

The University Senate of Michigan Technological University

Proposal 15-13

(Voting Units: Academic)

“Proposal for a New Concentration in Business Analytics” (within the B.S. in Mathematics)

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1. General description and characteristics of program

Business analytics describes the use of mathematical and statistical modeling to optimize business performance. Concomitant increases in computing power and the amount of data collected have led to the development and widespread adoption of analytics by numerous industries.

The proposed concentration in Business Analytics will combine core coursework in mathematics with advanced statistics, data mining, predictive analysis, and selected business disciplines, including marketing, operations and systems management, and management information systems. Graduates will present a combination of skills and conceptual understanding that will be highly valued by today’s employers.

2. Rationale

The impetus for this concentration in Mathematics has come from several different sources. A Michigan Tech alumnus who is a leader at IBM contacted the university to propose a collaboration to produce more graduates with analytics skills. In this conversation, he pointed out that IBM regards analytics as one of four main growth areas for the company. At the same time, Michigan Tech students majoring in Mathematics were beginning to get internships and jobs in analytics-related positions. Companies as diverse as Caterpillar, Target, Humana (insurance), and Mercer (actuarial consulting) have begun recruiting students for analytics positions.

Mathematical Sciences currently offers a concentration in Actuarial Science. It is the most popular concentration in Mathematics, and our graduates have been in high demand by insurance companies and actuarial consulting firms. The Actuarial Science concentration is designed to give graduates specific skills in mathematics and statistics needed for the actuarial profession, as well as a background in business that allows them to be successful in a business setting. Given the interest shown by various industries in analytics, the time is ripe for a similar concentration in Business analytics.

It is expected that Business Analytics will have the same kind of appeal to students that Actuarial Science has: It gives mathematically adept students an avenue to apply their unique skills and inclinations in an area that is in high demand. The introduction of the Actuarial Science concentration corresponded to an increase in the total number of students majoring in Mathematics. It is expected that the proposed Business Analytics concentration will also lead to more students majoring in Mathematics.

The proposed concentration in Business Analytics supports Michigan Tech’s strategic plan in the following areas:

Goal 1 A world-class and diverse faculty, staff, and student population.

- 1.1 Outstanding professional environment for all members of the Michigan Tech community.
 - * recruit, retain, support, and recognize bright, motivated, and adventurous students.

Goal 2 A distinctive and rigorous discovery-based learning experience grounded in science, engineering, technology, sustainability, the business of innovation, and an understanding of the social and cultural contexts of our contemporary world.

- 2.1 Integration of research, instruction, and innovation.
 - * strengthen existing programs and develop new offerings in emerging interdisciplinary areas.

The proposed program is in an emerging interdisciplinary area, and for this reason should make it possible to recruit and retain more students.

3. Discussion of related programs within the university and at other institutions

Master's degree programs in analytics have been started at several universities in the last few years:

- Master of Science in Analytics, North Carolina State University (2007)
- Master of Science in Predictive Analytics, DePaul University (2010)
- Master of Science in Predictive Analytics, Northwestern University (2011)
- Master of Science in Business Analytics, University of Tennessee-Knoxville (2010)

We are not aware of any degree programs or concentrations in Business Analytics at the bachelor's level.

Related programs at Michigan Tech include the other concentrations in Mathematics and three degree programs in the School of Business and Economics (SBE): Operations and Systems Management (OSM), Marketing (MKT), and Management Information Systems (MIS).

Other concentrations in Mathematics: The proposed concentration in Business Analytics will require the same courses that form the core of all concentrations in Mathematics: calculus (three semesters), linear algebra, and introductions to statistics, combinatorics, differential equations, abstract algebra, and real analysis. This core provides a broad introduction to Mathematics and allows students to change from one concentration to another with ease during the first four or five semesters in the program. Concentration requirements will include advanced coursework in probability and statistics as well as courses from SBE and Computer Science. In broad outline, the concentration requirements are similar to those of our successful concentration in Actuarial Science: we provide the advanced coursework in statistics required for a strong foundation in the area, while drawing on the strengths of SBE (and Computer Science for one course).

As noted above, the existing concentration in Actuarial Science is most similar to the proposed concentration. However, Actuarial Science is much more narrowly focused and industry-specific (most actuaries are employed by insurance companies and actuarial consulting firms). Business Analytics is applicable to a wide variety of industries.

Programs in SBE: Analytics is finding heavy use in the disciplines of marketing (targeted advertising based on analysis of consumer data) and operations management (especially supply chain management). It is based on many of the concepts and techniques of MIS. Students pursuing the Business Analytics concentration will take courses from SBE in each of these areas. SBE degree programs in OSM, MKT, and MIS are natural choices for a double major.

4. Curriculum design

Major requirements

Course #	Course Name	Credits
MA1160	Calculus with Technology I	4
MA2160	Calculus with Technology II	4
MA2330	Introduction to Linear Algebra	3
MA2710	Introduction to Statistical Analysis	3
MA3160	Calculus with Technology III	4
MA3210	Introduction to Combinatorics	3
MA3310	Introduction to Abstract Algebra	3
MA3450	Introduction to Real Analysis	3
MA3560	Math. Modeling with Differential Equations	3
CS1121	Introduction to Programming I	3
	Lab Science (BL,CH, or PH)	4
	Science, Engineering or Computer Science	5
	Major requirements subtotal	42

Concentration requirements

Course #	Course Name	Credits
MA3720	Probability	3
MA3740	Statistical Programming and Analysis	3

MA4710	Regression Analysis	3
MA4720	Design and Analysis of Experiments	3
MA4780	Time Series Analysis and Forecasting	3
MA4790	Predictive Modeling	3
CS4xxx	Data Mining	3
EC2001	Principles of Economics	3
MKT3000	Principles of Marketing	3
OSM3000	Operations and Supply Chain Management	3
MIS2000	IS/IT Management	3
MIS2100	Introduction to Business Programming	3
MIS3100	Business Database Management	3
	Required electives-choose two	
MIS3400	Business Intelligence	3
MKT3600	Marketing Research	3
OSM4760	Optimization Methods in Decision Making	3
	Concentration requirements subtotal	45

General Education requires 24 credits beyond what is listed above (12 credits for core courses, 12 HASS credits; note that STEM requirements are fulfilled within major requirements).

This degree program allows 13 credits of free electives.

5. New course descriptions

MA4790 Predictive Modeling Application, construction, and evaluation of statistical models used for prediction and classification. Topics include data visualization and exploratory methods, the normal theory regression model, logistic and Poisson regression, linear and quadratic discriminant analysis, and classification with logit models.

Pre-Requisite(s): One of: MA3740, MA4710, MA4720, or MA4780

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Lab Fee: Required

CS4xxx Data Mining Data mining focuses on extracting knowledge from large data sources. This course introduces data mining concepts, methodology (including measurement, visualization, and evaluation), algorithms (including classification/regression, clustering, and association), and applications (such as web mining, recommendation systems, and bioinformatics).

Pre-Requisite(s): ((MIS3100 or CS4421) and MA2330 and (MA2710 or MA3710) and ((MA3740 and (CS1121 or CS1131)) or CS2321)) or permission of instructor

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

CS4xxx has been offered as CS4090 Special Topics in Computer Science and a new course proposal is [attached](#).

6. Additional resources required

Because this concentration is based almost entirely on existing courses in Mathematical Sciences and SBE, no significant additional costs are anticipated. One new course is being developed in Mathematical Sciences, the cost of which can be absorbed in the departmental budget (Mathematical Sciences offers more than 175 sections per year, so the marginal cost is not significant). Also, one new course is being created in Computer Science, but that course probably would have been created independently of this proposal (it is in the research area of a new CS faculty member).

7 Accreditation requirements

None; there is no accrediting body.

8 Planned implementation date

Fall 2013

Introduced to Senate: 23 January 2013

Approved by Senate: 6 February 2013

Approved by Administration: 11 February 2013

Approved by BOC: 28 February 2013

Approved by State: 12 April 2013