Probability and Statistics for Data Science 4
c. Two courses selected from the following (6 credits):
CSE 402 Biometrics and Pattern Recognition 3
CSE 415 Introduction to Parallel Computing 3
CSE 431 Algorithm Engineering 3
CSE 440 Introduction to Artificial Intelligence 3
d. Two courses selected from the following (6 credits):
CMSE 401 Methods for Parallel Computing 4
CMSE 402 Data Visualization Principles and Techniques 3
CSE 402 Biometrics and Pattern Recognition 3
CSE 415 Introduction to Parallel Computing 3
CSE 431 Algorithm Engineering 3
CSE 440 Introduction to Artificial Intelligence 3
CSE 471 Media Processing and Multimedia Computing 3

| | | | |
|---|---|---|---|
| CSE | 472 | Computer Graphics | 3 |
| MTH | 451 | Numerical Analysis I | 3 |
| MTH | 468 | Predictive Analytics | 3 |
| STT | 464 | Statistics for Biologists | 3 |
| STT | 465 | Bayesian Statistical Methods | 3 |

**Northern Michigan University**

General Education 30-40
Required Courses in Major 34
MA 161 Calculus I [QUAR] 4
MA 211 Linear Algebra 3
CS 120 Computer Science I [QUAR] 4
CS 122 Computer Science II 4
CS 201 Programming in C++ 3
CS 202 Python 4
DATA 109 Introduction to Statistics 4
DATA 309 Data Visualization and Programming in R 4
DATA 472 Multiple Regression and ANOVA 4
Minor 16

**University of Michigan – Ann Arbor**

**Prerequisites** (calculus, linear algebra, introductory programing)
**Requirements**
A minimum of 42 credits is required (each with a minimum grade of C or higher), distributed as follows.

I. **Core:**
   1. *Computing and Discrete Mathematics*
      - EECS 203: Discrete Mathematics (preferred)
        *or*
        MATH 465: Introduction to Combinatorics
      - EECS 280: Programming and Elementary Data Structures.
   2. *Computing and Statistics*
      - EECS 281: Data Structures and Algorithms.
      - STATS 412: Introduction to Probability and Statistics.
      - STATS 413: The General Linear Model and Its Applications
   3. *Machine learning and data mining* (minimum 4 credits):
      - EECS 445: Machine Learning
        *or*
      - STATS 415: Data Mining
   4. *Data management and applications* (minimum 4 credits):
      - EECS 484: Database Management Systems
        *or*
      - EECS 485: Web Database and Information Systems
   5. *Data Sciences Applied to a Domain* (minimum 4 credits):
      - 400+ courses in Statistics and CSE on analytics in healthcare human behavioral analytics, financial analytics
      - 400+ level courses in bioinformatics (specify: is this bioinformatics courses in any SUBJECT or courses in BIOINF)

II. **Capstone Experience.** One course of at least 4 credits approved as satisfying the Data Science Capstone Experience requirement. STATS 485 and the proposed Data Science-oriented CSE courses that also meet the Major Design Experience (MDE) requirements as playing this role.

III. **Advanced Technical Electives in Data Science:** At least 8 credits of advanced technical. These courses must be selected from the list of courses below, or other courses by exception selected with advisor approval prior to taking the course.
   BIOINF 463 / BIOPHYS 463 / MATH 463: Mathematical Modeling in Biology

BIOINF 527: Introduction to Bioinformatics & Computational Biology
BIOINF 528: Structural Bioinformatics
BIOINF 545 / STATS 545 / BIOSTAT 646: High Throughput Molecular Genomic and Epigenomic Data Analysis
BIOINF 547 / MATH 547 / STATS 547: Probabilistic Modeling in Bioinformatics
BIOPHYS 463 / BIOINF 463 / MATH 463: Mathematical Modeling in Biology
BIOSTAT 449 / STATS 449: Topics in Biostatistics
BIOSTAT 646 / BIOINF 545 / STATS 545: High Throughput Molecular Genomic and Epigenomic Data Analysis
COGSCI 445: Machin Learn for NLP
EECS 388: Introduction to Computer Security
EECS 442: Computer Vision
EECS 444: Analysis of Societal Networks
EECS 449: Conversational Artificial Intelligence
EECS 467: Autonomous Robotics
EECS 471: Applied Parallel Programming with GPUs
EECS 476: Data Mining
EECS 477: Introduction to Algorithms
EECS 484: Database Management Systems
EECS 485: Web Database and Information Systems
EECS 487: Introduction to Natural Language Processing
EECS 492: Introduction to Artificial Intelligence
EECS 498: Special Topics (approved sections only. By default, EECS 498 sections will not count towards the Data Science advanced technical electives)
EECS 505: Computational Data Science and Machine Learning
EECS 545: Machine Learning
EECS 549 / SI 650: Information Retrieval
IOE 310: Introduction to Optimization Methods
IOE 413: Optimization Modeling in Health Care
MATH 420: Advanced Linear Algebra
MATH 463 / BIOINF 463 / BIOPHYS 463: Mathematical Modeling in Biology
MATH 472: Numerical Methods with Financial Applications
MATH 547 / STATS 547 / BIOINF 547: Probabilistic Modeling in Bioinformatics
MATH 548 / STATS 548: Computations in Probabilistic Modeling in Bioinformatics
ROB 320: Robot Operating Systems
SI 649: Information Visualization
SI 650 / EECS 549: Information Retrieval
STATS 406: Introduction to Statistical Computing
STATS 415: Data Mining and Statistical Learning
STATS 426: Introduction to Theoretical Statistics
STATS 430: Applied Probability
STATS 449 / BIOSTAT 449: Topics in Biostatistics
STATS 451: Bayesian Data Analysis
STATS 470: Introduction to Design of Experiments
STATS 480: Survey Sampling Techniques
STATS 531: Analysis of Time Series
STATS 545 / BIOINF 545 / BIOSTAT 646: High Throughput Molecular Genomic and Epigenomic Data Analysis
STATS 547 / MATH 547 / BIOINF 547: Probabilistic Modeling in Bioinformatics
STATS 548 / MATH 548: Computations in Probabilistic Modeling in Bioinformatics

**University of Michigan, Dearborn**

Prerequisite Courses (general education, basic math and computer science).
Data Science Major Core

CIS 350 Data Struc and Algorithm Anlys 4
CIS 375 Software Engineering I 4
ECE 3100 Data Science I 4
CIS 3200 Data Science II 4
CIS 422 Massive Data Management 4
ENGR 400 Appl Business Tech for Engr 3
or ENT 400 Entrepreneurial Thinking&Behav
HHS 470 Information Science and Ethics 3
STAT 305 Intro. to Data Science for All 3
STAT 325 Applied Statistics I 4
or IMSE 317 Eng Probability and Statistics
STAT 430 Applied Regression Analysis 3
CIS 4971 Cap Sem for Data Sci I 2
CIS 4972 Cap Proj for Data Sci II 2
Data Science Applications 18
Data Science Electives 3-4
General Electives
Any 100 to 400 level course, as needed to get a minimum of 120 credits for graduation.

**Western Michigan University**

Background Support (8 hours)
MATH 1220 - Calculus I (4)
MATH 2300 - Elementary Linear Algebra (4)

Computer Science Core (16 hours)
CS 2610 - R Programming for Data Science (4)
CS 3100 - Storage, Retrieval, and Processing of Big Data (3)
CS 5821 - Machine Learning (3)
CS 4900 - Software Systems Development I: Requirements and Design (3)
CS 4910 - Software Systems Development II: Implementation, Testing (3)

Statistics Core (16 hours)
STAT 2600 - Data Analysis Using R (4)
STAT 2630 - Introduction to Mathematical Statistics Using R (3)
STAT 4640 - Introduction to Statistical Computing (3)
STAT 5680 - Regression Analysis (3)
STAT 5870 - Big Data Analysis Using Python (3)

Electives (6 hours)
Two courses from Statistics and/or Computer Science:
STAT (STAT 5610, STAT 5660, STAT 5820, STAT 5670, STAT 5850, STAT 5860)
CS (CS 3400, CS 3500, CS 4430/CS 5430, CS 5180, CS 5260, CS 5300, CS 5400, CS 5550, CS 5700, CS 5820, etc.)

Total: 46 hours in the major

**University of Michigan-Flint**

Full online

**Michigan Technological University**

Core Requirements: (55-57 hours)

Data Science Electives (12 hours)

Focus Area (9 hours – 15 hours)

Choosing one from Business Technology; Cybersecurity; Software Engineering; or Statistics.

Lab Science and General Education Requirements (19 hours)

# Appendix C: Typical Student Plan of Study

**Sample Curriculum**

| Semester 1 | | Credits |
|---|---|---|
| • [f,w]MTH 1441 | Precalculus | 4 |
| • [f]CSI 1320 | Introduction to Python Programming and Unix | 4 |
| • *Gen Ed: Exploration – Arts, and Diversity* (A course from Gen Ed list that satisfies both requirements) | | 4 |
| • *Gen Ed: Foundation - Writing Found.:* [f,w]WRT 1050 | Composition I | 4 |
| | | **16** |

| Semester 2 | | Credits |
|---|---|---|
| • *Gen Ed: Foundation - Formal Reasoning:* [f,w]MTH 1554 | Calculus I | 4 |
| • [f,w]CSI 2300 | Object Oriented Programming | 4 |
| • *Gen Ed: Exploration - Social Science:* [f,w]PH 3000& or [f,w]ECN 1500& | Introduction to Public Health / Economics in Today's World | 3/4 |
| • *Gen Ed: Foundation - Writing Found.:* [f,w]WRT 1060 | Composition II | 4 |
| | | **15/16** |

| Semester 3 | | |
|---|---|---|
| • [f,w]STA 2226 | Applied Probability and Statistics | 4 |
| • [f,w]MTH 1555 | Calculus II | 4 |
| • [f,w]CSI 3450 | Database Design and Implementation | 4 |
| • *Gen Ed: Exploration – Global Perspective:* [f,w]CDS 2070 or *Gen Ed: Exploration – Nat. Sci and Tech:* [f,w]MIS 1050 | Health Care Systems Around the World / Web Technologies for Managing Infor. Resources | 3 |
| | | **15** |

| Semester 4 | | |
|---|---|---|
| •*Gen Ed: Writing Intensive – GenEd:* *Gen Ed: Exploration – Nat. Sci and Tech* [f,w]BIO 3000 or *Gen Ed: Exploration - Global Perspective* [f,w]MGT 1100 | Biology and Society / Contemporary World Business | 4 |
| • [f,w]MTH 2775 | Linear Algebra | 4 |
| • [f,w]APM 2663 | Discrete Mathematics | 4 |
| • *Gen Ed: Exploration - Western Civilization:* [f,w]PHL 1320 or [f,w]PHL 1310 | Introduction to Ethics for Healthcare Professions / Introduction to Ethics in Science and Engineering | 4 |
| | | **16** |

| Semester 5 | | |
|---|---|---|
| • *Gen Ed: Integration – Capstone:* [f]STA 4111 | Statistical Methods in Data Science [new] | 4 |
| • Application area elective | | 4 |
| • [f,w]CSI 2310 | Data Structures | 4 |
| • *CAS Exploratory Requirement (minor)#:* [f,w]MTH 2554 or [f]STA 4002 | Multivariable Calculus / Applied Linear Models I | 4 |
| | | **16** |

| Semester 6 | | |
|---|---|---|
| • *Gen Ed: Writing Intensive – Major:* [w]STA 4840 | Introduction to R for Data Science [new] | 4 |
| • Application area elective | | 3 |
| • Applied quantitative elective | | 4 |
| • [w]STA 4006@ | Statistical Computing | 4 |
| | | **15** |

| **Semester 7** | | **Semester 8** | |
|---|---|---|---|
| • Application area elective | 4 | • Applied quantitative elective | 4 |
| • Applied quantitative elective | 4 | • Applied quantitative elective | 4 |
| • *Gen Ed: Exploration – Literature* (A course from Gen Ed list) | 4 | • Application area elective[&] | 4/3 |
| • *Gen Ed: Integration – Knowledge Appl:* [f,w]QMM 2410 Statistical Methods for Business II<br>or<br>Alternative course from this Gen Ed category | 3 | • *Gen Ed: Exploration – Lang. and Culture* (A course from Gen Ed list) | 4 |
| | **15** | | **16/15** |

**Total Credits = minimum 124**

[f]Fall semester
[w]Winter semester
[&]If PH 3000 (3 crd) is chosen, the last Application area elective can be 4 credits. If ECN 1500 (4 crd) is chosen, the last Application area elective can be 3 credits.
[#] CAS exploratory requirement satisfied through a minor either in Mathematics or Applied Statistics: "Completion of a double major or degree or completion of a College of Arts and Sciences minor or concentration satisfies the exploratory requirement." (CAS Exploratory Requirement in the OU catalog)
[@]STA 4111 will be included as a 'or' prerequisite

**A SURVEY ON A PROPOSED PROGRAM IN QUANTITATIVE DATA SCIENCE**

- Proposed major in quantitative data science
  - ✓ Earn B.S. in data science, one of the fastest job growth areas in recent years.
  - ✓ Major for student with good mathematical, statistical, computer science and programming skills who wants to apply them in various fields.
  - ✓ High paying entry jobs in industry, health care, business, government, etc.
  - ✓ Good preparation for graduate study in data science, mathematics, statistics, business, computer science, and other areas.

- Proposed program includes courses in four areas:

1. **Mathematics and Statistics.** Examples of courses include (but not limited to) Calculus I and II, Applied Probability and Statistics, Linear Algebra, Discrete Mathematics, Statistical Methods in Data Science, Introduction to R for Data Science.
2. **Computer Science.** Examples of courses include (but not limited to) Introduction to Python Programming and Unix, Database Design and Implementation, Big Data Analysis with Cloud Computing.
3. **Application area.** Examples of elective courses in areas where data science may be applied include (but not limited to) Introduction to Geographic Information Systems, Functional Genomics and Bioinformatics, Business Analytics, Engineering Operations Research.
4. **General education courses.** Similar to other BS degrees.

Survey Questions:

1. What is your academic level? (1) Freshman (2) Sophomore (3) Junior (4) Senior

2. Do you have a current major? (1) Yes (2) No
   If yes, what is it? _____ If no, what is your future plan? _____

3. How many credits of math/stat and computer science courses have you taken prior to this semester? Math/Stat_____ Computer Science_____

4. Prior to this survey, how much did you know about data science?
   (1) A great deal (2) Some (3) Very little (4) Nothing

5. Would such a program interest you, or would it have interested you, had it been available when you enrolled at Oakland University? (1) Yes (2) No (3) Maybe

6. Would you consider majoring in data science?
   (1) Yes (2) Maybe (3) No, I prefer other major (4) No, I am too far into my program

7. In what class are you taking this survey? Course Number _____
   Instructor's Name _____

Thank you for completing the survey.

The survey was administered in Fall 2022, and responses from students enrolled in the following courses were received: Apm2555, Apm2663, Mth1221, Mth1441, Mth1554, Mth1555, Mth2554, Mth2775, Sta2220, Sta2226, Sta4002, Sta4227. The upper-level courses STA 4002 and STA 4227 enroll students in our existing majors who most likely have an interest in the proposed data science program. In total there were 586 responses. We discuss the results for questions 5 and 6, viewed as the most relevant for the planned data science program.

5. *Would such a program interest you, or would it have interested you, had it been available when you enrolled at Oakland University? (1) Yes (2) No (3) Maybe*

This question gauged the students' general interest in such a program. We combined the answers 'Yes' and 'Maybe' into one category called 'Potentially interested', while the answer 'No' is viewed as 'Not interested' in such a program. The table below shows the responses by major, where 'B' stands for business-related major, 'E' stands for engineering-related major, 'M' is one of the majors offered currently by the Mathematics-Statistics department, 'O' stands for other majors (e.g. chemistry, physics, etc.) not being as closely related to data science, and 'N' stands for not decided on a major yet.

| Interest \ Major | B | E | M | O | N |
|---|---|---|---|---|---|
| Potentially interested | 36 (61%) | 246 (69%) | 33 (87%) | 36 (39%) | 24 (60%) |
| Not interested | 23 (39%) | 110 (31%) | 5 (13%) | 57 (61%) | 16 (40%) |
| Total | 59 (100%) | 356 (100%) | 38 (100%) | 93 (100%) | 40 (100%) |

The percentages of students having a potential interest in the data science program outlined in the survey are above 60% for most areas where data science/analytics plays an important role (business, engineering, mathematics-statistics), with majors in the Mathematics-Statistics leading at almost 90%. In addition, 60% of students who are yet to choose a major have a potential interest in a data science degree.

6. *Would you consider majoring in data science?*
*(1) Yes (2) Maybe (3) No, I prefer other major (4) No, I am too far into my program*

This question is perceived as making a stronger commitment to the data science program, as reflected by the lower percentages of students who potentially consider majoring in such a program ('Yes' or 'Maybe') versus those who would not consider it (any type of 'No'). Nevertheless, among students who already chose a degree in the Mathematics-Statistics department about one third potentially consider majoring in data science, while almost half of those undecided potentially consider majoring in data science. In addition, among the students majoring in either business or engineering, one quarter potentially consider the data science program outlined in the survey. Since about one quarter of all students who would not consider the proposed data science program stated that they are too advanced into their current program (details not shown in the table), the proportions of students who potentially consider the program could be actually higher.

| Consider \ Major | B | E | M | O | N |
|---|---|---|---|---|---|
| Potentially considering | 15 (25%) | 96 (27%) | 14 (37%) | 10 (11%) | 17 (42%) |
| Not considering | 44 (75%) | 260 (73%) | 24 (63%) | 83 (89%) | 23 (58%) |
| Total | 59 (100%) | 356 (100%) | 38 (100%) | 93 (100%) | 40 (100%) |

During the administration of our survey we have not received reports from students that they have already completed a largely identical data science survey prior to ours. This means that ours was the first such survey administered to them, or the students perceived it as a survey for a different data science program.

## Appendix D: Detailed New Course Descriptions or Syllabi

**STA 4111** – Statistical Methods in Data Science (4).
Course description: Linear regression, Supervised and unsupervised learning, Classification, Decision trees, Support vector machines, Factor-models and principal component analyses, Clustering, Feature screening, Resampling methods, Neural Networks, Time series models, Machine learning methods. Prerequisites: STA 2226 and MTH 2775.

**STA 4840** - Introduction to R for Data Science (4).
Course description: Data import/export, Data frames, Relational data, Vectors/matrices/arrays, Functions and iterations, Data visualization, Data transformation, Exploratory data analysis, R Markdown, R packages for data science, Applications to statistical modeling and analysis. Prerequisites: STA 2226 and MTH 2775.

**STA 4007** – SAS Programming with Statistics Applications (4).
Course description: This course prepares students with programming aspects of statistical modelling, which is an integral part of most statistics and data sciences courses. The emphasis is on generating meaningful computer outputs with special references to statistical procedures and methodologies. Prerequisites: STA 2226 and MTH 2775.

**APM 4560** - Mathematical Models in Biology (4)
Course description: This course explores applications of mathematics to modeling biological and medical processes using discrete methods and differential equations. Computer simulations will also be presented. Prerequisites: APM 2555, MTH 2775 with a grade of C or higher (or MTH 2556 with a grade of C or higher) and proficiency in a computer programming language or instructor permission.

**APM 4350** - Technical Analysis of Stocks Trading Data (4)
Course description: This is a hands-on product development course for feature extractions of stocks' trading data and development of probabilistic trading algorithms. Students are trained to develop a working platform to computationally identify market behaviors of stocks and ETFs. Students will work with large data sets using a suite of statistical packages. Emphasis is placed on practical implementation of selected trading algorithms with stocks' historical data. Prerequisites: MTH 1555, STA 2226 with a grade of C or better, knowledge of programming.

## Appendix E: Pro Forma Budget

Submitted separately.

# Appendix F: Library Budget Report

OAKLAND UNIVERSITY
Libraries

March 17, 2023

**To:** Dorin Drignei, Professor of Statistics, Department of Mathematics and Statistics, College of Arts and Sciences (CAS)

**From:** Helen Levenson, Associate Professor and Collection Development Librarian, University Libraries

James E. Van Loon, Assistant Professor and Liaison Librarian to SECS, University Libraries

**Re:** Library collection evaluation for proposed B.S. program in Quantitative Data Science

In developing this collection evaluation, we reviewed the draft proposal for the bachelor's program in quantitative data science, as well as title lists of core journals and resources in the field. Overall, the library is well-positioned to support the proposed program; only a few resources appropriate for undergraduate use should be added to strengthen the collection in subject areas relevant to the new program. Below is a brief description of the resources currently available, those that should be acquired, and a five-year cost estimate in support of this proposed program.

**Journals and Conference Proceedings**

Currently, the library subscribes to the IEEE Library, which includes all journals, proceedings and standards produced by the IEEE. The library also maintains online access to all Association of Computing Machinery (ACM) journals, magazines, transactions and conference proceedings through the ACM Digital Library. The ACM and IEEE digital libraries, along with the library's current subscription to the Springer publisher package, provide full-text access to most of the journal and proceedings literature. Interlibrary loan also provides quick access to articles published in other relevant journals. Our review of the major journals (Appendix A) and major proceedings and series (Appendix B) in this subject area lead us to conclude that the library's current holdings of journals and proceedings would provide strong support for the new B.S. program with the addition of the two journals recommended below.

Two journals not currently subscribed to have been identified in Appendix A for acquisition, and funding for subscription to these two journals has been requested in Appendix C. These journals have been suggested for acquisition by the Mathematics and Statistics department, publish articles on a range of topics relevant to the proposed B.S. program, and are subscribed to by several of the targeted peer institutions; as such they represent resources to which immediate online access will be a benefit for students and faculty of the proposed B.S. program.

**Databases and Indexes**

To access the journal and conference literature in quantitative data science, the University Libraries maintain subscriptions to a number of online databases and indexes. The most important of these are Scopus (an Elsevier product), which indexes journals and conferences across all subjects; Compendex (accessed through Engineering Village), a bibliographic index to journals and conference proceedings in engineering and computing from 1969 to the present; and Science Citation Index (available online through the Web of Science platform), which indexes journals from 1980 to present in the sciences. The library also provides access to MathSciNet, an online database which indexes reviews, abstracts and bibliographic information for the mathematical science literature. Other important resources include the ACM Digital Library and IEEE Xplor, both of which index journals and conferences published by their respective societies. No additional indexes are needed to support the proposed program adequately.

**Monographs and Reference Sources**

The library purchases the complete collection of Springer eBooks each year, which includes the essential book series Lecture Notes in Computer Science (and all its subseries) and other book and book series, totaling more than 29,000 volumes related to computer science. Beyond the Springer eBook collection, the library purchases only a minimal number of books related to quantitative data science and related aspects (statistical modeling and analysis, stochastic processes, time series and analysis, optimization, and applications of mathematical statistics to biological or industrial sciences). Table 1 shows the library's holdings (total, and recently acquired) in the Library of Congress subject classifications most relevant to quantitative data science, and highlights the gaps in the collection relevant to new course offerings.

To ensure that the Libraries' monographic collection adequately supports the new proposed bachelor's degree program, we recommend the purchase of approximately three ebooks per year in each of the five subject areas highlighted in Table 1; these materials would be selected at a level appropriate for undergraduate use.

Table 1: Monographic titles in subjects relevant to the proposed B.S. in Quantitative Data Science

| LC call number | Subject | Number of books owned (all publication years) | Number of books owned (publication 2015-present) |
|---|---|---|---|
| HA29 - HA32 | Statistics, Theory and method of social science statistics | 503 | 77 |
| HB137 | Economic Statistics | 33 | 14 |
| HD30.215 | Industrial Management / Theory and Methods / Statistical methods | 32 | 17 |
| HG4638 | Investment analysis / Charts, diagrams | 32 | 2 |
| Q183.9 | Science - Data processing | 54 | 21 |
| Q325.5 - Q325.787 | Machine learning | 577 | 422 |
| Q335 - Q336 | Cybernetics - Artificial intelligence | 758 | 449 |
| QA76.585 | Computer science - Cloud computing | 381 | 255 |
| QA76.73.R3 | Programming languages - R | 1 | 1 |
| QA76.9.B45 | Computer science - Big data | 294 | 270 |
| QA76.9.D343 | Computer science - Data mining | 750 | 357 |
| QA76.9.I52 | Computer science - Information visualization | 79 | 45 |
| QA76.9.Q36 | Computer science - Quantitative research. Quantitative data | 8 | 8 |
| QA273 - 274.9 | Probabilities | 1361 | 315 |
| QA276 - 280 | Mathematical Statistics | 2331 | 646 |
| QA276.4 | Statistics - Data processing | 75 | 20 |
| QA276.45.R3 | Statistics - Data processing - R (Computer program language) | 70 | 39 |
| QH324.2 - QH324.7 | Bioinformatics | 461 | 193 |
| QH441 - QH441.2 | Genetics - techniques, data processing | 18 | 8 |
| R858 - R859.7 | Computer applications to medicine. Medical informatics | 511 | 261 |
| T57.5 | Industrial engineering - Quantitative methods - Data | 7 | 3 |

Note: Shaded rows indicate subject areas relevant to new course offerings or having gaps in the collection, with associated funding requested in Appendix C.

**Library Budget Request**

Appendix C provides cost estimates for new resources needed to support the proposed bachelor's level program:

- funding to purchase approximately three ebooks per year in each of the five subject areas relevant to the new program highlighted in Table 1 (average current cost for these monographs is $180), and
- funding to subscribe to the two journals highlighted in Appendix A which publish articles on subjects especially relevant to the new program, and held by peer institutions with similar programs.

Because this program will rely largely on existing library resources, we have also included funding to cover anticipated annual inflationary cost increases for the library's current journals and research databases (estimated at ten percent per year) in computer science. Without additional funding, the library cannot guarantee that we will be able to continue to subscribe to our current resources. Therefore, we ask that the library be given funds each year to assist us in continuing to subscribe to these necessary resources for computer science faculty and students.

## Appendix A

### Major Journals - Quantitative Data Science

| Title | Publisher | OU Access |
|---|---|---|
| Annals Of Applied Probability | IMS | yes (48 month embargo) |
| Annals Of Applied Statistics | IMS | yes (48 month embargo) |
| Annals Of Probability | IMS | yes (48 month embargo) |
| Annals Of Statistics | IMS | yes (36 month embargo) |
| Applied Mathematical Modelling | Elsevier | via Interlibrary Loan |
| BMC Bioinformatics | Springer Nature | yes |
| Bulletin Of Mathematical Biology | Springer Nature | yes |
| Communications In Statistics - Theory And Methods | Taylor & Francis | via Interlibrary Loan |
| Computational And Mathematical Methods In Medicine | Hindawi | yes |
| Computational Intelligence And Neuroscience | Hindawi | yes (open access) |
| Environmental Monitoring And Assessment | Springer Nature | yes |
| IEEE Access | IEEE | yes |
| International Journal of Data Science and Analytics | Springer | recommend direct subscription |
| Journal of Big Data | Springer | yes (open access) |
| Journal Of Computational And Graphical Statistics | Taylor & Francis | yes (15 month embargo) |
| Journal Of Instrumentation | IOP | yes |
| Journal Of Theoretical Biology | Elsevier | via Interlibrary Loan |
| Mathematical Biosciences | Elsevier | via Interlibrary Loan |
| Mathematical Geosciences | Springer Nature | yes |
| Mathematics | MDPI | yes (open access) |
| Neural Networks | Elsevier | via Interlibrary Loan |
| Neurocomputing | Elsevier | via Interlibrary Loan |
| Plos Computational Biology | PLOS | yes (open access) |
| Plos One | PLOS | yes (open access) |
| Science Of The Total Environment | Elsevier | yes |
| SIAM Journal on Mathematics of Data Science | SIAM | recommend direct subscription |
| Statistical Analysis and Data Mining: The ASA Data Science Journal | Wiley-Blackwell | yes |
| Statistical Methods In Medical Research | SAGE | yes |
| Statistical Science | IMS | yes (36 month embargo) |
| Statistics In Medicine | Wiley-Blackwell | yes |

Note: Shaded rows indicate journals recommended for subscription, with associated funding requested in Appendix C.

## Appendix B

### Major Conference Proceedings and Series - Quantitative Data Science

| Title | Publisher | OU Access |
|---|---|---|
| ACM International Conference Proceeding Series | ACM | yes |
| Advances In Experimental Medicine And Biology | Springer | yes |
| Advances In Intelligent Systems And Computing | Springer | yes |
| Aip Conference Proceedings | AIP | yes |
| Ceur Workshop Proceedings | RWTH Aachen University | yes (open access) |
| Communications In Computer And Information Science | Springer | yes |
| E3s Web Of Conferences | EDP Science | yes (open access) |
| International Archives Of The Photogrammetry Remote Sensing And Spatial Information Sciences ISPRS Archives | ISPRS | yes (open access) |
| International Conference on Bioinformatics Research and Applications | ACM | yes |
| International Conference on Computing and Data Science | ACM | yes |
| International Conference on Data Science and Information Technology | ACM | yes |
| Iop Conference Series Earth And Environmental Science | IOP Science | yes (open access) |
| Iop Conference Series Materials Science And Engineering | IOP Science | yes (open access) |
| Journal Of Physics Conference Series | IOP Science | yes (open access) |
| Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics | Springer | yes |
| Lecture Notes In Electrical Engineering | Springer | yes |
| Lecture Notes In Networks And Systems | Springer | yes |
| Procedia Computer Science | Elsevier | yes (open access) |
| Procedia Engineering | Elsevier | yes (open access) |
| Proceedings Of SPIE The International Society For Optical Engineering | SPIE | via Interlibrary Loan |
| Smart Innovation Systems And Technologies | Springer | yes |
| Springer Proceedings In Mathematics And Statistics | Springer | yes |

## Appendix C
## Library Budget for Proposed B.S. in Quantitative Data Science

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Monographs[1] | $ 2,700 | $ 2,970 | $ 3,267 | $ 3,594 | $ 3,953 |
| International Journal of Data Science and Analytics[2] | $ 712 | $ 783 | $ 862 | $ 947 | $ 1,042 |
| SIAM Journal on Mathematics of Data Science[2] | $ 1,362 | $ 1,498 | $ 1,648 | $ 1,813 | $ 1,994 |
| Support for current resources[3] | $ 5,000 | $ 5,500 | $ 6,050 | $ 6,655 | $ 7,321 |
| Total | $ 9,774 | $ 10,751 | $ 11,827 | $ 13,009 | $ 14,310 |

[1]Presumes the purchase of 3 ebooks per year in the 5 identified LC classifications, with an 10% annual inflationary increase

[2]Presumes a 10% annual inflation rate

[3]Presumes a 10% annual inflation rate

cc: Polly Boruff-Jones, Dean of University Libraries
Amanda Nichols Hess, University Libraries Representative to University Senate

## Appendix G: University Assessment Plan

Oakland University Assessment Committee

**Assessment Plan**

**Step 1: Basic Information**

Program Name: B.S., Applied Data Science
School or College your program resides in:
Program Level (check all that apply):

| | |
|---|---|
| Undergrad | X |
| Master's | ☐ |
| Doctoral | ☐ |

Date Plan Submitted:
Current Assessment Contact Representative (& E-mail): Dorin Drignei (drignei@oakland.edu)
Current Department or Program Chair (& E-mail): Anna Maria Spagnuolo (spagnuolo@oakland.edu)
Current Dean (& E-mail): Elaine Carey (ecarey@oakland.edu)

**Step 2: Type of Assessment Plan**

**Option A.** Programs that have an external accrediting agency other than the Higher Learning Commission may be eligible to use their accreditor's response in lieu of following the UAC's standard process. These programs use the UAC's 'external accreditation mapping' form instead of this form. For more information, please contact the UAC/OIRA liaison Reuben Ternes (ternes@oakland.edu). Programs without external accreditation should proceed to option B.

**Option B.** If you are not accredited by an external body (or your accreditor's standards do not meet the standards set by the Higher Learning Commission), then proceed to Steps 3-5 to create your assessment plan. Members of the UAC are always willing to work with individuals from any department to develop or revise their assessment plans. In addition, the Office of Institutional Research and Assessment (OIRA) has some very helpful tools for faculty and departments listed on their website. If at any time you have any questions, need any assistance, or would like to schedule a meeting with any UAC representatives, please contact the UAC and OIRA liaison, Reuben Ternes (ternes@oakland.edu).

**Step 3: Aligning Program Goals, Student Learning Outcomes, and Assessment Measures**

Please begin your program assessment plan by completing the table below. Use the "Table" menu in Word to add rows, merge cells, etc. as needed.

- In column 1, record your program goals as they relate your unit's program goals.
- In column 2, record your program's planned student learning outcomes related to each program goal.
    - SLOs should be written using observable and measurable verbs (e.g. write, state, explain, apply, demonstrate, etc.) as opposed to verbs that are difficult to observe directly (e.g. learn, know, etc.).
- In column 3, record the assessment measure(s) that evaluate each student learning outcome (note: each learning outcome should have an associated assessment measure).
- Add rows to the table as necessary.

| (1) Program Goals | (2) Student Learning Outcomes | (3) Assessment Measures |
|---|---|---|
| 1. The program will provide students with foundational knowledge in data science, specifically in mathematics, statistics, and software analysis/programming. | SLO 1. Demonstrate foundational knowledge in data science, specifically in mathematics concepts such as calculus or algebra.<br><br>SLO 2. Demonstrate foundational knowledge in data science, specifically in statistics concepts such as regression or inference.<br><br>SLO 3. Demonstrate foundational knowledge in data science, specifically in software analysis and programming related to performing statistical analysis using software such as R or SAS. | Measure 1a: Assignment/presentation/report/test given in the capstone course. There will be at least one question related to each domain: mathematics (SLO 1), statistics (SLO 2), software analysis/programming (SLO 3).<br><br>Measure 1b: Questions 3 (SLO 1), 4 (SLO 2), 5 (SLO 3) in the Exit survey. |
| 2. The program addresses quantitative aspects of data science through specific applied mathematics or applied statistics elective courses. | SLO 4. Demonstrate knowledge in quantitative aspects of data science, through advanced applied mathematics courses in areas such as mathematical biology, stocks trading or optimization.<br><br>SLO 5. Demonstrate knowledge in quantitative aspects of data science, through advanced applied statistics courses in areas such as survival analysis, time series analysis or survey analysis. | Measure 2a: Assignment/presentation/report/test given in one of the quantitative elective courses: applied mathematics (SLO 4) or applied statistics (SLO 5).<br><br>Measure 2b: Questions 6 (SLO 4) and 7 (SLO 5) in the Exit survey. |

| (1) Program Goals | (2) Student Learning Outcomes | (3) Assessment Measures |
|---|---|---|
| 3. The program will provide students with opportunities to take courses in areas where data science may have applicability, such as business, healthcare, geoinformatics or engineering. | SLO 6. Demonstrate knowledge in application areas of data science, specifically in business-related areas such as finance or economy.<br><br>SLO 7. Demonstrate knowledge in application areas of data science, specifically in healthcare-related areas such as bioinformatics or population health.<br><br>SLO 8. Demonstrate knowledge in application areas of data science, specifically in geoinformatics areas such as geographic information systems or remote sensing.<br><br>SLO 9. Demonstrate knowledge in application areas of data science, specifically in engineering areas such as engineering operations research or engineering risk analysis. | Measure 3a:<br>For the DMS data science students taking an application area course (SLOs 6-9), we'll request an aggregated score on the final exam/project/presentation, from the department/unit teaching the course. Such a score could be e.g. the mean or median (as a percentage) on the final exam, only for the DMS data science students. The final exam represents a synthesis of the material in that application area course. The scores will then be compared across application areas (e.g. business courses vs healthcare courses) to determine where improvement is necessary. In addition, we'll compare grade distributions across several application areas to identify areas where students might struggle.<br><br>Measure 3b: Questions 8 (SLO 6), 9 (SLO 7), 10 (SLO 8), 11 (SLO 9) in the Exit survey. |

**Step 4: Participation in Assessment Process**

| Who Will Participate in Carrying Out the Assessment Plan | What Will Be Their Specific Role/s |
|---|---|
| Instructors in selected courses | Instructors in courses where the assignment/presentation/report/test is given will evaluate it and pass it along to the Chair of the Committee on Undergraduate Programs. |
| Data science program coordinator | The data science program coordinator will administer the Exit surveys and pass them along to the Chair of the Committee on Undergraduate Programs. |
| Faculty in the Committee on Undergraduate Programs | The Committee on Undergraduate Programs will review the above information along with aggregated scores and grade distributions in application area courses to create the Assessment Report. |

| Who Will Participate in Carrying Out the Assessment Plan | What Will Be Their Specific Role/s |
|---|---|
| All full-time faculty | All full-time faculty will discuss, implement possible changes, and approve the Assessment Plan/Report. |
| Part-time faculty | They are not expected to be involved in the assessment process, but they will be given an opportunity to do so if they wish. |

**Step 5: Plan for Analyzing and Using Assessment Results to Improve Program**
A. How will you analyze your assessment data?

Measure 1a: Questions related to each of the three domains (mathematics, statistics and software analysis/programming) will be included in the assignment/presentation/report/test given in the capstone course and will be used to assess whether the SLOs 1-3 are adequately achieved. The score distribution of each question will be analyzed to identify domain(s) where students struggle, if any.
Measure 1b: The responses to Exit survey Questions 3-5 will be used to additionally assess whether the SLOs 1-3 are adequately achieved. These responses will be evaluated to determine if they are positive, neutral, or negative, then create a distribution of categorized responses. In addition, the "least beneficial" required courses will be further evaluated for potential improvement.

Measure 2a: The score distribution to the assignment/presentation/report/test given in a quantitative elective course will be used to assess whether the SLOs 4-5 are adequately achieved. We plan to offer at least two quantitative elective courses each year.
Measure 2b: The responses to Exit survey Questions 6-7 will be used to additionally assess whether the SLOs 4-5 are adequately achieved. These responses will be evaluated to determine if they are positive, neutral, or negative, then create a distribution of categorized responses. In addition, the "least beneficial" required courses will be further evaluated for potential improvement.

Measure 3a: To assess whether the SLOs 6-9 are adequately achieved, the aggregated scores and grade distributions across application areas (e.g. business, healthcare, engineering courses) will be compared to identify if/where students struggle. If there are such application areas, the root causes will be identified by discussing with the instructors involved. For example, if it is determined that the prerequisite/background is inadequate, additional preparatory courses may be considered. Including alternative courses in the same application area may also be an option, if they achieve the same goals. This measure will be used only in conjunction with Measure 3b below, assessing students' opinion about application area courses.
Measure 3b: The responses to Exit survey Questions 8-11 will be used to assess whether the SLOs 6-9 are adequately achieved. These responses will be evaluated to determine if they are positive, neutral, or negative, then create a distribution of categorized responses. In addition, the "least beneficial" courses will be evaluated to determine if they should continue to remain in the Application area list of courses.

Exit survey.
The survey will be distributed to the exiting students. The survey form is included below. It contains questions about the students' perception on their overall experience at Oakland University, as well as about the instruction received in the proposed data science program. Questions 3-11 map directly onto the SLOs. However, questions 12-14 can also inform about the proposed curriculum.

B. How will you use results to improve your program?

The Committee on Undergraduate Programs will regularly review the assessment results and will determine if changes in the data science program are necessary. When changes are needed, the Committee on Undergraduate Programs makes recommendations that will be presented to the full-time faculty in the department. If a majority of the faculty determines that such recommendations should be implemented, the Department will make changes to the program directly, and if required, the Chair of the Committee on Undergraduate Programs will submit a revised Assessment Plan to UAC as well.

**Step 6: Submit Assessment Plan**
Send completed form electronically to ternes@oakland.edu.

**Exit Survey for Quantitative Data Science B.S. Graduates**

Responses will be confidential and anonymous.

1. What were the reasons that you attended Oakland University?

2. What and/or who influenced you to major in quantitative data science?

3. Overall, were the mathematics required data science courses beneficial? Which such courses were most/least beneficial? Why?

4. Overall, were the statistics required data science courses beneficial? Which such courses were most/least beneficial? Why?

5. Overall, were the software analysis/programming required data science courses beneficial? Which such courses were most/least beneficial? Why?

6. Overall, were the quantitative elective applied mathematics courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

7. Overall, were the quantitative elective applied statistics courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

8. Overall, were the business-related application area courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

9. Overall, were the healthcare-related application area courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

10. Overall, were the geoinformatics-related application area courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

11. Overall, were the engineering-related application area courses beneficial? Which such courses were most/least beneficial? Why? Write NA if not applicable.

12. What are your future career goals? Do you feel that you are adequately prepared for your career goals?

13. What do you believe that either the University or the Department of Mathematics and Statistics should do in the near future to improve the undergraduate experience at Oakland University?

14. Are there any other comments that you would like to make?

Thank you for completing this survey.

## Appendix H: Support Letters

**Beaumont**

February 18, 2023

Anna Maria Spagnuolo, Ph.D.
Chair
Professor of Mathematics
Executive Director of the OU Math Corps
368 MSC
Department of Mathematics and Statistics
Oakland University
Rochester, MI 48309

Re: B.S in Quantitative Data Science, Department of Mathematics and Statistics

Dear Anna,

I am glad to write in strong support for your proposal to create B.S. in Quantitative Data Science, Department of Mathematics and Statistics.

Data scientists work in various industries, including healthcare. They use their knowledge of probability and statistics, data visualization, machine learning, and more to enhance various aspects of healthcare, including illness diagnosis, drug discovery, patient health tracking, g risk patient identification and reducing healthcare expenses. During COVID-19 pandemic, data scientists help monitor the spread of the disease within the country and accordingly coordinate with the authorities to send resources to the most impacted areas.

3.5 billion US dollars were invested in digital health startups in 2017, allowing the healthcare companies to fulfill their ambitions of revolutionizing the world's general perceptions of health. This created a large number of job opportunities for data scientists in the healthcare companies.

Data scientists need training in quantitative research, machine learning, statistical analysis, inference computation, and methodological approach to epidemiology. It is important to offer a program that emphasizes the quantitative mathematics and statistics aspects, which are foundational to data science.

I am a Director of Biostatistics and Health Informatics at Beaumont Health, which is Michigan's largest healthcare system, provides high quality, efficient, accessible services in a caring environment for southeastern Michigan residents and beyond. It consists of eight hospitals with 3,375 beds, 155 outpatient sites, nearly 5,000 physicians, more than 38,000 employees and about 2,000 volunteers.

3811 West Thirteen Mile Road
Royal Oak, MI 48073

lili.zhao@beaumont.org
734-353-1652

The immense amount of data from Beaumont Health requires skilled data scientists to manage and analyze. The B.S program in data science will train students to have necessary quantitative and computational skills to work in Beaumont Health or other healthcare companies. I hope to get more data scientists from your department to work in my company, and at the same time I would like to create internship opportunities to provide practical experience for your students, so they will be prepared to become competitive data scientists on the job market.

I enthusiastically support B.S degree in Quantitative Data Science in the Department of Mathematics and Statistics at Oakland University. If you have any further questions, please do not hesitate to contact me at (734)-353-1652 or send me an e-mail lili.zhao@beaumont.org.

Sincerely yours,

Zhao Li

Lili Zhao, PhD
Director of Biostatistics and Health Informatics
Beaumont Health
Research Institute
3811 West Thirteen Mile Road, Suite 501
Royal Oak, MI 48073
Adjunct Research Professor
Biostatistics Department, University of Michigan
1415 Washington Heights
Ann Arbor, MI 48109

**DEPARTMENT OF THE ARMY**
U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND
GROUND VEHICLE SYSTEMS CENTER
6501 E. 11 MILE ROAD
DETROIT ARSENAL, MI 48397-5000

March 8, 2023

Anna Maria Spagnuolo, Ph.D.
Chair, Professor of Mathematics
Executive Director of the OU Math Corps
368 MSC Department of Mathematics and Statistics
Oakland University Rochester, MI 48309
E-mail: spagnuolo@oakland.edu
Phone: 248-370-4032

Dear Dr. Spagnuolo,

I reviewed the B.S. Quantitative Data Science proposal, and I would like to express my support for the proposed program. It is particularly strong in the foundational quantitative aspects of data science, and the program also includes the computer science courses necessary for data science. The U.S. Army ground community, including our government employees and industry partners, need a program like this. Our software and robotics/autonomy groups as well as our digital engineering activities well outpace the traditional mechanical sciences areas.

U.S. Army Ground Systems Center (GVSC) partners with the academia and the industry on various projects, some of them supported through the Automotive Research Center (ARC), in areas such as Human-Autonomy Interaction, Intelligent Power Systems, Virtual Experiments, and Robotics. Many of these projects make use of data science and analytics concepts and tools.

More broadly, given that our society becomes increasingly data-driven, data science is needed in commercial business and industry. There is a shortage of well qualified data scientists. The job prospects of future graduates of a data science program such as yours are very good, and they are likely to find internships and employment in the much-needed area of data science.

Sincerely, GORSICH.DAVID.J.123 0509863 Digitally signed by GORSICH.DAVID.J.1230509863 Date: 2023.03.16 12:49:05 -04'00'

Dr. David Gorsich, ST, SAE & AMSE Fellow
Chief Scientist, U.S. Army Ground Systems
U.S. Army Futures Command, DEVCOM-GVSC
6501 E. 11 Mile Rd, Bldg 200A Warren, MI 48397

February 22, 2023

**Prof. Anna Maria Spagnuolo, Chair**
**Dept. of Mathematics and Statistics**
**Oakland University**
**spagnuolo@oakland.edu**

Dear Prof. Spagnuolo,

Thank you for sharing your ideas on establishing a new B.S. major in Quantitative Data Science. I believe this is a timely move that aligns well with a strong demand for data scientists in research and engineering. Graduates with the skills to manage large bodies of data, extract meaning in the form of mathematical models, and interpret the statistical nature of the results will be prepared to make substantial contributions to our economy, both here in Michigan and nationally. I particularly appreciate the emphasis on quantitative aspects, which is a strength of your department.

Your draft plans of course requirements and electives are well thought out, with strong fundamentals while also allowing a rich set of electives. I believe it will be attractive to both students and their potential employers, or as the case may be, to graduate programs in the field.

Congratulations to your team for crafting such a strong proposal, and best wishes in moving the plan forward.

Sincerely,

Charles W. Wampler, II

Charles W. Wampler
Sr. Technical Fellow
GM Global R&D Center
Battery Cell Systems Research

TECHNICAL FELLOWS
GENERAL MOTORS

peaker services, inc.

8080 KENSINGTON COURT
BRIGHTON, MICHIGAN 48116-8591

February 23, 2023

Department of Mathematics and Statistics
Professor Anna Maria Spagnuolo, Ph.D.
Chair
368 MSC
Oakland University
Rochester, MI 48309

Dear Professor Spagnuolo:

I would like to convey my enthusiastic support for the proposal to offer a B.S. in Quantitative Data Science.

There is an enormous need nationally and locally for graduates in this field, as I am sure you are aware.

We are living in a world where data is being produced at an ever increasingly high rate. The skills to provide insights from such data are therefore increasingly critical.

To combine the capabilities of modeling and diagnostics from traditional applied statistics courses with understanding of the modelling approaches possible through modern machine learning algorithms as you plan is tremendously valuable.

I also feel that the interdisciplinary options planned are excellent for developing a broader systems view in your students which will be personally enriching and prepare them well for the work environment.

I wish you great success with your proposal and, hopefully, future program

Sincerely,
Peaker Services, Inc

Ian Bradbury

President & CEO

248-437-4174 • 800-622-4224 • FAX 248-437-8280

Dr. Anna Maria Spagnuolo
Chair
Professor of Mathematics
Executive Director of the OU Math Corps.
Department of Mathematics and Statistics
Oakland University
Rochester, MI 48309

6 March 2023

**Subject: Letter of Support for Proposed OU B.S. in Quantitative Data Science within the OU Department of Mathematics.**

Dear Prof. Spagnuolo:

I am writing this letter to you in support of the proposed OU B.S. program in Quantitative Data Science with the OU Department of Mathematics and Statistics. I have carefully read the "draft" proposal for this program you sent to me last week and it's contents thoroughly. I believe that the key elements contained in this proposal are sound and well thought out and cover the key points (need, execution, etc.) for the proposed program.

As a "data science" executive and researcher with over 30 years experience in both academia and industry across the globe, I enthusiastically endorse the proposed program at OU. Drawing on my global experience conducting and leading multiple "data science" solutions for many corporate clients across many industries (e.g., automotive, healthcare, transportation, retail, etc.) it is clear to me that there is great demand for graduates of such this program. Further, I predict that in the future this program will become one of the most successful programs at OU.

Again, I enthusiastically (and without reservation). endorse the proposed B.S. program in Quantitative Data Science.

Thank You,

With Best Regards,

Dr. Jeffrey Tew
Chief Scientist and Executive Directo -- TCS North America Innovation Labs

Tata Consultancy Services, Ltd.

1000 Summit Dr., Milford, OH 45150

Email: Jeffrey.tew@tcs.com

Phone: 1-248-894-0490

PURDUE UNIVERSITY | The Data Mine

April 25, 2023

To Whom It May Concern:

I am Director of The Data Mine program at Purdue University. I am writing to express my support for the Proposal for a B.S. in Quantitative Data Science. My colleagues in the Department of Mathematics and Statistics at Oakland University have shared the proposal with me. I am genuinely excited about this new initiative.

I want to emphasize that new programs in Quantitative Data Science are being implemented in all types of universities, at all levels, throughout the USA (and, indeed, internationally as well). Programs of this type prepare students for the constantly evolving and growing needs for data science competencies in industry.

For comparison, at Purdue, our campus-wide initiative called The Data Mine had approximately 1300 students this year, and anticipates more than 1700 students during the upcoming year. The majority of the student participants are undergraduate students. Much like with the proposed program at Oakland, the students are learning data science skills that will be valuable in industry. Yesterday, here at Purdue, we had our end-of-the-year Data Mine Corporate Partners Symposium. Altogether, 80 teams of students displayed the work that they have accomplished throughout the year with our Corporate Partners.

I believe that Oakland's new B.S. in Quantitative Data Science will be highly valued by students and will lead to many partnerships of myriad types. Here at Purdue, if it would be helpful, we could support this initiative with some new Corporate Partners, and also by sharing our curricular materials (we have perhaps more than 2000 pages of materials and perhaps more than 1000 videos to accompany the material) and computational resources. We currently have students from 44 universities working on programs in The Data Mine and would like to further expand our partnerships.

We are fully in support of the Proposal for a B.S. in Quantitative Data Science at Oakland University and will help any way that we can.

I am happy to clarify any details; please feel welcome to contact me at any time. My email address is mdw@purdue.edu.

Sincerely,

Mark Daniel Ward

Mark Daniel Ward, Ph.D.
Professor of Statistics and
(by courtesy) of Agricultural & Biological Engineering,
Computer Science, Mathematics, and Public Health;
Director of The Data Mine

THE DATA MINE
Hillenbrand Hall
1301 Third Street, West Lafayette, IN 47906–4206
Office: 765-496-9563 Web: datamine.purdue.edu

OAKLAND
UNIVERSITY

November 16, 2023

Dr. Anna Spagnuolo
Chair
Professor of Mathematics
Executive Director of the OU Math Corps
Department of Mathematics and Statistics
Oakland University
Rochester, MI 48309

Re: Support letter for BS in Quantitative Data Science, Department of Mathematics and Statistics

Dear Dr. Spagnuolo,

I am writing this letter to enthusiastically support the proposed BS in Quantitative Data Science in the Department of Mathematics and Statistics. After a chance to review your proposal and discuss it with you, I am in full support of your program, its development, and planned implementation.

This program will add a very important degree not only for Mathematics and Statistics students but for all OU students. This new opportunity will allow our students to be more competitive in a job market where data scientists are in high demand. The rigorous training the students will receive will also allow them to apply their skills in many different fields, within and beyond data science.

I also appreciate the collaborative nature of your proposal with the School of Engineering and Computer Science. Data science is an inherently interdisciplinary field and your proposed program reflects this. I believe this will be a unique opportunity to train students beyond the boundaries of a single disciplines to support their growth into well-rounded and nimble scientists. I look forward to seeing the growth of this program and how future collaborations will stem from it.

For these reasons, I give my full support to the BS in Quantitative Data Science and look forward to its implementation in our curriculum.

Sincerely,

Elaine Carey

COLLEGE OF ARTS AND SCIENCES
OFFICE OF THE DEAN

Varner Hall, Rm. 217
371 Varner Dr.
Rochester, Michigan 48309-4485

(248) 370-2140
Fax: (248) 370-4280
cas@oakland.edu
oakland.edu/cas

OAKLAND UNIVERSITY

March 1, 2024

Letter of Support for Emerging Program
Bachelor of Science in Applied Data Science Program
Mathematics and Statistics
Oakland University

Dear Colleagues,

I am writing to express my enthusiastic support for the proposed Bachelor of Science in Applied Data Science program within the Department of Mathematics and Statistics. As the landscape of data science continues to evolve rapidly, the need for programs that blend rigorous quantitative analysis with practical application areas becomes increasingly critical. The Department of Mathematics and Statistics is uniquely positioned to offer such an innovative program that promises to enhance our institution's academic offerings and significantly contribute to the field of data science.

The proposed Applied Data Science program distinguishes itself through a unique emphasis on advanced applied quantitative analysis and methods. By focusing on applied mathematics and applied statistics courses specifically tailored to data science, the program offers a depth of understanding and technical competency essential for tackling complex data-driven problems. This rigorous analytical foundation sets the program apart and prepares students for the challenges and opportunities of the modern data landscape.

Furthermore, including elective courses in specific application areas such as geoinformatics, healthcare, and business is a testament to the program's commitment to interdisciplinary learning and practical skill development. This approach aligns with the inherently interdisciplinary nature of data science and significantly enhances students' employability and adaptability in diverse professional environments. By providing students with opportunities to apply their quantitative skills in real-world contexts, the program ensures that graduates are proficient in theoretical concepts and capable of contributing meaningfully to their chosen fields.

The collaboration between the College of Arts and Sciences (CAS) and the School of Engineering and Computer Science (SECS) has always been a cornerstone of our institution's strength in offering comprehensive and cutting-edge academic programs. The continuation of this collaborative tradition through the proposed Applied Data Science program is both commendable and strategic. The coexistence of the Data Science programs within CAS and SECS, each with its unique focus and strengths, embodies the spirit of interdisciplinary collaboration and mutual enhancement. Specifically, the Applied Data Science program's robust emphasis on mathematics and statistics and higher credit requirements in application areas complements the existing Data Science program by providing a pathway for students interested in a more quantitative and application-oriented approach.

OFFICE OF THE DEAN
SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

Engineering Center, Rm. 301
115 Library Drive
Rochester, Michigan 48309-4479

(248) 370-2217
Fax: (248) 370-4261
secsdean@oakland.edu
oakland.edu/secs

In conclusion, the Bachelor of Science in Applied Data Science program represents a forward-thinking and strategically designed addition to our academic offerings, promising to equip students with the skills and knowledge required to excel in the rapidly evolving field of data science. I wholeheartedly support this initiative and am confident that it will contribute significantly to the academic and professional success of our students and the broader academic community.

Sincerely,

Louay M. Chamra, Ph.D.
Professor and Dean

March 14, 2023

Prof. Anna Spagnuolo

Department of mathematics and Statistics

Oakland University

Rochester, MI 48309

Dear Prof. Spagnuolo:

We, the founding members of the Center for Data Science and Big data Analytics are pleased to know that your department is submitting a proposal for a new undergraduate program in "*Quantitative Data Science*" and with this letter, we would like to express our full support, in spirit and efforts, to this new initiative from the Department of Mathematics and Statistics.

As one can easily see from the name of our center, our group strives to promote all aspects of data science within the university and beyond. To be an effective interdisciplinary center promoting collaborative and fundamental research, it is imperative for all of us in the university to steer our efforts to quantitative literacy, not just at a basic level, but also at the advanced levels. Starting various degree programs in data science would be a right step towards that goal. Notwithstanding our personal goal as the founding members of the center, our nation at present also badly needs trained data scientists who can then immerse themselves in interdisciplinary work – in industry as well as academia and there are far fewer such trained professionals than the country actually currently needs. Thus, under the circumstances, it is hard to argue against any such initiatives especially when our university must steer itself towards programs where demand is high, supply is low and where there is a considerable career-interest in such programs from young college going cohort.

We strongly support the new undergraduate degree program in "*Quantitative Data Science*". Please feel free to contact any of us if we can be of more help.

Sincerely,

Fabia M. Battistuzzi

Fabia Battistuzzi

Ravi Khattree

Vijayan Sugumaran

Digitally signed by DH305BIO
DN: cn=DH305BIO
Date: 2023.03.15 12:41:23 -04'00'

Randy Westrick

**The Founding Members of the Center for Data Science and Big Data Analytics**

OAKLAND UNIVERSITY

School of Engineering and Computer Science

August 2, 2022

Professor Anna Maria Spagnuolo, Chair
Department of Mathematics and Statistics
Oakland University

Dear Anna:

It is my pleasure to write this letter of strong support for the proposed Bachelor of Science degree in Quantitative Data Science in the Department of Mathematics and Statistics (DMS). I have had the opportunity to review the program outline which builds upon the strong foundation that your department possesses in the area of quantitative analysis. The new program will offer significant benefits to students, to faculty researchers in many disciplines, and to the broader community that Oakland University serves.

Department of Computer Science and Engineering (CSE) has a long collaborative relationship with DMS for the benefit of our students and programs, and we look forward to continue lending our support to the new program in DMS. As we have discussed during our recent meetings that CSE is glad to open all its existing undergraduate-level courses and the new courses that CSE is developing for its proposed Bachelor of Science degree in Data Science to the students of the Quantitative Data Science program. In particular, we are pleased that the students of the Quantitative Data Science program in DMS will take multiple CSE courses including some of our new courses such as CSI 2810 (Introduction to Data Science in Python), CSI 3820 (Data Visualization), and CSI 4840 (Big Data Analysis with Cloud Computing). We are also delighted that you have agreed to open all your existing and new undergraduate-level courses to the students of the Data Science program in CSE, and the data science program committee in CSE will explore incorporating additional DMS courses to the depth area of the enclosed draft of the Data Science program.

CSE undergraduate curriculum committee is looking forward to regularly meet DMS undergraduate curriculum committee to coordinate different activities including advertisement of the programs, recruitment of the students, and improvement of the programs.

It is my belief that the new program in DMS will not only benefit your department through higher enrollment and graduation but it will also help increase enrollment in the courses offered by CSE. In summary, CSE offers unequivocal support to the Quantitative Data Science program in DMS. We look forward to collaborate with you in delivering this timely program.

Sincerely,

Lunjin Lu

Lunjin Lu, Ph.D.
Professor and Chair

Department of Computer Science and Engineering

Engineering Center | 115 Library Drive, Rochester, Michigan 48309-4479
(248) 370-2200 | Fax: (248) 370-4625

OAKLAND UNIVERSITY

Department of Philosophy

March 13, 2023

To Whom it May Concern:

I am writing to support the Department of Mathematics and Statistics' proposal for a new BS degree program in Quantitative Data Science.

The Quantitative Data Science degree program meets an important student need for preparation for data science careers. In the age of Big Data, our communities need a large number of professionals who can use digital information to illuminate and solve social and scientific problems. An education in data science opens pathways to rewarding careers in diverse industries, including health care, business, and government, as well as graduate study in various disciplines.

The Philosophy Department is looking forward to being a part of the Quantitative Data Science program. I note that the Sample Curriculum (Appendix B) suggests that students fulfill their Western Civilization General Education Exploratory requirement by taking Introduction to Ethics in Science and Engineering (PHL 1310) or Introduction to Ethics in Healthcare Professions (PHL 1320). Both courses address pressing ethics and justice issues for data scientists, including privacy, confidentiality, public safety, informed consent, social equity, and professional integrity.

The Quantitative Data Science program has the strong support of the Philosophy Department.

Sincerely,

Mark C. Navin
Professor and Chair of Philosophy
Oakland University
navin@oakland.edu

## Appendix I: UCM Assessment Plan

**Budgetary Recommendation:**
University Communications and Marketing would suggest a budget of $5,000 per year for the first 3 years, and $3,000 for the fourth year.

**Internal Marketing Focus:**
The B.S. in Applied Data Science would be best served with internal marketing, based on the students the program would likely draw. The program would allow students already interested in the Department of Mathematics and Statistics at Oakland University to specialize in a more tailored field. Overall, recommended marketing would include a range of print and digital options with the possibility of a paid media digital campaign to reach external audiences, pending a target audience review from Brogan & Partners, UCM's partnered agency, focused on paid media campaigns.

All print materials would all have a cost associated with them. A flier or brochure would be recommended to ensure departmental offices have materials on hand to share with students. If there were any events to promote the program, these materials would also apply. Additionally, depending on future events, a range of additional print materials could be added; for example, a formal event program may accompany a related awards ceremony, or a poster could draw interest from students on campus to an event. Below there are several examples of print materials used for similar marketing.

Print Materials:
Brochure
Event Program
Flier
Folder (and Insert)
Hanging Banner
Poster
Postcard

Digital materials will be free of charge in most cases, except publishing in a newspaper, photography or a paid digital media campaign. Recommended digital materials would include an Axis TV, Marquee, Oakland Post advertisement and social media graphics. These options would generate organic traction on campus. There are several examples listed below.

Digital Materials:
Axis TV
Emma Header
Google Form Header
Marquee Top and Bottom
Oakland Post/Newspaper Ad
Photography
Powerpoint Slide
Social Media Graphics (varies based on platform)

An informational webpage for the program would further elevate digital materials. The page would be linked to other materials with a QR code. An announcement article from our news team would be appropriate to promote its official launch, and the article could be promoted on social media. Both of these options would be free of charge.

**External Marketing:**
Possible external marketing avenues can be determined through Brogan & Partners with a minimum budget of $5,000 per year.

## B.S. Applied Data Science
## Media and Community Engagement Recommendations

The following is a recommendation for both paid and organic tactics to promote the new B.S. Applied Data Science program.

**Paid Media Recommendations:**

- **Paid search** – Paid search is an impactful tactic to promote the new program for those searching for data science majors. A campaign/Ad Group could be developed to include those searching for math majors and data science majors and information can be shared on a landing page for prospective students and parents to learn more.
- **Paid/boosted social** – Our team recommends announcing the new program across OU social channels organically. These posts could then be boosted to those that don't follow OU to increase reach. Or a paid promoted ad can run (separate from living on the OU page). The paid promoted ad could run in the current Undergraduate social campaign.

**On Campus Promotion:** Our agency agrees with the university's approach to provide information to current, internal math students. Other ideas to promote on campus: signage in buildings that house math classes (posters, screen announcements), emails to math majors, inclusion of the program information during admissions events.

**Community Engagement Recommendations:** Community and high school engagement are other organic ways for college admissions staff to provide information on the new B.S. Applied Data Science program to high schools and counselors.

**College and Career Centers, High School Counselors:** Most metro-Detroit high schools include a college and career center where college admissions teams can provide information on programs, application process and more. Brand materials like postcards with URL/interactive landing page could help explain this new program and why it could be a great fit for the inquiring student.

**Math-specific programs/potential partnerships:** There are also several STEM, or STEAM programs in the metro-Detroit area that the university could partner or potentially sponsor (if accepted by the program). Those include:

- **Mathcounts Competition Series/ National Math Club:** has 4 levels of competition—school, chapter, state and national. (years 6-8) https://www.mathcounts.org/programs/national-math-club
- **Michigan Mathematics League** (years 6-12) https://old.mathleague.com/reglist/REGMI.HTM

- **DAPCEP (Detroit Area Pre-College Engineering Program)** is an educational 501(c)3 organization providing high quality and standards-aligned science, technology, engineering, and mathematics (STEM) programming to youth in metropolitan Detroit. (years6-12) https://www.dapcep.org/who-we-are/

**Email correspondence with Emily Morris (Marketing Account Manager)**

from: Emily Morris <emorris@oakland.edu>
to: Dorin Drignei <drignei@oakland.edu>
cc: Anna Maria Spagnuolo <spagnuolo@oakland.edu>
date: Sep 13, 2023, 10:42 AM
subject: Re: Marketing and advertising a new B.S. program
mailed-by: oakland.edu
signed-by: oakland.edu
security: Standard encryption (TLS) Learn more

Hello Dorin,

I created a brief report with the help of my supervisor. This report prioritizes internal marketing, which would likely be our focus with this program, but we can provide some information about external avenues in a couple weeks. Unfortunately, that's just how long an external analysis takes.

Feel free to move forward with this though, and we can fill in external details later, unless you prefer to wait on those details.

Take care,

--
Emily R. Morris, she/her
Marketing Coordinator
University Communications and Marketing
Oakland University
(248) 370-3691
Professional Website
One attachment
- Scanned by Gmail

---

from: Emily Morris <emorris@oakland.edu>
to: Dorin Drignei <drignei@oakland.edu>
cc: Anna Maria Spagnuolo <spagnuolo@oakland.edu>
date: Sep 21, 2023, 3:46 PM
subject: Re: Marketing and advertising a new B.S. program
mailed-by: oakland.edu
signed-by: oakland.edu
security: Standard encryption (TLS) Learn more

Hello again!

Below I attached the external marketing recommendation report.

Take care,

One attachment
- Scanned by Gmail

ATTACHMENT B

# SBRC Proforma Template

## Applied Data Science, B.S.

FY2025

Most Likely Scenario

| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|
| Est. New Students to Program | | 6 | 6 | 7 | 7 | 7 |
| 1st Year Cohort Revenue | | $ 106,859 | $ 106,859 | $ 124,668 | $ 124,668 | $ 124,668 |
| 2nd Year Cohort Revenue | | $ - | $ 99,801 | $ 99,801 | $ 116,435 | $ 116,435 |
| 3rd Year Cohort Revenue | | $ - | $ - | $ 113,624 | $ 113,624 | $ 132,561 |
| 4th Year Cohort Revenue | | $ - | $ - | $ - | $ 108,266 | $ 108,266 |
| Gross Tuition Revenue | | $ 106,859 | $ 206,660 | $ 338,093 | $ 462,992 | $ 481,929 |
| Less: Avg Financial Aid (30%) | | $ (32,058) | $ (61,998) | $ (101,428) | $ (138,898) | $ (144,579) |
| **Net Tuition Revenue** | | **$ 74,801** | **$ 144,662** | **$ 236,665** | **$ 324,094** | **$ 337,350** |
| Expenses | | | | | | |
| Salaries | | | | | | |
| Faculty Salaries | 6101 | | $ 73,544 | $ 75,382 | $ 77,267 | $ 79,200 |
| Visiting Faculty | 6101 | | | | | |
| Administrative Professionals | 6201 | | | | | |
| Clerical Technical | 6211 | | | | | |
| Administrative IC | 6221 | | | | | |
| Faculty Inload/Replacement Costs | 6301 | | | | | |
| Faculty Overload | 6301 | | | | | |
| Part-Time Faculty | 6301 | | | $ 26,121 | $ 26,774 | $ 27,443 |
| Graduate Assistant | 6311 | $ - | $ - | $ - | $ - | $ - |
| Casual/Temp | 6401 | | | | | |
| Out of Classification | 6401 | | | | | |
| Student Labor | 6501 | | | | | |
| **Total Salary Expense** | | **$ -** | **$ 73,544** | **$ 101,503** | **$ 104,041** | **$ 106,643** |
| Fringe Benefits | 6701 | $ - | $ 31,477 | $ 34,353 | $ 35,212 | $ 36,093 |
| **Total Compensation** | | **$ -** | **$ 105,021** | **$ 135,856** | **$ 139,253** | **$ 142,736** |
| Operating Expenses | | | | | | |
| Supplies and Services | 7101 | | | | | |
| Graduate Tuition | 7101 | - | - | - | - | - |
| E-Learning Support | 7102 | | | | | |
| Travel | 7201 | | | | | |
| Equipment | 7501 | | | | | |
| Maintenance | 7110 | | | | | |
| Recruitment and advertising | 7101 | $ 5,000 | $ 5,000 | $ 5,000 | $ 3,000 | $ 3,000 |
| Library | 7401 | $ 9,774 | $ 10,751 | $ 11,827 | $ 13,009 | $ 14,310 |
| Faculty Startup Funding | | | $ 4,000 | $ 5,000 | | |
| Total Operating Expenses | | $ 14,774 | $ 19,751 | $ 21,827 | $ 16,009 | $ 17,310 |
| **Total Expenses** | | **$ 14,774** | **$ 124,772** | **$ 157,683** | **$ 155,262** | **$ 160,046** |
| University Overhead | | $ 18,000 | $ 18,000 | $ 21,000 | $ 21,000 | $ 21,000 |
| **Net Income (Loss)** | | **$ 42,027** | **$ 1,890** | **$ 57,982** | **$ 147,832** | **$ 156,304** |

[1]The tuition calculations do not account for any attrition of students.

# Applied Data Science, BS

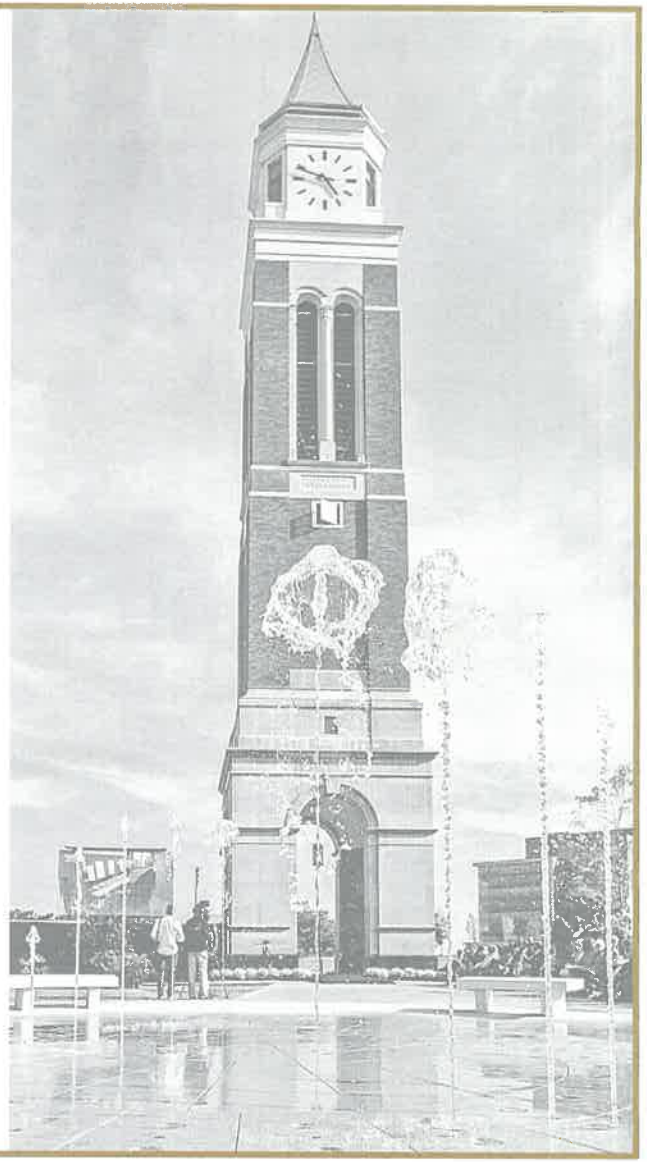
*Board of Trustees*

# Applied Data Science, B.S.

*Department of Mathematics and Statistics, CAS*

*presented by: Anna Maria Spagnuolo*

OAKLAND UNIVERSITY



# Summary of Need / Market Analysis

- Evidence of need and workforce demand
  - **202,900 job openings nationwide** in 2023 and **1600+** job openings currently in Michigan (ZipRecruiter)
  - Expected job growth from 2023-33 is 36%.
- Goals and objectives
  - Provide students with foundational knowledge to develop critical thinking skills, analytical abilities, and techniques for working on complex (interdisciplinary) problems where data science can drive solutions.

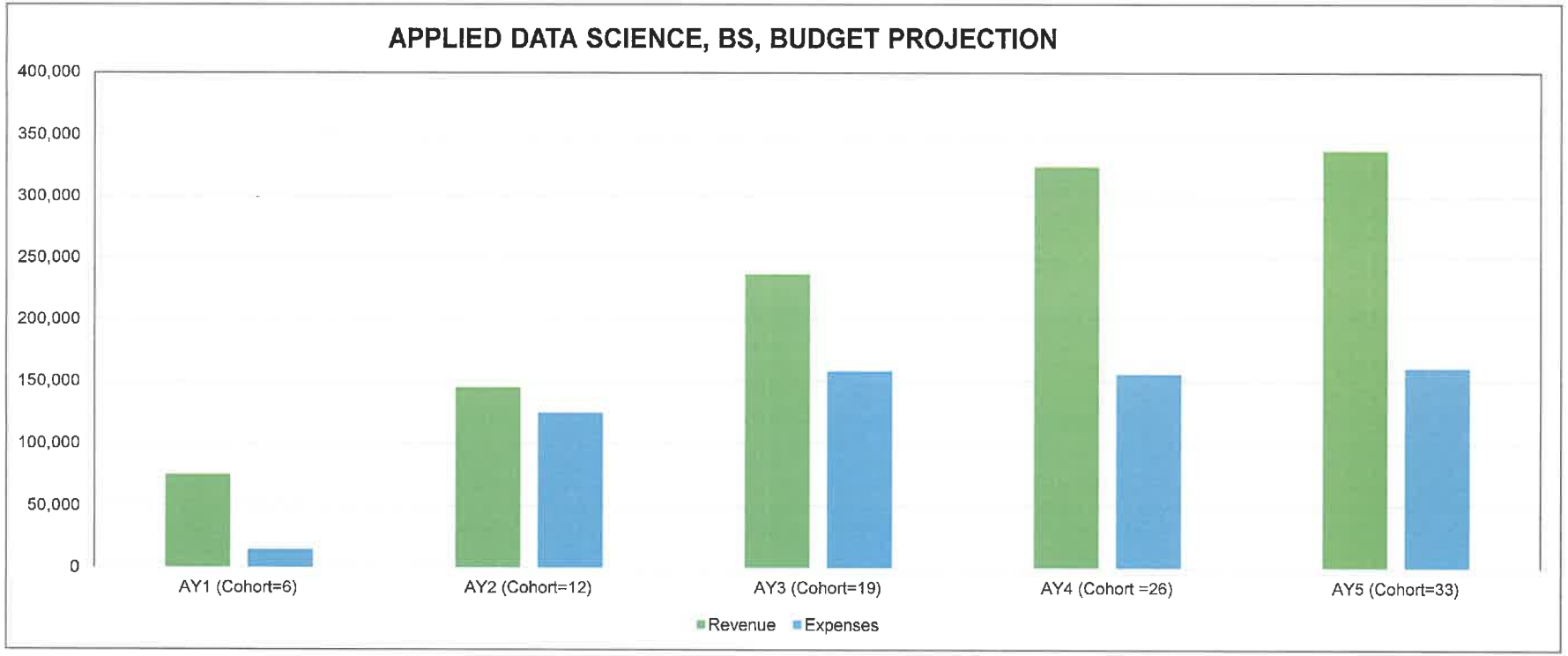
# Rationale

- Strong need. Comparable programs offered at Michigan public and regional or national institutions
  - University of Michigan, Ann Arbor: Data Science degrees offered in the LSA and the College of Engineering.
  - Michigan State University: Data Science degrees offered in the College of Natural Science and College of Engineering.
  - Central Michigan University: BS in Data Science
  - Eastern Michigan University: BS in Data Science and Analytics
  - Western Michigan University: BS in Data Science

# Description of Program

- Brief summary: 124 credits
  - Required Courses (52 credits): Foundational courses (20 credits) , Program core courses (20 credits), and Additional (12 credits)
  - Program Specific Electives (30 credits): Applied quantitative methods (16 credits) and one or a combination of two application areas from geoinformatics, healthcare, computer science, business, engineering (14 credits)
  - General Education Courses (42 credits)

# Proforma


APPLIED DATA SCIENCE, BS, BUDGET PROJECTION
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
AY1 (Cohort=6)
AY2 (Cohort=12)
AY3 (Cohort=19)
AY4 (Cohort =26)
AY5 (Cohort=33)
Revenue
Expenses

# ROI - Return on Investment

- **Attract new students locally** by providing a necessary and important program at Oakland University in a growing, high-demand specialty sought out by local and national employers.
- **Support the state of MI** with graduates that have in-demand knowledge and expertise in data science.
- Create and strengthen industrial collaborations by cooperating with industry on interdisciplinary jobs for our students. Use the model and resources offered by Purdue University's Data Mine program to develop new industrial collaborations with interdisciplinary projects.
- **Recruitment, DEI, retention, and graduation rates** will continue to be a major focus of all DMS programs (including this one).