

Wichita State University

Master of Science in Mathematical Foundations of Data Analysis

Program Approval

I. General Information

A. Institution Wichita State University

B. Program Identification

Degree Level:	Master's Degree
Program Title:	The Mathematical Foundations of Data Analysis
Degree to be Offered:	Master of Sciences
Responsible Department or Unit:	Mathematics, Statistics, & Physics
CIP Code:	30.7001
Modality:	Face-to-Face
Proposed Implementation Date:	Spring 2021

Total Number of Semester Credit Hours for the Degree: 30

II. Clinical Sites: Does this program require the use of Clinical Sites? No

III. Justification

Big data has become the revolution of Information Technology which is transforming industries around the world. Along with global demand for employees with expertise in handling “big data”, there has been a growing need for local Wichita companies as well. Wichita State University (WSU) is strongly dedicated to supporting this data revolution by making teaching and research of data science and analytics an institutional priority. As such, at WSU, three distinct albeit aligned interdisciplinary data science master programs are being proposed in parallel. In support, WSU has recently invested in a High-Performance Computing (HPC) infrastructure and personnel.

The MS in Mathematical Foundations of Data Analysis is one of the three distinct albeit aligned programs being proposed. This interdisciplinary program focuses on the mathematical foundation behind data analysis methods. This program is designed for individuals who wish to pursue a mathematical focus within data science at the graduate level.

The primary goal of this program is the fundamental understanding of the mathematics behind data science algorithms and methods. This program will produce professionals who can communicate the principles of data science statistics and analytics and assist with the design and implementation of data systems. However, this will not be a traditional master's program in a math/statistics department that only produces theoretical professionals. This interdisciplinary program will require students to study data science perspectives and applications in business and engineering. Graduates will have not only in-depth mathematic and statistical understanding of data analysis methods, but also the knowledge of how to apply these methods to different areas within this ever-growing field. We believe this interdisciplinary approach is crucial in creating well-rounded Data Analysis professionals.

The proposed programs will advance WSU's mission as an economic driver for Kansas and the greater public good by equipping students with the analytical tools they need to thrive in the big data era.

These programs will also meet specific goals in WSU's Strategic Plan:

- Every student in our proposed programs will gain applied learning experience by working on projects and research within the industry and the community. This will meet the applied learning goal.
- Each student will be required to take core perspective courses from the Business and Engineering School, and they will have the opportunity to take electives outside the Math Department. This will meet the interdisciplinary curricula goal.
- The proposed programs will offer students the greatest number of choices when selecting a career in data science, from theoretical research to technical applications in different fields. This will meet the goal of quality educational opportunities.
- The proposed programs will create opportunities for students to discover new models and creative analytics solutions, any of which may become the next big idea in data science. This will meet the goal of discovery, creation, and transfer of new knowledge.

IV. Program Demand:

The proposed program, once approved, would be the first interdisciplinary data science master’s program in Kansas with an emphasis on a mathematical foundation. KSU offers an interdisciplinary MS program in data science but only through the Business School with an emphasis on business applications. KSU’s Statistics Department also offers a data science and analytics track for its MS program, but it is not an interdisciplinary program. The same is true for KU’s MS in statistics with an emphasis in analytics or data science. At WSU, we already offer a Graduate Certificate in the Mathematical Foundations of Data Analytics in the math department, but it is only a one-year program and is not interdisciplinary in nature.

Thus, the proposed interdisciplinary data science program would be unique in Kansas, attracting many students and leading to enrollment growth for WSU.

The innovation campus at WSU would provide a unique locational advantage for this interdisciplinary master’s program. Students in the proposed program would be required to take a data analysis capstone course, which is an individual, directed study in an area of data analysis that is appropriate for each student’s career objectives. On-campus research and applied learning partners (Airbus, Dassault Systemes, and Spirit AeroSystems) would undoubtedly provide many research internship opportunities for students as well.

A. Survey of Student Interest

Number of surveys administered:	<u> 30 </u>
Number of completed surveys returned:	<u> 30 </u>
Percentage of students interested in program: ...	<u>100%</u>

Results of a survey from 30 current undergraduate and graduate students in the math department provides descriptive information regarding the need of an interdisciplinary master’s degree program in Mathematical Foundations of Data Analysis. Twenty percent of the respondents are undergraduate students, 33% of the respondents are the current master students, and the rest are PhD students. All the respondents are interested in choosing this new interdisciplinary master’s degree program. Seventy-three percent of respondents would choose this interdisciplinary data science program if they were given the opportunity to select the program again and the rest of the respondents answered that they may consider choosing this program. Eighty-three percent of the respondents believed that this new program would benefit the students of Wichita State and the rest thought it maybe benefit to the Wichita State. Ninety-three percent of the respondents would recommend this interdisciplinary program to their friends at Wichita State. Some of the respondents even wanted to consider choosing this master’s program as the second program to study.

B. Market Analysis

A quick look at most companies big and small suggests the kind of jobs that are going to be in demand for quite some time and most of the ones that deal with mathematics have to do with analyzing data. Data Scientist has been named the best job in America for three years running by Forbes Online, with a median base salary of \$110,000 and 4,524 job openings.

To keep up with the explosion of big data across all industries, colleges and universities have debuted many data analytics programs during the past few years, mostly at the graduate level. The number of master programs in data science has been growing rapidly. Currently, there are more than 250 programs offering master's degrees in analytics or data science at universities based in the U.S., which now produce an estimated 8,000 to 10,000 graduates per year.

The reality is that the demand for the data science professionals is so strong that many companies have begun to hire students from the regular statistics program as data analysis professionals. In 2019 Harry Collins from our MS program was hired as a data analyst II and a head of the department in Washington, DC. Currently, one of our master students is working for the police department as a data analyst. On one hand, this fact has shown the strong demand for the data science professionals, on the other hand, it tells us: If our regular master's program can already produce data science professionals liked by the industry, we have no reason not to be excited about the future graduates from this new interdisciplinary data analysis program.

V. Projected Enrollment for the Initial Three Years of the Program

Year	Headcount Per Year		Sem Credit Hrs Per Year	
	Full- Time	Part- Time	Full- Time	Part- Time
Implementation	10	0	180	0
Year 2	15	5	390	45
Year 3	15	5	450	90

VI. Employment

The Bureau of Labor Statistics (BLS) clearly demonstrates the growing need of students with analytics backgrounds in business, computer science, and mathematics. The BLS's publication "Beyond the Numbers" from June 2018 projects growth of operational research (OR) analysts and statisticians as 27.4% and 33.8% respectively from 2016 to 2026. The BLS also shows Wichita, KS is one of the metropolitan areas with high demand for such jobs. A report by IBM predicts demand for data professionals will soar to 28% in 2020 which translates to increase by 364,000 openings to 2,720,000.

In addition to data from BLS and other published reports, the Business School conducted a study to assess the demand for graduates with Analytics background in Wichita, KS. The first study was a roundtable of executives from local businesses. A total of 12 individuals representing 8 companies participated (Spirit, Textron, Airbus, Koch, Cargill, Ametek, Johns Manville, Thrive Restaurant Group). We had them fill a survey to start with, then introduced them to the interdisciplinary master's program followed by a discussion. The survey results clearly showed that 91% are in need of hiring full time students and 82% in need of hiring interns. There was consensus about the need to introduce interdisciplinary courses from computer science and mathematics. When asked which department in business they would need to hire analytics expertise in, the highest was operations at 91% and when asked what tools are required of graduates, the highest was Excel.

VII. Admission and Curriculum

A. Admission Criteria

Students will be admitted to full graduate standing in the Mathematical Foundations of Data Analysis program if they have the equivalent of an undergraduate major in mathematics, have a grade point average of at least 3.000 in mathematics and computer sciences courses and meet Graduate School admission requirements. Students may be admitted on a conditional basis if they do not have all the pre-requisite coursework.

B. Curriculum

30 hours are required for graduation, and students must earn a 3.0 overall GPA, a 3.0 GPA in courses required in the program.

Year 1: Fall

SCH = Semester Credit Hours

Course #	Course Name	SCH....
Math 746	Data Perspectives in Mathematics	3
CS 697AK	Data Perspectives in Engineering	3
DS 775	Data Perspectives in Business	3

Year 1: Spring

Course #	Course Name	SCH....
Math 553	Mathematical Modeling	3
CS 697AB	Machine Learning	3
	Statistical Electives	3

Year 2: Fall

Course #	Course Name	SCH....
	Statistical Electives	3
	Computing Elective	3
	Other Elective	3

Year 2: Spring

Course #	Course Name	SCH....
Math 802	Data Analytics Capstone	3

Total Number of Semester Credit Hours [30]

Statistical Electives Courses

Stat 763	Applied Regression Analysis	3
Stat 764	Analysis of Variance	3
Stat 776	Applied Statistical Methods II	3

Computing Elective Courses

Stat 774	Statistical Computing	3
Math 751	Numerical Linear Algebra	3
CS 560	Design and Analysis of Algorithms	3

Other Elective Courses

CS 665	Introduction to Database	3
--------	--------------------------	---

MIS 600	Database Management System	3
IME 780AN	Big Data Analytics in Engineering	3
DS 875	Advanced Business Analytics	3

VIII. Core Faculty

Faculty Name	Rank	Highest Degree	Tenure Track Y/N	Academic Area of Specialization	FTE to Proposed Program
Thomas Delillo	Professor	PhD in Mathematics	Y	Applied/Computational Math	0.3
Adam Jaeger	Assistant Professor	PhD in Statistics	Y	Statistics and Data Science	0.2
Tianshi Lu	Associate Professor	PhD in Mathematics	Y	Applied/Computational Math	0.1
Xiaomi Hu	Professor	PhD in Statistics	Y	Statistics	0.1
Chunsheng Ma	Professor	PhD in Statistics	Y	Statistics	0.1
Jason Clemens	Post Doc	PhD in Mathematics	N	Data Science	0.1
Ziqi Sun	Professor	PhD in Mathematics	Y	PDE and Inverse Problems	0.1

IX. Expenditure and Funding Sources

A. EXPENDITURES	First FY	Second FY	Third FY
Personnel—Reassigned or Existing Positions			
Faculty	\$79,692	\$82,083	\$84,546
Administrators (<i>other than instruction time</i>)	\$6,562	\$6,759	\$6,961
Graduate Assistants	--	--	--
Support Staff for Administration (<i>e.g., secretarial</i>)	\$6,290	\$6,479	\$6,673
Fringe Benefits (<i>total for all groups</i>)	\$27,763	\$ 28,596	\$ 29,454
Other Personnel Costs	--	--	--
Total Personnel Costs—Reassigned or Existing	\$120,307	\$123,917	\$127,634
Personnel—New Positions			
Faculty	--	\$80,000	\$82,400
Administrators (<i>other than instruction time</i>)	--	--	--
Graduate Assistants	--	\$15,038	\$30,996
Support Staff for Administration (<i>e.g., sec</i>)	--	--	--
Fringe Benefits (<i>total for all groups</i>)	--	\$24,145	\$25,019
Other Personnel Costs	--	--	--
Total Personnel Costs—New Positions	\$0	\$119,183	\$ 138,415
Start-Up Costs—One-Time Expenses			
Library/learning resources	--	--	--
Equipment/Technology	--	\$10,000	\$10,000
Physical Facilities: Construction or Renovation	--	--	--

A. EXPENDITURES	First FY	Second FY	Third FY
Other	--	--	--
Total Start-Up Costs—One-Time Expenses	\$0	\$10,000	\$10,000
Operating Costs—Recurring Expenses			
Supplies/Expenses	\$1,000	\$2,000	\$3,000
Library/Learning Resources	--	--	--
Equipment/Technology	--	\$2,000	\$4,000
Travel	--	--	--
Other	--	--	--
Total Operating Costs—Recurring Expenses	\$1,000	\$4,000	\$7,000
GRAND TOTAL COSTS	\$ 121,307	\$257,100	\$283,049

B. FUNDING SOURCES (projected)	Current	First FY (New)	Second FY (New)	Third FY (New)
Tuition/State Funds		\$95,792	\$221,409	\$267,199
Student Fees		\$13,584	\$36,223	\$46,410
Other Sources		--	--	--
GRAND TOTAL FUNDING		\$109,376	\$257,632	\$313,609

C. Projected Surplus/Deficit (+/-) (Grand Total Funding <i>minus</i> Grand Total Costs)		(\$11,931)	\$532	\$30,560
---	--	-------------------	--------------	-----------------

X. Expenditures and Funding Sources Explanations

A. Expenditures

Personnel—Reassigned or Existing Positions

- **For the first year:**
 - Faculty: Each core faculty's salary is multiplied by the FTE and then take the sum.
 - Administrator: 5% of the Chair's salary.
 - Support staff for Administration: 20% of the current graduate secretary's salary.
 - Fringe is calculated based on the current WSU fringe rates.
- **For the second year:**
 - 3% of raise for all the costs.
- **For the third year:**
 - 3% of raise for all the costs.

Personnel—New Positions

- **For the first year:**
 - The estimated 10 student enrollment can be managed by existing resources as the existing MS program may undergoes a potential shrinking.
- **For the second year:**
 - The estimated 25 student enrollment requires an additional faculty member. The cost is 100% of the new faculty's salary.
 - The estimated 25 student enrollment requires an additional GTA.

- **For the third year:**
 - The estimated 30 student enrollment require 2 more GTAs.
 - All costs are increased by an estimated 3% of raise

Start-Up Costs—One-Time Expenses

- **For the first year:**
 - Current resources are sufficient.
- **For the second year:**
 - Due to the enrollment growth, we need 10 computers for a lab (at \$2k each).
- **For the third year:**
 - Due to the enrollment growth, we need additional 10 computers for a lab (at \$2k each).

Operating Costs—Recurring Expenses

- **For the first year:**
 - Supplies (copying, office supplies) are estimated at \$1k.
- **For the second year:**
 - Supplies are estimated at \$2k.
 - 10 computers amortized over 5 years result in \$4k.
- **For the third year:**
 - Supplies are estimated at \$3k.
 - 20 computers amortized over 5 years result in \$8k

B. Revenue: Funding Sources

Revenue is calculated based on the enrollment table from Section V:

- \$307.98 of graduate tuition is calculated for half the full-time student credit hours.
- \$756.38 of graduate tuition (out-of-state) is calculated for the other half of full-time student credit hours since we are expecting a large portion of the D.S. students to be international.
- All part-time student credit hours are calculated using the \$307.98 tuition.
- Student fee:
 - 7.00 or more credit hours \$679.18/fall or spring semester
 - 4.00-6.75 credit hours \$452.78/fall or spring semester

XI. References

- Columbus, Louis. (2018, Jan. 29). Data scientist is the best job in America according to Glassdoor's 2018 ranking. *Forbes Online*. <https://www.forbes.com/sites/louiscolumnbus/2018/01/29/data-scientist-is-the-best-job-in-america-according-glassdoors-2018-rankings/#296709025535>.
- U.S. Department of Labor. (2018). Occupational Outlook Handbook – Business and Financial Occupations. U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/business-and-financial/home.htm>.