



TOPIC: University of Maryland University College: Master of Science in Data Analytics

COMMITTEE: Education Policy and Student Life

DATE OF COMMITTEE MEETING: January 16, 2013

SUMMARY: The proposed M.S. in Data Analytics is designed to meet the growing need for highly skilled professionals who can transform the growing amount of data confronting all organizations into usable information for use by their decision makers. Students will apply sophisticated software tools to functions such as data mining, predictive modeling and visual analytics for the purpose of structuring large data sets to unearth hidden information that will allow their organizations to build and sustain a long-term competitive advantage. To be successful, students entering the program will need strong quantitative skills.

This program is unique in that it requires students to understand the business operations of an organization and the information technology requirements necessary to ensure its viability. Toward this end, students will gain a set of business competencies, data competencies, and computational competencies that will allow them to bridge the worlds of business and information technology. There will be an emphasis on what comprises effective decision-making and the information technology infrastructure necessary to aid in the decision-making.

In a December 2011 report from Gartner Industry Research indicated that, “[s]uffering from an overall skills shortage, organizations will continue to struggle with recruiting the necessary talent to meet their analytics objectives.... Organizations must recognize that one good data scientist can mean the difference between identifying a profitable business opportunity, competitive threat or imminent risk, or not. Typical backward-looking aggregate summaries of trailing performance — that can be generated by almost any BI professional — do little to drive an organization forward.... For larger enterprises in particular, generating a pipeline for skilled statisticians should include aggressive outreach and relationships with leading universities.” Another Gartner Industry Research report in February 2012 stated that “[p]ervasive, advanced analytics will become necessary for leading organizations that want to gain competitive advantage. The explosion of data volume, and its variety and velocity, will enable new, high-value advanced analytic insights and use cases. Lack of skills will be a critical inhibitor to adoption and deriving value from advanced analytics. Only a small percentage of organizations (13%) currently report extensive use of predictive analytics” indicating the potential market that can be exploited.”

The target audience includes practitioners working in data analytics, e.g., data analysts, data “scientists,” who want to enhance their skills; large companies and organizations looking to build or enhance a business intelligence function; and individuals who may be seeking to change careers. Expected job titles for students graduating from the MS in Data Analytics program include, but are not limited to: data scientists, data analyst, data intelligence, operations research analyst, statisticians, business analyst, business intelligence, statistician, market research analyst.

ALTERNATIVE(S): The Regents may not approve the program or may request further information.

FISCAL IMPACT: No additional funding is necessary. The program will be supported through tuition.

CHANCELLOR'S RECOMMENDATION: That the Committee on Education Policy recommend that the Board of Regents approve the proposal from the University of Maryland University College to offer the Master of Science in Data Analytics.

COMMITTEE RECOMMENDATION:

DATE:

BOARD ACTION:

DATE:

SUBMITTED BY: Joann A. Boughman

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UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program

University of Maryland University College

Institution Submitting Proposal

Master of Science in Data Analytics

Title of Proposed Program

Master of Science

Degree to be Awarded

Fall 2013

Projected Implementation Date

0503

Proposed HEGIS Code

52.1302

Proposed CIP Code

The Graduate School

Department in which program will be
located

Robert Goodwin, Interim Dean

Department Contact

(240) 684-2400

Contact Phone Number

Robert.Goodwin@umuc.edu

Contact E-Mail Address

Marie A. Cini

Signature of President or Designee

12/20/12

Date

University of Maryland University College
Master of Science in Data Analytics

University of Maryland University College (UMUC) proposes to offer a new academic program, the Master of Science in Data Analytics. The degree will require successful completion of 36 semester hours of graduate level course work.

Mission

The mission of University of Maryland University College is to offer top-quality educational opportunities to adult students in Maryland, the nation, and the world, setting the global standard of excellence in adult education. By offering academic programs that are respected, affordable and accessible technologically and through a variety of face-to-face formats, UMUC broadens the range of career opportunities available to students, improves their lives, and maximizes their economic and intellectual contributions to Maryland, the nation, and the world.

This mission is rooted in UMUC's institutional purpose as stipulated by State statute (Md. Education Code Ann. § 13-101(2012)); specifically that the university shall:

- (1) Operate as Maryland's open university, serving nontraditional students who reside in Maryland, the United States and around the world;
- (2) Provide the citizens of Maryland with affordable, open access to higher education;
- (3) Continue as a leader in distributed education.

As the public state and national leader in distance and distributed education, UMUC awards associate's, bachelor's, master's and doctoral degrees, as well as undergraduate and post-baccalaureate certificates. The university's academic inventory offers programs that are core to any public university, but UMUC's mission to the adult student results in an emphasis on workforce relevant programs. Consequently, the university awards degrees and certificates in the arts and humanities, behavioral and social sciences, business and management, health-related fields, computing, education and technology, including degrees in fields facing critical shortages, such as cybersecurity, information assurance and graduate level teacher training in STEM areas. As part of its emphasis on workforce needs, UMUC offers non-credit professional development programs such as those in executive leadership and, through its Inn and Conference Center and its Largo facility, hosts professional conferences and meetings that support the economic and societal needs of the State.

The mission of UMUC is to offer high quality, workplace relevant academic programs to adult students that expand their range of career opportunities. The MS in Data Analytics program fills an increasing need for individuals who can integrate the growing amount of data being collected by all organizations into the operational decision making processes at all levels. The program will build upon the experience gained in UMUC's existing portfolio of cybersecurity programs to assist students in applying the latest software tools through the use of a virtual lab environment. The lab will provide students with access to a variety of the latest industry-standard software.

Rationale and Need for the Proposed Program

In today's increasingly competitive marketplace, organizations need individuals with the requisite skills to transform the growing amount of industry, product, and customer behavior data into actionable information to support operational decision making. This new "big data" world demands that organizations analyze large datasets to discover hidden knowledge, develop predictive modeling solutions to successfully adapt to new situations, and present information in such a way that decision makers across the organization can fulfill their responsibilities in an efficient and effective manner.

The M.S. in Data Analytics is designed to meet the growing need for highly skilled professionals who can transform the growing amount of data confronting all organizations into usable information for use by their decision makers. Students will apply sophisticated software tools to functions such as data mining, predictive modeling and visual analytics for the purpose of structuring large data sets to unearth hidden information which will allow their organizations to build and sustain a long-term competitive advantage. To be successful, students entering the program will need strong quantitative skills.

This program is unique in that it requires students to understand the business operations of an organization and the information technology requirements necessary to ensure its viability. Toward this end, students will gain a set of business competencies, data competencies, and computational competencies that will allow them to bridge the worlds of business and information technology. There will be an emphasis on what comprises effective decision making and the information technology infrastructure necessary to aid in the decision making.

The M.S. in Data Analytics will comprise 6 six-credit courses to be taken in a prescribed order, together with a three-credit prerequisite course that will be required for admission into the program. The program will be designed to develop business analysts who can merge the collection, storage and retrieval of data in an organization with the information requirements of its operational managers. The integrated curriculum will allow students to understand the real challenges that such analysts face. The capstone course at the end of the program will focus on the implementation issues that organizations must overcome to successfully integrate big data into their decision making processes.

There is an acknowledged shortage of individuals with the requisite analytic experience and skill and relatively few academic programs that address this demand. An August 2010 Bain industry brief entitled "Using data as a hidden asset" stressed the need for analytical talent and additionally described how new graduate programs have recently been created:

These leading companies see data as the new currency for building competitive advantage. They invest in new, innovative ways to aggregate and use the data that they own or that surrounds their company's customers and ecosystem.

If companies don't lean into the data opportunity, they risk losing ground to the competition. The data surge is creating a tremendous need for people who understand

data and how to collect, analyze and synthesize data on a large scale. Despite a moribund job-market, statisticians, data architects, and database analysts and administrators remain in high demand. In fields like healthcare informatics and statistics, new graduate programs have been created and grown dramatically in the US. As data gains importance, enterprises will be stretched to build their capabilities and find the right talent.”¹

An October 2011 McKinsey Global Institute study entitled “Are you ready for the era of big data” states the demand for analytical talent is outpacing the supply:

Up to this point, we have emphasized the strategic opportunities big data presents, but leaders must also consider a set of complications. Talent is one of them. In the United States alone, our research shows, the demand for people with the deep analytical skills in big data (including machine learning and advanced statistical analysis) could outstrip current projections of supply by 50 to 60 percent. By 2018, as many as 140,000 to 190,000 additional specialists may be required. Also needed: an additional 1.5 million managers and analysts with a sharp understanding of how big data can be applied. Companies must step up their recruitment and retention programs, while making substantial investments in the education and training of key data personnel.²

The Maryland *State Plan for Post-Secondary Education* has as two its five goals to fulfill “the educational needs of students and the economic and societal development needs of the state and the nation” and to “promote growth and vitality through the ... development of a highly qualified workforce.” The M.S. in Data Analytics will support both of these goals by offering the citizens of Maryland this first-of-its-kind academic program of study in the growing field of “big data” given that no other institution in the state offers such a program.

Market Demand

In June 2011 *Forbes.com* reported that “[p]redicting what’s coming around the next corner is the Holy Grail for today’s marketing department, and the prize will go to the monitoring company that first cracks the nut on understanding intent, effectively blurring the line between marketing and sales....”³

In December 2011 *Forbes.com* stated that “[i]f becoming a data-driven organization is about fostering a better feel for data among all employees, visualization plays a vital role in delivering data manipulation abilities to those without direct programming or statistical skills”⁴

¹Bain & Co. (2010, August 16). *Using data as a hidden asset*. Retrieved from <http://www.bain.com/publications/articles/using-data-as-a-hidden-asset.aspx>.

²Brown, B., Chui, M., & Manyika, J. (2011, October). Are you ready for the era of big data. *McKinsley Quarterly*. Retrieved from http://www.mckinseyquarterly.com/Are_you_ready_for_the_era_of_big_data_2864

³Savitz, E. (2011, June 7). The potentially huge market in ‘future-tense analytics. *Forbes.com LLC*. Retrieved from <http://www.forbes.com/sites/ciocentral/2011/06/07/the-potentially-huge-market-in-future-tense-analytics/>.

⁴O’Reilly Media. (2011, December 5). Big data in 2012: Five predictions. *Forbes.com LLC*. Retrieved from <http://www.forbes.com/sites/oreillymedia/2011/12/15/big-data-in-2012-five-predictions/>.

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Another Gartner Industry Research report in February 2012 stated that “[p]ervasive, advanced analytics will become necessary for leading organizations that want to gain competitive advantage. The explosion of data volume, and its variety and velocity, will enable new, high-value advanced analytic insights and use cases. Lack of skills will be a critical inhibitor to adoption and deriving value from advanced analytics. Only a small percentage of organizations (13%) currently report extensive use of predictive analytics” indicating the potential market that can be exploited.”⁶

CIO.com reported in March 2012 that “CIOs are competing for workers with strong math skills, proficiency working with massive databases and with emerging database technology as well as with expertise in search, data integration, and other areas such as business knowledge, ... business knowledge, such as understanding processes, customers and products, is at least equally as important as the tech skills.”⁷

In April 2012 *The Wall Street Journal Online* published the following comments by Pat Gelsinger, President and Chief Operating Officer of EMC Corp.: “Thirty years ago we didn't have computer-science departments; now every quality school on the planet has a CS department. Now nobody has a data-science department; in 30 years every school on the planet will have one.”⁸

⁵Bitterer, A., Chandler, N., Gassman, B., & Laney, D. (2011, December 14). Skill gaps are the biggest challenge in leveraging new opportunities in analytics and performance management. *Gartner, Inc.* Retrieved from http://my.gartner.com/portal/server.pt?open=512&objID=202&&PageID=5553&mode=2&in_hi_userid=2&cached=true&resId=1875815&ref=AnalystProfile.

⁶Sallam, R.L., & Cearley, D.W. (2012, February 16). Advanced analytics: Predictive, collaborative and pervasive. *Gartner, Inc.* Retrieved from <http://www.gartner.com/id=1926214>.

⁷Violino, B. (2012, March 27). CIOs overcome shortage of business analytics talent. *CXO Media, Inc.* Retrieved from http://www.cio.com/article/702972/CIOs_Overcome_Shortage_of_Business_Analytics_Talent?page=1&taxonomyId=3000

⁸The Wall Street Journal. (2012, April 29). Big data's big problem: Talent shortage. Retrieved from http://online.wsj.com/article/SB10001424052702304723304577365700368073674.html?mod=wsj_share_tweet&qoback=%2Egmp_45685%2Egde_45685_member_110895380.

Student Audience and Potential Careers

The target audience includes practitioners working in data analytics, e.g., data analysts, data “scientists,” who want to enhance their skills; large companies and organizations looking to build or enhance a business intelligence function; and individuals who may be seeking to change careers.

Expected job titles for students graduating from the MS in Data Analytics program include, but are not limited to: data scientists, data analyst, data intelligence, operations research analyst, statisticians, business analyst, business intelligence, statistician, market research analyst.

National (BLS National Occupation Outlook data thru 2020) and local (MD Dept. of Labor Occupation Outlook data thru 2020) growth rate searches on relevant job titles yielded the following:

- National growth rate for 2010-2020⁹
 - 41% growth - Market Research Analysts and Marketing Specialists
 - 22% growth - Management Analysts
 - 15% growth - Operations Research Analyst
 - 14% growth - Statisticians
- Local growth rate for 2010-2020¹⁰
 - 38% growth - Statisticians
 - 37% growth - Market Research Analysts and Marketing Specialists
 - 28% growth - Mathematical Scientists
 - 24% growth - Management Analysts
 - 17% growth - Operations Research Analysts

Program Duplication; Relevance to Historically Black Institutions (HBIs)

A search of the MHEC inventory of approved academic programs in Maryland found no graduate or undergraduate programs in “data analytics” or “business analytics.” This includes the four Historically Black Institutions in Maryland (Bowie State University, Coppin State University, University of Maryland Eastern Shore, or Morgan State University). Thus UMUC’s proposed program will have no impact on the uniqueness and institutional identities and missions of the HBIs, and will not harm these schools, or on other institutions in Maryland.

⁹ U.S. Bureau of Labor Statistics. (2012, March 29). *Occupational outlook handbook*. Retrieved from <http://www.bls.gov/ooah/a-z-index.htm#M>

¹⁰ Maryland Department of Labor, Licensing and Regulation. (2012, July 12). Maryland occupational projections - 2010-2020. Retrieved from <http://www.dllr.state.md.us/lmi/iandoproj/>

Characteristics of the Proposed Program

Description of Proposed Program

In today's increasingly competitive marketplace organizations need individuals with the requisite skills to transform the growing amount of industry, product, and customer (behavior) data into actionable information to support strategic and tactical decision making. This new "big data" world demands that organizations analyze large datasets to discover hidden knowledge, develop predictive modeling solutions to successfully adapt to new situations, and present information in such a way that decision makers across the organization can fulfill their responsibilities in an efficient and effective manner.

The M.S. in Data Analytics is designed to meet the growing need for highly skilled professionals who can transform the growing amount of data confronting all organizations into usable information for use by their decision makers. Students will acquire hands-on experience with a variety of analytical tools available for the purpose of structuring large data sets to unearth hidden information which will allow their organizations to build and sustain a long-term competitive advantage.

The program will offer student the opportunity to apply sophisticated software tools to functions such as data mining, predictive modeling and visual analytics using large data sets. To be successful students entering the program should have strong quantitative skills.

Student Learning Outcomes

The student who completes the Master of Science in Data Analytics will be able to

1. Design and implement databases, dimensional models, and data warehousing strategies.
2. Transform large data sets into actionable information in an easy-to-understand format to support organizational decision making through the use of advanced analytical tools.
3. Manage the quality, security, and privacy of data relevant to an organization to enhance its value.
4. Manage data analytics projects to ensure delivery of a successful data analytics initiative throughout its lifecycle.
5. Apply advanced methods of data warehousing and data mining in a variety of organizational environments.
6. Assess alternative approaches and infrastructures for implementing big data analytics.
7. Assess the appropriate methods and tools for data analysis in specific organizational contexts to include selecting a modeling approach, building a model using appropriate tools, validating the model, and deploying the model for prediction and analysis.
8. Develop experience tackling industry and organization-specific problems and challenges using advanced analytics and computational methods.

Evaluation and assessment for the program will take place in the required courses, including regular course evaluations, review of grade distributions, and faculty review of student

performance on embedded course assessments. Additional review includes tracking of student course completion and program completion rates.

General Requirements for the Degree

To be admitted to the program, students will be required to pass a standardized test and to successfully complete a three-semester-hour prerequisite course, DATA 600 Fundamentals of Data Analytics.

The degree will require 36 semester hours of course work, consisting of 6 six-semester-hour courses, as follows:

- DATA 610 Decision Management Systems (6 semester hours)
- DATA 620 Data Management and Visualization (6 semester hours)
- DATA 630 Data Mining (6 semester hours)
- DATA 640 Predictive Modeling (6 semester hours)
- DATA 650 Big Data Analytics (6 semester hours)
- DATA 660 Data Analytics Practicum (6 semester hours)

Students must take the six required courses in the order listed above. The capstone course, DATA 660, will focus on the application of software tools used to analyze large data sets. These tools will be applied in one or more case studies mirroring the challenges that organizations are facing today.

All courses for the program are new and will be developed in conjunction with the Course Development unit at UMUC. The development of DATA 600, 610 and 620 should be complete by May 2013. The development of DATA 630, 640, 650, 660 should be complete by December 2013. No new resources are required for course development.

Enrollment Projections

The following table shows projected unduplicated student headcounts for the first five years of the program:

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Enrollment	50	75	100	125	125

It is anticipated that approximately 40 degrees will be awarded each year after the degree is established and reaches steady state. The program is designed to be completed in two years of study with students taking an average of 18 semester hours each year.

Program Delivery and Principles of Good Practice

The M.S. in Data Analytics will be offered fully online, in support of UMUC's mission to serve working adults. UMUC is one of the largest providers of online instruction, offering courses to students around the world. Currently, UMUC offers more than 100 undergraduate and graduate degree and certificate programs fully online. In FY 2011, UMUC had more than 234,000 online course enrollments and offered 836 distinct courses online. As of FY 2011, 74% of UMUC's total course enrollments were online.

UMUC's approach to online learning is to provide a highly interactive environment that supports the development of skills in written communication, critical thinking, specialized program knowledge, information literacy, and technology fluency – the five graduate learning areas identified as institutional-level learning outcomes by the university's *Institutional Plan for the Assessment of Student Learning*.

Curriculum and Instruction

UMUC is committed to providing the best online teaching and learning possible and to excellence in all of its programs. There is no difference in coherence, cohesiveness, or academic rigor between programs offered in traditional instructional formats and those offered from a distance. Each program is designed to result in learning outcomes appropriate to the rigor and breadth of the program and all programs assess student achievement of defined learning outcomes through regular and formal assessment planning. Online and onsite courses and programs are fully aligned and integrated -- designed around the same learning outcomes and principles, overseen and taught by the same faculty, held to the same standards, and assessed in the same way.

All of UMUC's online courses have been designed by faculty members in appropriate disciplines in collaboration with instructional designers and other experts in the field. Course learning outcomes and course descriptions are the same for every section of the course. The learning outcomes for each course are the foundation of the course; the learning activities, assessments and content of the course are in alignment with the outcomes and provide a clear pathway for mastery of the outcomes.

Role and Mission

All programs at UMUC are designed to be consistent with the mission of the institution. Each program has a mission and program outcomes aligned to the university mission as described in the catalog.

All existing UMUC programs are subject to periodic program reviews, including the review of the appropriateness of the technology being used to meet a program's objectives. The results of periodic program reviews are reported to the University System of Maryland (USM).

Demonstrable Quality of Program Faculty

UMUC has a substantial roster of faculty with expertise in areas related to the project management. A master's degree is the minimum requirement to teach, but more than 80% of UMUC faculty members hold terminal degrees. Teaching effectiveness is monitored by class observation and student course evaluations. UMUC is actively recruiting faculty to expand offerings in areas related to proposed program.

The following is a partial list of current faculty with their highest degree, academic title/rank, and the courses they will teach.

- Michael Evanchik, Ph.D., Professor, DATA 600, 610, 660
- Garth McKenzie, D.M., Associate Professor, DATA 600, 620
- Bahram Meysami, Ph.D., Associate Professor, DATA 600, 620, 640, 650, 660
- Leslie Dinauer, Ph.D., Associate Professor, DATA 600, 630, 660
- Carrie Beam, Ph.D., Associate Professor, DATA 600, 620, 640, 650, 660
- Steve Knode, Ph.D., Professor, DATA 600, 610, 660

Faculty Support

All UMUC faculty are trained to teach online, including training in the use of the learning management system as well as in the pedagogy of distance education. Additionally, faculty have the opportunity for additional trainings throughout the course of their employment with UMUC. All faculty have 24/7 access to support services for both on-site and on-line courses, including the learning management system. All new faculty have access to mentors – faculty experienced in the same subject area.

As part of their formal training, new graduate faculty become familiar with the expectations that The Graduate School has set for them as well as their students. Program directors, the administrators responsible for managing the faculty and all aspects of an academic program, reinforce these expectations in their regular reviews of and communications with their faculty. A formal document specifying the teaching expectation of The Graduate School can be found online and is available to all faculty, students, and interested parties at http://www.umuc.edu/faculty/facsupport/facultyexams/upload/The_Graduate_School_Faculty_Expectations.pdf.

Additional support is provided through workshops offered by the University's Center for Teaching and Learning, as well as online coaching and mentoring programs for faculty (<http://www.umuc.edu/faculty/facsupport/>).

UMUC's learning management system provides appropriate real-time and asynchronous interaction between faculty and students in online classes, as well as access to course materials and a wide array of online library resources. All online graduate classes have required conferences in which students interact with faculty and with each other.

Student Support

UMUC provides all students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competencies and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies. Students have access to the complete range of student services available at UMUC in support of their distance education activities. All students are provided with the academic support they need to be successful in the online environment.

All advertising, recruiting, and admissions materials are the same for all students, and accurately represent programs and services available. Full information is available at www.UMUC.edu.

Evaluation and Assessment

Students have the opportunity to evaluate courses and faculty through a standard evaluation of every course. In addition, faculty are evaluated by their supervisors on a pre-determined schedule using a standard evaluation instrument, on the basis of direct observation.

Formal assessment planning in The Graduate School ensures assessment of student learning in alignment with program and course learning outcomes. The Graduate School approach to assessment begins with alignment of missions at institutional and program levels, alignment of mission with learning outcomes, then program outcomes with curriculum, flowing down to course outcomes and assignments. Assessment activities emphasize analysis of results and feedback loops for continuous improvement.

Additional evaluation includes tracking of student retention, grade distributions, and cost-effectiveness, and regular academic program reviews consider these factors, including comparisons between online and face-to-face formats.

Consistency with the State's Minority Student Achievement Goals

UMUC's student body is diverse. In fall 2010, 35% of UMUC's stateside students were African American, and minority students comprised 44% of total enrollment. UMUC enrolls more African American students than any single one of the four historically black colleges and universities in Maryland. UMUC annually awards more degrees to African American students than any other institution in Maryland.

UMUC has seven Core Values: students first; accountability; diversity; integrity; excellence; innovation; and respect. These core values are central and enduring tenets — a set of principles to guide institutional and individual professional behaviors. Promoting diversity is incorporated into every program. This program, in a discipline with demonstrated growth in employment opportunities, will help to ensure that minority students are prepared to enter the job market.

Technology Fluency

Technology fluency is a core learning area for UMUC students and is assessed at the institutional level as well as being incorporated into all degree programs. All courses in this program will be taught entirely online, so that all students will be required to use enhanced technology to complete assignments. Students will also use the online databases and the UMUC library's other extensive online holdings to fulfill course requirements. The program will thus require students to acquire and maintain a high level of technological proficiency.

Library Requirements

UMUC's Information and Library Services (ILS) provides access to a vast array of library resources and services to UMUC students, faculty, and staff worldwide to meet their academic needs. Resources include a wide array of books, journal articles, reports, cases, and other materials available electronically via a comprehensive selection of online library databases. Services include instruction, reference, electronic reserves, and document delivery for materials not otherwise available in the library databases. ILS relies on technology as its primary mechanism to provide access to resources and services to a dispersed, nontraditional student population.

The online resources available to UMUC students provide full-text access to a wealth of articles as well as book chapters and some complete books via 120 databases that cover a vast array of topic areas. The FindIt option allows patrons who have found a citation for an article that is not available in full text within the database being searched to link to the full text of the article if it is available in other databases to which ILS subscribes. In addition, ResearchPort allows patrons to search multiple databases simultaneously.

Resources in the University System of Maryland and Affiliated Institutions (USMAI) consortium are accessible to UMUC students and faculty. UMUC students, faculty, and staff have access to more than nine million volumes from the 16 USMAI libraries, which include Bowie State University, Center for Environmental Science (University of Maryland), Coppin State University, Frostburg State University, Morgan State University, Salisbury University, St. Mary's College of Maryland, Towson University, University of Baltimore, University of Baltimore Law Library, University of Maryland-Baltimore County, University of Maryland-College Park, University of Maryland-Eastern Shore, University of Maryland Health Sciences and Human Services Library, University of Maryland Law Library, and University of Maryland University College.

Students and faculty in the continental United States may order books from the USMAI online catalog for delivery to their home or to any USMAI library that is most convenient to their home or workplace. ILS also delivers USMAI books to faculty overseas. In addition to its book delivery service, ILS also offers document delivery services (see below) to all UMUC students, faculty, and staff worldwide for a variety of materials, including journal articles book chapters. Further, ILS has a collection of 15,451 electronic books (e-books) that allow users to retrieve and read entire texts online and download or print selected sections of the text. The real-time

availability of e-books has significantly increased ILS' ability to meet the needs of UMUC's global population.

Because the library resources are so vast, no additional resources will be required to support the proposed program.

Facilities and Equipment

Physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and online and technology resources.

Finances

No new general funds will be required for implementation of the proposed revision to this program. As shown in the following tables, the program is expected to be self-supporting.

Resources and Expenditures

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c+g below) ^a	\$624,600	\$936,900	\$1,249,200	\$1,561,500	\$1,561,500
a. #F.T. Students	0	0	0	0	0
b. Annual Tuition/Fee Rate	N/A	N/A	N/A	N/A	N/A
c. Annual Full Time Revenue (a x b)	N/A	N/A	N/A	N/A	N/A
d. # Part Time Students	50	75	100	125	125
e. Credit Hour Rate ^a	\$694	\$694	\$694	\$694	\$694
f. Annual Credit Hours per student per year	18	18	18	18	18
g. Total Part Time Revenue (d x e x f)	\$624,600	\$936,900	\$1,249,200	\$1,561,500	\$1,561,500
3. Grants, Contracts, & Other External Sources	\$0	\$0	\$0	\$0	\$0
4. Other Sources	\$0	\$0	\$0	\$0	\$0
TOTAL (Add 1 - 4)	\$624,600	\$936,900	\$1,249,200	\$1,561,500	\$1,561,500

Note a: The tuition rate is the same as that for UMUC's existing MBA and Cybersecurity programs.

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Total Faculty Expenses (b + c below)	\$49,356	\$74,034	\$98,712	\$123,390	\$123,390
a. Total sections taught	6	9	12	15	15
b. Total Salary (Adjunct faculty salary at \$1371 per credit hour) ^b	\$49,356	\$74,034	\$98,712	\$123,390	\$123,390
c. Total Benefits	0	0	0	0	0
2. Total Administrative Staff Expenses (b + c below)	\$113,850	\$113,850	\$113,850	\$113,850	\$113,850
a. # FTE	1	1	1	1	1
b. Total Salary	\$90,000	\$90,000	\$90,000	\$90,000	\$90,000
c. Total Benefits (26.5%)	\$23,850	\$23,850	\$23,850	\$23,850	\$23,850
3. Total Support Staff Expenses (b + c below)	\$63,250	\$63,250	\$63,250	\$63,250	\$63,250
a. # FTE	1	1	1	1	1
b. Total Salary	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
c. Total Benefits (26.5%)	\$13,250	\$13,250	\$13,250	\$13,250	\$13,250
4. Equipment	\$200,000	\$100,000	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses (Course development, marketing, overhead)	\$100,000	0	0	0	0
TOTAL (Add 1 - 7)	\$526,456	\$351,134	\$275,812	\$300,490	\$300,490

Note b: The adjunct faculty salary rate is the median salary rate for an adjunct associate faculty member with a terminal degree at longevity step 11 in The Graduate School.

Appendix A
Master of Science in Data Analytics
Course Descriptions

DATA 600 Foundations in Data Analytics (3 Credits)

Introduces students to the key business, computational and data competencies needed by business analysts to fulfill the information needs of decision makers at all levels of an organization. The course focuses on how “big data” can be used to help decision makers improve organizational competitiveness. Students also gain experience with several software tools used for data analysis and reporting.

DATA 610 Decision Management Systems (6 Credits)

Prerequisite: DATA 600. Examines the process of decision making in large organizations and the technologies that can be used to enhance data-driven decision making. The course focuses on the underlying framework of good decision making featuring operational decisions as reusable assets that can be automated through the creation of business rules. Students explore how data can add analytic insight to improve decisions. Best practices for long-term success of an analytics project in terms of project management and communications are also covered.

DATA 620 Data Management and Visualization (6 Credits)

Prerequisite: DATA 610. Presents the fundamental concepts and techniques in managing and presenting data for effective data-driven decision making. Topics in data management and design include data modeling such as entity-relationship, relational/object-oriented database design approaches; design approaches for performance and availability, covering data storage and indexing strategies; data warehousing to include requirement analysis, dimensional modeling and ETL processing; and meta-data management. Topics in data visualization include understanding data types; data dimensionalities to include time-series and geospatial data; forms of data visualization to include heat maps, infographs; and best practices for usable, consumable, and actionable data/results presentation.

DATA 630 Data Mining (6 Credits)

Prerequisite: DATA 620. Covers standard exploratory data analysis techniques using advanced quantitative statistical and graphical methods used for data mining. Students use major software tools to perform business analysis. Topics include association rules, k-NN classifier, cluster analysis, discriminant analysis, classification and regression trees, logistic regression, and neural networks.

DATA 640 Predictive Modeling (6 Credits)

Prerequisite: DATA 630. Introduces fundamental concepts and techniques to discover patterns in data, identify variables with most predictive power and to develop predictive models. Topics include data mining and machine learning concepts and methods: data selection, representation, cleansing and preprocessing; algorithms such as artificial neural networks, classification, clustering and association rules; advanced techniques such as

text mining and web mining. Best practices on the selection of methods and tools to build predictive models will also be covered.

DATA 650 Big Data Analytics (6 Credits)

Prerequisite: DATA 640. Introduces concepts and techniques in managing and analyzing large data sets for data discovery and modeling. Topics include understanding unstructured data sets, distributed file systems and map-reduce technology (e.g., Hadoop) allowing the student to leverage the power of untapped institutional data.

DATA 660 Data Analytics Practicum (6 Credits)

Prerequisite: DATA 650. Capstone course. Hands-on exercises and projects using the latest techniques/tools that prepare the student to put all the knowledge learned through previous courses into practice. Commercial and open-source tools would be used to conduct analyses and build prototypes using real-world case studies and data sets. Case studies cover building predictive models in selected industries (e.g., healthcare, medicine, defense, finance, banking, energy).