



Office of the Provost and
Senior Vice President for Academic Affairs

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TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacqueline E. Huntoon

DATE: March 4, 2022

SUBJECT: Senate Proposal 21-22

Attached is Senate proposal 21-22, "Proposal for a BS in Business Analytics," and a memo stating the Senate passed this proposal at their March 2, 2022 meeting. I have reviewed this memo and recommend approving this proposal.

I concur X do not concur with the provost's recommendation as stated in this memo.

Richard Koubek, President

3/10/22

Date



Michigan Tech

University Senate

DATE: March 3, 2022
TO: Richard Koubek, President
FROM: Sam Sweitz
University Senate President
SUBJECT: Proposal 21-22
COPIES: Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on March 2, 2022, the University Senate approved Proposal 21-22, "Proposal for a BS in Business Analytics". Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University

Proposal 21-22

(Voting Units: Academic)

Proposal for a BS in Business Analytics

1. Date of Proposal:

10/27/2021

2. Proposer(s) Contact Information:

- Jiguang Sun, Professor of Mathematics, Department of Mathematical Sciences, jiguangs@mtu.edu
- Yeonwoo Rho, Associate Professor of Statistics, Department of Mathematical Sciences, yrho@mtu.edu
- Jeffrey Wall, Associate Professor of Management Information Systems, College of Business, jdwall@mtu.edu
- Mari W. Buche, Associate Dean and Professor, Management Information Systems, College of Business, mwbuche@mtu.edu
- Emanuel Xavier-Oliveira, Associate Professor of Economics, College of Business, emolivei@mtu.edu
- Roger Woods, Senior Lecturer, College of Business, rhwwoods@mtu.edu
- Fan Dai, Assistant Professor of Statistics, Department of Mathematical Sciences, fand@mtu.edu
- Jason Gregersen, Senior Lecturer, Department of Mathematical Sciences, jdgreger@mtu.edu

3. Interdisciplinary Programs:

Please find attachments from the College of Business: [2021-10-15 Faculty Meeting Minutes Excerpt.pdf](#). The proposal is coming from the Math Department, which approves the new degree; the attachment gives the minutes of the College of Business Faculty meeting at which Business approved the major as well. Therefore both Departments approve the new degree.

4. General Description:

The Bachelor's of Science in Business Analytics is a joint proposal between the Department of Mathematical Sciences and the College of Business. The degree will be housed in the Department of Mathematical Sciences with responsibilities for program governance and maintenance shared with the College of Business. The 120 hour degree program will provide students with mathematical and business knowledge necessary to meet the current and emerging analytics needs of organizations. Students will learn business domain knowledge and mathematical and statistical skills to provide support for data-driven decision making.

Catalog Description:

The B.S. in Business Analytics provides students with business domain knowledge and mathematical and statistical knowledge to prepare them for careers in analytics functions within organizations. Students will learn to use mathematics and statistics to answer business questions and facilitate data-driven decision making within organizations.

Learning Goals:

Upon completion of the Business Analytics program, students will be able to:

1. Construct analytical arguments to solve business problems and evaluate the validity of those arguments
2. Effectively translate between business ideas and analytical models
3. Model and analyze business data to inform data-driven decision making
4. Apply appropriate analytical techniques to data in order to answer business questions

5. Title of Program:

Bachelor's of Science in Business Analytics

6. Rationale:

With advances in technology, organizations possess the means to make effective, data-driven decisions. For this technology to be utilized to its fullest potential, industry has a need for employees who possess an actionable skill set that allows them to utilize statistics and advanced information technologies to gather and analyze relevant data to evaluate business questions and make better decisions. The BS in Business Analytics answers these industry demands by providing students with a deep understanding of statistics and mathematics and a strong knowledge of the way businesses use information technology and make decisions. By leveraging the curriculum in the Department of Mathematical Sciences and College of Business, the degree will prepare students better than other business analytics degrees that focus on one area to the exclusion of the other. The synergies incorporated in the development of this interdisciplinary degree deliberately encourage students to expand their knowledge in unique combinations and to carefully tailor their study to their career goals.

A number of business analytics programs in Michigan exist only at the graduate level or are computer information systems degrees converted into business analytics undergraduate degree programs. The unique combination of mathematics and business courses in this proposal offers a distinct business analytics program for students in Michigan and the Midwest who wish to pursue careers in business analytics.

The Department of Mathematical Sciences already possesses a Business Analytics concentration. However, the program lacks the visibility and support it needs to grow. Enrollment in the concentration has been low. With the combined curricular and marketing support of the Department of Mathematical Sciences and College of Business, a new BS in Business Analytics stands a greater chance of growing.

7. Related Programs:

A number of graduate-level business analytics programs exist within the state of Michigan and around the country (e.g., <https://michiganross.umich.edu/graduate/master-of-business-analytics>). Far fewer business analytics programs exist at the undergraduate level. The following related undergraduate programs exist in Michigan and in the US:

- Western Michigan University - Department of Business Information Systems - BS Business Analytics
<https://wmich.edu/infosystems/academics/business-analytics-major>
- Oakland University - School of Business Administration - BS Management Information Systems with Specialization in Business Analytics
<https://oakland.edu/business/undergraduate-majors-minors/business-analytics/>
- Northern Michigan University - College of Business - BS Business Analytics and Information Systems
<https://nmu.edu/business/business-analytics-and-information-systems>
- Eastern Michigan University - Department of Mathematics and Statistics - BS Data Science and Analytics
<https://www.emich.edu/programs/data-science-analytics.php>
- University of Wisconsin Whitewater - College of Business and Economics - BS Business Analytics
<http://uww-public.courseleaf.com/undergraduate/business-economics/information-technology-supply-chain-management/business-analytics-bba/>
- University of Wisconsin Green Bay - School of Business - BS Business Analytics
<http://catalog.uwgb.edu/undergraduate/programs/business-administration/major/#businessanalyticstext>
- Marquette University - College of Business Administration - BS Business Analytics
<https://www.marquette.edu/business/undergraduate/majors/business-analytics.php>
- Purdue University - School of Management - BS Business Analytics & Information Management
https://catalog.purdue.edu/preview_program.php?catoid=14&poid=19480&_ga=2.128278020.967306509.1631929223-531491446.1631929223
- George Washington University - Decision Sciences Department/School of Business - BS Business Analytics
<https://business.gwu.edu/academics/programs/undergraduate/bs-business-analytics>
- Wilmington University - College of Business - BS Business Analytics
<https://www.wilmu.edu/business/business-analytics-curriculum.aspx>
- Saint Francis University - School of Business - BS Business Analytics
https://catalog.francis.edu/preview_program.php?catoid=13&poid=5441
- Grand Canyon University - College of Business - BS Business Analytics and BS in Applied Business Analytics
<https://www.gcu.edu/degree-programs/bachelor-science-business-analytics> <https://www.gcu.edu/degree-programs/bachelor-science-applied-business-analytics>
- Concordia University - Business School - Bachelor of Arts in Business Analytics and Change Management
<https://www.cuw.edu/academics/programs/business-analytics-change-management-bachelors/index.html>

- University of Pennsylvania - joint between business and math - Concentration in Business Analytics
<https://undergrad-inside.wharton.upenn.edu/buan/>
<https://statistics.wharton.upenn.edu/programs/undergraduate/business-analytics-joint-concentration/>

The distinct combination of mathematics and business courses in this proposal is unlike other undergraduate programs at Michigan Technological University. The following related programs exist within Michigan Technological University, but are focused primarily in either business or mathematics:

- Statistics - Department of Mathematical Sciences
<https://www.mtu.edu/math/undergraduate/statistics/>
- Management Information Systems - College of Business
<https://www.mtu.edu/business/undergraduate/mis/>
- Accounting with a Data Analytics Concentration - College of Business
<https://www.mtu.edu/business/undergraduate/accounting/data-analytics-concentration/>

8. Projected Enrollment:

We project an enrollment of 10 students in the first year, followed by 10 new students per year thereafter. A description of faculty lines needed to support this is described in Section 14.

9. Curriculum Design:

The BS Business Analytics degree will consist of a set of core courses, a set of technical electives, a set of business domain electives, and business analytics focused electives in mathematics and business.

Core required courses (43-46 credits) – complete the courses from this list.

Course Number	Course Title	Credit(s)	Pre-Requisites
MA 1160 or MA 1161	Calculus with Technology I Calculus plus with Technology I	4 5	MA 1032 or MA 1031 or MA 1120 or Placement
MA 2160	Calculus with Technology II	4	MA1160 or MA1161
MA 2320 or MA 2321 or MA 2330	Intro to Linear Algebra Elementary Linear Algebra Introduction to Linear Algebra	2 2 3	MA1160 or MA1161
MA 2710 or MA 2720	Intro to Statistical Analysis Statistical Methods	3 4	MA 1160 or MA 1161 or MA 1135 or MA 1121

or MA 3710	Engineering Statistics	3	MA 1020 or MA 1030 or MA 1120 or MA 1032 or MA 1031 or Placement MA 2160 or MA 3160
MA 3720	Probability	3	MA1160 or MA1161
MA 4710	Regression Analysis	3	MA2710 or MA2720 or MA3710 or MA3715 or MA5701
MA 4790	Predictive Modeling	3	MA 3740 or MA 4710 or MA 4720 or MA 4780
BUS 2300	Quantitative Problem Solving	3	BUS 2100 or MA 2710 or MA 2720 or MA 3710 or MA 3720
BUS 3000	Intro to Business Analytics	3	BUS2300
EC 2001	Principles of Economics	3	MA 1020 or MA 1031 or MA 1032 or MA 1120 or MA 1135(C) or MA 1160(C) or MA 1161(C) or MA 1121(C)
EC 4200	Econometrics	3	(EC 2001 or EC 3002 or EC 3003) and (BUS 2100 or MA 2710 or MA 2720 or MA 3710) and (MA 1135 or MA 1160 or MA 1161 or MA 1121)
MIS 2100	Intro to Business Programming	3	None
MIS 3100	Business Database Management	3	MIS 2000(C) or MIS 2100(C)
MIS 4100	Information Systems Projects	3	(MIS 2100 and MIS 3100 and MIS 3200) or (MIS 2100 and MIS 3100 and MA 3720)

Technical elective courses (3 credits) – complete one course from this list.

Course Number	Course Title	Credit(s)	Pre-Requisites
CS 4821	Data Mining	3	(CS 3425 or MIS 3100) and (MA 2330 or MA 2320 or MA 2321) and (MA 2710 or MA 2720 or MA 3710)
MA 3740	Statistical Programming and Analysis	3	MA2710 or MA2720 or MA3710 or MA3715

Focused electives in Mathematics and Business (31-34 credits)

Students must take 31-34 credits from the two focus elective areas below. At least 6 of the focus elective credits must be taken from Mathematics and at least 15 of the focus elective credits must be taken from Business with a minimum of 9 from the Language of Business sub-list. Students may choose the focus elective area for the remaining 10-13 credits.

Mathematics focus elective courses (at least 6 credits) – complete at least 6 credits from the list below.

Course Number	Course Title	Credit(s)	Pre-Requisites
MA 2600	Scientific Computing	3	MA2160 and (MA2320 or MA2321 or MA2330)
MA 3160	Multivariable Calculus with Technology	4	MA2160
MA 3520 or MA 3521 or MA 3530 or MA 3560	Elementary Differential Equations Elementary Differential Equations Introduction to Differential Equations Mathematical Modeling with Differential Equations	2 2 3 3	MA2160 and (MA2320 or MA2321 or MA2330)
MA 3750	Intro to SAS Programming	1	MA 2710 or MA 2720 or MA 3710 or MA 3715

MA4330	Linear Algebra	3	(MA2320 or MA2321 or MA2330) and MA3160
MA 4720	Design and Analysis of Experiments	3	MA2710 or MA2720 or MA3710 or MA3715 or MA5701
MA 4730	Nonparametric Statistics	3	MA2710 or MA2720 or MA3710 or MA3715
MA 4760	Mathematical Statistics I	3	MA 3720 or EE 3180
MA 4770	Mathematical Statistics II	3	MA 4760
MA 4780	Time Series Analysis and Forecasting	3	(MA 2710 or MA 2720 or MA 3710 or MA 3715) and (MA 3720 or EE 3180)
MA 3810	Introduction to Actuarial Mathematics	3	MA3160
MA 4810	Financial Markets and Actuarial Math	3	MA 3720 and MA 3810
MA 4820	Loss Distributions and Actuarial Math	3	MA 3720 and MA 3810

Business focus elective courses (at least 15 credits) – complete at least 15 credits from the list below, including at least 9 credits from the “Language of Business” sub-list, which is marked with an asterisk in the table: (ACC 2000, EC3400 or FIN 3000 (counted as equivalent in the College of Business), MKT 3000, OSM 3000).

Course Number		Course Title	Credit(s)	Pre-Requisites
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ACC 2000	*	Accounting Principles I	3	None
ACC 4000		Accounting Data Analytics	3	ACC 2000
EC 3002		Microeconomic Theory	3	EC 2001 and (MA 1135 or MA 1160 or MA 1161 or MA 1121) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
EC 3003		Macroeconomic Theory	3	EC 2001 and (MA 1135 or MA 1160 or MA 1121 or MA 1161) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
EC 4050		Game Theory	3	UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
EC 4100		Mathematical Economics	3	(EC 3002 or EC 3003) and (MA 1160 or MA 1161 or MA 1121 or MA 1135)
FIN 3000	*	Principles of Finance	3	ACC 2000 and (MA 1020 or MA 1030 or MA 1031 or MA 1032 or MA 1120 or MA 1160 or MA 1161
or				or
EC3400	*	Economic Decision Analysis	3	UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
FIN 4000		Investment Analysis	3	EC 3400 or FIN 3000 and (MA 2710 or MA 2720 or MA 3710)
FIN 4200		Derivatives and Financial Engineering	3	EC 3400 or FIN 3000 and (MA 2710 or MA 2720 or MA 3710)
MIS 3200		Systems Analysis and Design	3	MIS 2000(C)

MIS 4000		Emerging Technologies	3	MIS 3100 and MIS 3200
MIS 4400		Business Intelligence and Analytics	3	MIS 2000 and (MIS 3100 or CS 3425)
MGT 3000		Organizational Behavior	3	None
MGT 4700		Human Resource Management	3	MGT 3000
MKT 3000	*	Principles of Marketing	3	None
MKT 3200		Consumer Behavior	3	MKT 3000
MKT 3600		Marketing Data Analytics	3	(MA 2710 or MA 2720 or MA 3710 or BUS 2100) and MKT 3000
OSM 3000	*	Operation & Supply Chain Management	3	(MA 1135 or MA 1160 or MA 1161 or MA 1121) and (MA 2710 or MA 2720 or MA 3710 or MA 3720 or EET 2010 or BUS 2100 or CEE 3710)
OSM 3600		Procurement and Supply Chain	3	None
OSM 4650		Six Sigma Fundamentals	3	MA 2710 or MA 2720 or MA 3710 or MA 3720 or BUS 2100 or CE 3710 or CEE 3710
OSM 4700		Logistics and Transportation Management	3	(MA 2710 or MA 2720 or MA 3710 or CE 3710 or CEE 3710) and (MA 1135 or MA 1160 or MA 1161 or MA 1121)

General Education with Lab Science Requirements (31 credits)

Free Elective Credits:

Choose enough free electives to total 120 credit hours. (The minimum amount of additional credit hours required after satisfying all other requirements would be 6.)

Total credit hours: 120 hours

10. New Course Descriptions:

The degree program will not require any new courses.

11. Model Schedule:

The following is a sample schedule for the program, outlining a sequence for the required, elective, and general education courses. The program can be completed within 4 years.

Year 1

Fall Sample Courses (~15 credits)

MA 1160 or MA 1161 (4-5 credits) MIS 2100 (3 credits) General education or elective courses (6-7 credits)

Spring Sample Courses (~15 credits)

MA 2160 (4 credits) MA 2320 or MA 2321 or MA 2330 (2-3 credits) EC 2001 (3 credits) MIS 3100 (3 credits) General education or elective course (2-3 credits)

Year 2

Fall Sample Courses (~15 credits)

MA 2710 or MA 2720 or MA 3710 (3-4 credits) BUS 2300 (3 credits) MA 3720 (3 credits) EC4200 (3 credits) General education or elective course (2-3 credits)

Spring Sample Courses (~15 credits)

BUS 3000 (3 credits) General education or elective courses (12 credits)

Year 3

Fall Sample Courses (~15 credits)

MA 4710 (3 credits) General education or elective courses (12 credits)

Spring Sample Courses (~15 credits)

MA 4790 (3 credits) General education or elective courses (12 credits)

Year 4

Fall Sample Courses (~15 credits)

General education or elective courses (15 credits)

Spring Sample Courses (~15 credits)

MIS 4100 (3 credits) General education or elective courses (12 credits)

12. Library and Other Learning Resources:

The program requires no additional resources beyond those currently available to the Department of Mathematical Sciences and the College of Business.

13. Description of Available/Needed Equipment:

The program requires no additional resources beyond those currently available to the Department of Mathematical Sciences and the College of Business.

14. Program Costs:

Many of the business and mathematics courses in the proposed curriculum can handle a moderate increase in enrollment. However, the following courses are new, or at/near full capacity in the Department of Mathematics and the College of Business.

- MA2720 (required for Business Analytics)
- MA3720 (required for Business Analytics)
- MA4710 (required for Business Analytics)
- MA4790/5790 (required for Business Analytics)
- MA4720 (elective for Business Analytics)
- BUS 2300 (required for Business Analytics)

- BUS 3000 (required for Business Analytics)

With the increasing need for cutting edge skills at the intersection of these domains, this program will likely require additional resources to manage expected enrollment growth. In particular, the Math department plans to create a dedicated section (or a new course) of MA4790/5790 Predictive Modeling for the business audience. This new section/course of Predictive Modeling would be able to add more cutting-edge methods to the mathematical-business foundation students built in BUS 3000 and EC4200, providing a stronger tie between the two programs. To effectively prepare for this challenge, the following instructional resources are anticipated:

- One lecturer or professor of practice with a PhD, or a tenure track professor in Statistics.
- One lecturer or professor of practice in Business Analytics, Operations Management, Econometrics, or Management Information Systems

The only new cost anticipated is in the marketing of the major, which should total no more than \$10K/year.

The following revenue from enrollment is conservatively projected if the program is approved to begin in Fall 2023. If approval is successful for Fall 2022, all years can be shifted down one.

Revenue	FY23	FY24	FY25	FY26	FY27
Student FTE Increase over FY21	10	20	30	40	40
Net Tuition Rate per FTE	\$ 10,217	\$ 10,421	\$ 10,630	\$ 10,842	\$ 11,059
Change in Student Fees					
Total	\$ 102,170	\$ 208,427	\$ 318,893	\$ 433,694	\$ 442,368

15. Accreditation Requirements:

The degree program will be accredited through the Association to Advance Collegiate Schools of Business (AACSB) .

16. Planned Implementation Date:

Fall 2022