UNIVERSITY OF MARYLAND
GLOBAL CAMPUS
OFFICE OF THE CHIEF ACADEMIC OFFICER

January 28, 2021

James D. Fielder, Jr., PhD
Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty St.
Baltimore, MD 21201

Dear Dr. Fielder:

On behalf of the University of Maryland Global Campus (UMGC), this letter serves as official request for a new bachelor's degree program in Data Science. (HEGIS: 07.0301 CIP: 30.7001). In accordance with COMAR 13B.02.03, the following proposal is submitted for your review.

As noted in this proposal, UMGC plans to offer an undergraduate certificate in Business Analytics that is embedded within this bachelor's degree program. A proposal for that certificate has also been submitted for your review.

Payment for review of this new academic program has been made to MHEC via R*STARS interagency fund transfer, transaction number JAIA0860, in the amount of $850 in accordance with the MHEC fee schedule.

Sincerely,

Blakely R. Pomietto, MPH
Senior Vice President and Chief Academic Officer

CC: Antoinette Coleman, Associate Vice Chancellor for Academic Affairs, University System of Maryland

Office Use Only: PP#

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	University of Maryland Global Campus

Each action below requires a separate proposal and cover sheet.

- (●) New Academic Program
- ( ) New Area of Concentration
- ( ) New Degree Level Approval
- ( ) New Stand-Alone Certificate
- ( ) Off Campus Program
- ( ) Substantial Change to a Degree Program
- ( ) Substantial Change to an Area of Concentration
- ( ) Substantial Change to a Certificate Program
- ( ) Cooperative Degree Program
- ( ) Offer Program at Regional Higher Education Center

Payment Submitted: (●) Yes ( ) No | Payment Type: (●) R*STARS ( ) Check | Payment Amount: 850.00 | Date Submitted: 1/28/21

Department Proposing Program	School of Cybersecurity and Information Technology	
Degree Level and Degree Type	bachelor's degree	
Title of Proposed Program	Data Science	
Total Number of Credits	120	
Suggested Codes	HEGIS: 70301.00	CIP: 30.7001
Program Modality	( ) On-campus	(●) Distance Education (*fully online*)
Program Resources	(●) Using Existing Resources	( ) Requiring New Resources
Projected Implementation Date	( ) Fall (●) Spring ( ) Summer	Year: 2022
Provide Link to Most Recent Academic Catalog	URL: https://www.umgc.edu/current-students/degree-requirements/catalogs.cfm	
Preferred Contact for this Proposal	Name: Blakely Pomietto	
	Title: Senior Vice President and Chief Academic Officer	
	Phone: (301) 985-7414	
	Email: blakely.pomietto@umgc.edu	
President/Chief Executive	Type Name: Blakely Pomietto	
	Signature: 	Date: 01/28/2021
	Date of Approval/Endorsement by Governing Board:	01/28/2021

Revised 3/2019

A. Centrality to Institutional Mission and Planning Priorities:

1. Provide a description of the program, including each area of concentration (if applicable), and how it relates to the institution's approved mission.

Consistent with the institutional purpose as stipulated by State statute (Md. Education Code Ann.§ 13-101(2013)1), the mission of UMGC is improving the lives of adult learners. UMGC will accomplish this by:

(1) Operating as Maryland's open university, serving working adults, military servicemen and servicewomen and their families, and veterans who reside in Maryland, across the United States, and around the world;
(2) Providing our students with affordable, open access to valued, quality higher education; and
(3) Serving as a recognized leader in career-relevant education, embracing innovation and change aligned with our purpose and sharing our perspectives and expertise.

Each facet of UMGC's mission has direct bearing on the programs the university offers and how those programs are designed and delivered. By mission and state mandate, every aspect of the UMGC student experience is designed from its origins for working-adult and military-affiliated students to access online education and built to leverage our unique and longstanding expertise in designing online learning. The learning resources, the selection, training, and evaluation of faculty, the non-academic supports, the success-coach advising model, the virtual classroom, the academic resources, the term and session structure, and course length are all deliberately derived from adult-learning science in distributed, online modalities, and the learning ecosystem is designed for a learner experience taking place anywhere in the world. These students' demographic profile drives the design and delivery of our learning model: The average age of UMGC's undergraduate student is 33 years old, 75% of them work full-time, and 46% have dependent children. For these students, their often-complicated life circumstances while pursuing higher education means they need and benefit most from the authentic online education that UMGC has delivered for more than two decades.

Authentic online education is fundamentally different from courses and programs originating at traditional institutions and taught remotely in the same way as face-to-face classes. Instead, authentic online education is a distinctive educational architecture intentionally designed for virtual teaching, learning and assessment, with technology tools strategically deployed for engagement and outcomes, as well as wraparound services that provide support throughout the online student life cycle. These features set UMGC apart in the higher education landscape of Maryland.

Our history and expertise have allowed us to build strong relationships with the military community which is nothing less than part of UMGC's institutional identity. As of Fall 2020, 65% of UMGC's undergraduate students are military affiliated, including active duty servicemembers, their families, and Veterans. This dimension of UMGC's identity is a particular point of pride, beginning with the university first sending faculty overseas in 1949 to teach America's soldiers on military installations in Europe. The relationship between UMGC and the military has grown ever stronger in the decades since as a result of our intentional program design and delivery model that meets adult learners *where they are,* whether through asynchronous online courses or on military bases in

Germany, Italy, Japan, Korea, Guam, Colorado, Virginia, and many other military facilities around the world.

Today UMGC holds competitively awarded contracts from the U.S. Department of Defense (DOD), under which we serve military servicemembers in Europe, Asia, and the Middle East, delivering specifically solicited programs of study identified by the DOD as responsive to the training, education, and upskilling needs of the military. UMGC is recognized as one of the top military- and veteran-friendly schools in the country, with an unmatched expertise and established reputation as a preeminent provider of quality, affordable, career-relevant postsecondary education. Recognition as one of the Best Military Friendly Online Colleges (GuideToOnlineSchools.com) and as the Military Times No. 4 Best Cybersecurity Program for 2018, among other accolades, are evidence of UMGC's successful commitment to serving our nation's troops. Most recently, in 2019 UMGC was competitively selected as one of five partner institutions to the emergent U.S. Naval Community College to serve the Navy and Marines.

All of these considerations are reflected in UMGC's proposal herein to offer a new Bachelor of Science in Data Science degree. The proposed B.S. in Data Science is designed to meet the growing need for highly skilled professionals who can keep pace with the growth in demand for data science expertise in the workforce. 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 "data world" demands that organizations analyze large datasets to discover hidden knowledge, develop predictive modeling solutions to successfully adapt to new economic and social 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 proposed Bachelor of Science program in Data Science is designed to meet the growing need for highly skilled professionals who can transform the increasing amounts of data confronting all organizations into usable forms. One of the major outcomes of the program is to provide students with hands-on experience with a variety of the most ubiquitous analytical tools available for the purpose of organizing large data sets. At the same time, students will acquire fundamental knowledge and skills in data science that will equip them to adapt to future changes in tools, technology, and the marketplace. The program endeavors to produce graduates who can respond to workforce demands and emerging needs and who, upon graduation, possess an immediately implementable skill set to succeed in a global environment of workforce diversity, technological innovation, expanding competition, and ever-increasing amounts of data in our highly digitized world.

The proposed B.S. in Data Science program will prepare students for careers in a sector that Glassdoor[1] reports in the top spot of the 50 best jobs in America in terms of salary, job satisfaction, and openings for the third year in a row.

The proposal aligns with UMGC's mission by providing a learner-focused program based on leading-edge adult learning theory and curriculum design that accommodates the needs of students and the community. In addition, this Bachelor of Science in Data Science program aligns with UMGC's mission to offer high quality, workplace-relevant

[1] https://www.glassdoor.com/List/Best-Jobs-in-America-2019-LST_KQ0,25.htm

academic programs that expand the range of credentials and career opportunities for working adult, federally employed, and military affiliated students.

The Bachelor of Science in Data Science will support students' professional development with opportunities to learn from employers and peers. Students are given time to practice skills as they progress through formative instruction. The fully online, asynchronous program model offers flexibility, continuing education, and social opportunities to adults interested in refreshing and reshaping their career opportunities. Detailed descriptions of the program and courses within the major are in section G.

2. Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.

As the public state and national leader in distance and distributed education, UMGC awards associate, 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 UMGC's mission to serve adult students results in a sustained academic emphasis on career-relevant and workforce-aligned 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. As part of its emphasis on career-relevant education, UMGC offers non-credit professional development programs and hosts professional conferences and meetings supporting economic and societal needs of the State.

The B.S. in Data Science was constructed using UMGC's institutional learning goals that help students master academic and professional content and include a strong emphasis on technology and information literacy. Data Science is an interdisciplinary field, requiring synthesis of knowledge across a variety of related fields of skill and ability. The program builds upon UMGC's general education requirements and a solid understanding of scientific and quantitative reasoning through required coursework in mathematics, statistics, computer science and information technology. Although data science professionals must possess a high level of quantitative and technical expertise, the ability to translate the results of data science methods for non-technical managers is critical to positively impact decision-making processes. Thus, critical thinking and problem-solving, communication, teamwork and the ability to accommodate diverse perspectives are all as important as technical knowledge and skills.

The Data Science program begins with courses in applied statistics, business intelligence, data analytics and visualization, which also comprise the embedded undergraduate certificate in Business Analytics, a certificate that is accessible to majors and non-majors alike. Later courses address more advanced knowledge and skill-development in data science, machine learning, artificial intelligence, big data analytics, and data ethics. Although the program includes a distinct course in data ethics, the institutional learning goal of ethics and civic awareness is not restricted to that course but is a recurring theme running throughout the program. Finally, from the initial courses through to the capstone, institutional learning goals of developing job-seeking skills and the capacity for lifelong learning are essential for the continuously evolving field of Data Science.

Because this program will provide adult students with an opportunity to pursue the emerging and critical field of data science, it is an institutional priority in direct alignment with UMGC's statutory mandate and mission to provide career-relevant programs. In addition, the strong emphasis on technological and informational literacy and expertise, critical thinking, problem-solving, communication, teamwork, the ability to accommodate diverse perspectives, the development of job-seeking skills, and the capacity for life-long learning for both majors and students of other majors via the undergraduate certificate make this proposed program an institutional priority.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L.)

No new general funds are required for the implementation of this program. The financial table in section L is based only on students entering the new program.

New courses will be developed and funded through existing budget allocation of funds in this fiscal year and through a departmental budget allocation as part of the FY 2022 budget process. The financial data in Table 2 in section L reflects an existing base of FTE faculty, administrative staff, adjunct faculty, and support staff, which will be sufficient to support the launch of this Bachelor of Science in Data Science. Salaries are shown with benefits at current rates of 37%.

4. **Provide a description of the institution's commitment to:**
a) ongoing administrative, financial, and technical support of the proposed program

UMGC's support services are designed to accommodate students who may not be physically in Maryland or who would simply prefer to access support remotely. These services are, therefore, intentionally and thoughtfully built for complete online delivery rather than in the primarily face-to-face format that exists on traditional campuses. Support services include the following:

- Help@UMGC provides support services for the learning management system (LEO). A specialized technical support team for LEO questions and problems is available 24 hours a day, seven days a week, 365 days a year. In addition, UMGC trains faculty to handle some LEO troubleshooting, publishes LEO FAQs, provides chat, phone, and e-mail access to a Help Center with a comprehensive knowledge base and includes a peer-to-peer feature in the online classroom to encourage students to help each other with LEO issues.
- The Digital Teaching and Learning unit within Academic Affairs provides instructional-design support and consultation to Help Desk staff and program leadership to optimize the learning environment across delivery modes and resolve challenges or obstacles students and faculty encounter.
- Students also receive 24/7 support in the use of educational technology from UMGC's Virtual Lab Assistance team, which resolves students' technical questions and issues in lab environments. Complementarily, program leadership and faculty support students in the proficiency of use with educational technology tools.

- MyUMGC is a self-service portal that provides access to administrative functions and student records. UMGC has designed this portal to ensure that students around the world can complete administrative tasks and view records at their convenience.
- UMGC's library is directly accessible through a link within each online classroom. The library helps to educate students in the use of information resources and services and develops and manages UMGC's extensive online library collection.
- The Effective Writing Center (EWC) offers an array of writing-related services to students, including review of draft papers, guest lecturers on writing skills for the classroom, a plagiarism tutorial, resources on citing and referencing, and resources to support research activities. The EWC is also directly accessible through a link within each online classroom.
- Turnitin has been integrated within courses as a developmental tool for students to assist with achieving authenticity in their writing.
- Subject matter tutoring is available in select courses. Subject matter tutors can help define and explain concepts, clarify examples from course content, and guide students toward understanding a particular topic. Students can connect with a subject matter tutor by accessing a link in their online classroom.
- The Office of Accessibility Services arranges accommodations for students with disabilities. Students can register with this office via an online form and then work with a staff member to receive appropriate accommodations for either online or hybrid courses. UMGC students move locations frequently and often need to adjust their course schedules because of work or family obligations so the Office of Accessibility Services is prepared to help students with transitioning their accommodations even when these changes occur.
- The Office of Career Services and its CareerQuest portal provides quality resources and services to assist students and alumni with their career planning and job search needs including Mentoring and Internship Plus programs. This office supports students who are transitioning from one career to another or are looking to climb up the corporate ladder, in addition to those who are entering the workforce for the first time. The CareerQuest portal is available 24 hours a day, seven days a week and includes an online database that allows students to connect with local and national hiring managers.
- The Alumni Association is a way for graduates to network and connect. Its online community features a career center, information on available chapters, discussion boards, photo sharing, and a resource center.
- The Financial Aid Office helps students understand and navigate the process of filing for financial aid. Extended office hours ensure that students can receive support quickly and staff members have expertise with a variety of financial aid options as UMGC students may be using employer assistance, veterans' benefits, or other aid that is more common among adult student populations.
- Success Coaches assist students with mapping out degree plans, selecting and scheduling courses, and generally navigating the administrative and academic landscape of earning a degree or certificate.

b) Continuation of the program for a period of time sufficient to allow enrolled students to complete the program.

This is not applicable as this program is new.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan:

1. **Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:**
   - **a) The need for the advancement and evolution of knowledge**
   - **b) Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education**
   - **c) The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs**

   As an open access institution, UMGC makes educational opportunities and choices available for all students within the state of Maryland, including new college majority populations – especially military affiliated and working adults most often left behind by higher education. In the School of Cybersecurity and Information Technology, where the B.S. Data Science will be located, approximately 66% of undergraduate students are military affiliated, of whom approximately 38% are active duty. The average age of the school's student population is 31, 74% of students are working full-time, and 75% are enrolled part-time. On average, UMGC students transfer 38 credits to the university; 43% of students transfer between 30-59 credits and approximately 36% transfer between 60-89 credits. And UMGC's global reach means nearly 60% of students in the School of Cyber and IT live outside Maryland, including those enrolled overseas.

   In addition, the need for the advancement and evolution of knowledge critical to social and economic progress is a central concept in the curriculum of the proposed Data Science degree. Critical thinking, problem-solving, and communication skills are required skills for a data scientist and are central to the program's objectives to prepare students to enter the workforce and advance in their careers. The program also develops ethics, civic awareness, and the capacity for lifelong learning, which are all essential skills for the continuously evolving field of Data Science.

2. **Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education**.

   The program proposal is designed to meet present and future needs of the state, as identified in 2017-2021 State Plan for Post-Secondary Education: Student Success with Less Debt (State Plan).[2] This program supports the three primary goals in the State Plan in the following ways:

   - The program serves Goal 1 (Access) in the State Plan in that it is designed to support UMGC's overall mission to set a global standard for excellence and to be respected as a leader in affordable and accessible adult education programs. In addition, UMGC administers its programs to meet the University System of Maryland goals of effectiveness and efficiency by employing data-driven decision-making that ensures that academic programs are broadly accessible and offer high quality education at an affordable cost.

[2] Source: 2017-2021 Maryland State Plan for Postsecondary Education: http://www.mhec.state.md.us/About/Pages/2017StatePlanforPostsecondaryEducation.aspx

At UMGC, this commitment to affordability and access is synonymous with a commitment to diversity and inclusion. The university's open admission approach is central to this commitment. The process to apply for admission is streamlined and does not require the submission of standardized test scores. Admission requirements for the Bachelor of Science in Data Science are aligned with this mission.

- The program serves Goal 2 (Success) and Goal 3 (Innovation) in the State Plan, as it is based on principles of competency- and performance-based learning that are at the forefront of developments in adult learning in higher education. Competency-based learning is an outcomes-based approach to education that emphasizes what students should know and be able to do to be successful in their disciplines, fields, and careers. The approach is learner-focused, and authentic assessment (the measurement of what students have learned and the competencies students master) is embedded in every step of the learning process to assist students in building real-world, job-relevant competencies in real time. The Bachelor of Science in Data Science program will employ authentic, project-based assessments that are relevant to tasks that graduates will actually perform on the job; such projects serve as both the means of instruction and assessment of learning in the program. Retention and success focus on students' learning experiences and are improved through enhanced learning resources (e.g. readings, handouts, slides, etc.). These resources are provided online within the learning management system. The methodology and on-demand nature of this type of student support is innovative in higher education and online learning, thus reflective of best practices in adult teaching and learning.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State:

1. **Describe potential industry or industries, employment opportunities, and expected level of entry (*ex: mid-level management*) for graduates of the proposed program.**
2. **Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.**
3. **Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.**

   There is a rapidly increasing demand for data scientists at the bachelor's degree level - individuals who can extract data, formulate models and apply quantitative analysis in a proactive manner. Evidence of strong demand for data scientists is derived from reviews of job sites and industry reports. According to the 2020 LinkedIn Emerging Jobs Report[3], the highest growth jobs related to data science and data analysis include Artificial Intelligence Specialist, which requires expertise in machine learning, deep learning, python, and natural language processing (ranked #1 at 74% annual job growth); Data Scientist (37% annual job growth); and Data Engineer (33% annual job growth).

[3] https://business.linkedin.com/content/dam/me/business/en-us/talent-solutions/emerging-jobs-report/Emerging_Jobs_Report_U.S._FINAL.pdf

About 11.5 Million data science jobs will be created by 2026 according to U.S. Bureau of Labor Statistics (BLS)[4].

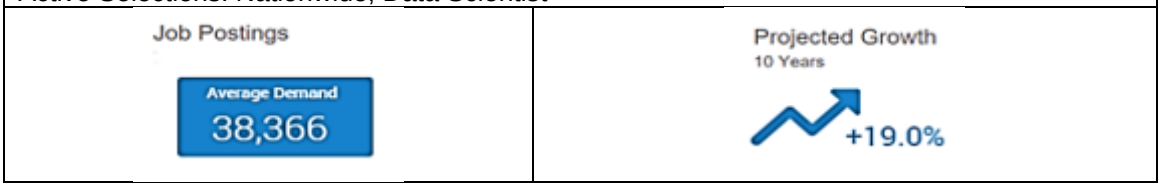
Burning Glass analysis shows that projected market demand for data scientists will grow 19% over the next 10 years (See Figure 1 below). Although researchers tend to define the jobs/occupations for data scientists differently – resulting in occasional differences in projected growth – the broadest consensus is that the job market for this field is strong.

Figure *1*: Burning Glass Projected Growth in Data Scientist Employment Market Occupation Analysis – Data Scientist

Utilizes skills and experience to systematically answer questions using data to provide actionable recommendations. Commonly utilizes advanced statistical analysis and machine learning techniques. Common responsibilities also include data cleaning and data management.

Common job titles: Data Scientist, Senior Data Scientist, Lead Data Scientist, Principal Data Scientist, Data Scientist II

Active Selections: Nationwide, Data Scientist

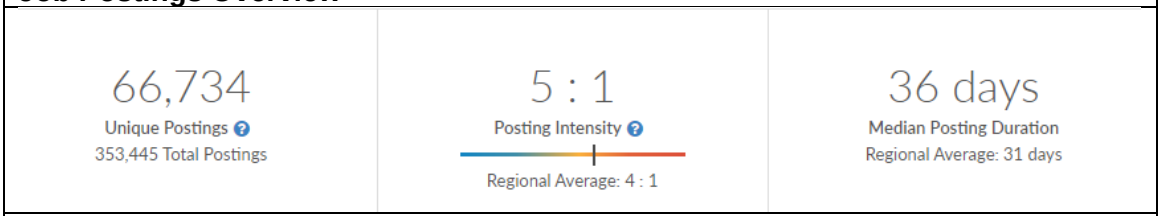


Source: Labor Insight (Burning Glass Technologies)

Similarly, EMSI modeling[5] of job listings related to data scientists found 66,734 unique positions listed nationwide from Sept. 2017 to Dec. 2020(See Figure 2 below). These positions are being posted with a higher frequency than the average for all other occupations within the region (5:1 for data scientists compared to 4:1 overall), demonstrating that these roles are harder to fill, despite market demand. This indicates the availability of openings in the job market to be served by the new program. These positions are also compensated very highly, with a median advertised salary of $120,700.

Figure 2: EMSI Data on the Data Scientist Employment Market

Job Postings Overview



There were 353,445 total job postings for your selection from September 2017 to December 2020 of which 66,734 were unique. These numbers give us a Posting Intensity of **5-to-1**, meaning that for every 5 postings there is 1 unique job posting.

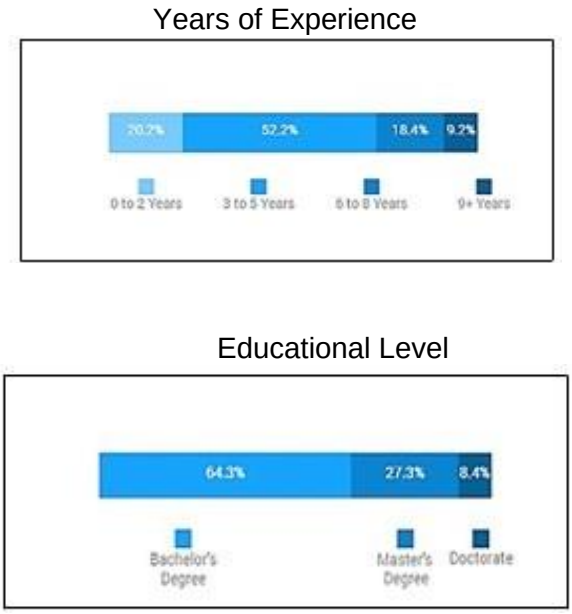
[4] BLS projects a 31% increase in the Data Science employment market between 2018-28: https://www.bls.gov/news.release/ecopro.nr0.htm
[5] Emsi Data Sources: https://www.economicmodeling.com/data-sources/

This trend is even stronger in the DMV (DC-VA-MD-WV) region where the posting intensity is 7:1 compared to the 4:2 average for all other occupations within the region, and the median advertised salary is $125,200.[6]

Our research shows high job demand for data scientists and a significant skill gap in the employment marketplace; companies are finding it difficult to fill their open positions with qualified candidates. LinkedIn[7] has noted that the number of individuals graduating with adequate skills to enter data professions trailed the job demand by 150,000.

For the third year in a row, Glassdoor reports[8] "data scientist" in the top spot of the 50 best jobs in America in terms of salary, job satisfaction and openings. According to Forbes/IBM,[9] 61% of data scientist and advanced analysis positions will be available to bachelor's degree holders, while 39% will require a master's degree or a PhD. Burning Glass Technology reported similar findings, noting that around 64% of the positions will be filled by bachelor's degree holders. Figure 3 shows the required years of experience and educational level.

Figure 3: Burning Glass: 64% of Data Science openings filled by B.S. degree holders.



The design of the B.S. in Data Science reflects extensive research to determine the optimal skill set for market-aligned curriculum. The top 15 keywords based on skills and topics for the B.S. in Data Science are summarized in Figure 4. There is nearly universal growth across this skill set (with the exceptions of data mining and statistics, which are increasingly being channeled toward machine learning and data science). Skills that this

[6] ibid.
[7] https://news.linkedin.com/2018/8/linkedin-workforce-report-august-2018
[8] https://www.glassdoor.com/List/Best-Jobs-in-America-2019-LST_KQ0,25.htm
[9] https://www.forbes.com/sites/louiscolumbus/2017/05/13/ibm-predicts-demand-for-data-scientists-will-soar-28-by-2020/

Data Science program will emphasize show an exceptional surge in projected demand – such as machine learning (↑ 34.7%), deep learning (↑ 84%), Python (↑ 21.6%), Tableau (↑ 28.2%), artificial intelligence (↑ 24.8%) and natural language processing (↑ 22.8%).

Figure 4: Burning Glass Skills Analysis, of Job Postings and Projected Job Growth[10]

Skill	Description	Job Postings Requesting (Last 12 month	Projected Growth (2 Years)
Data Science	Data science, also known as data-driven science, is an i	36,716	16.0%
Python	Python is a widely used high-level programming langua	28,503	21.6%
Machine Learning	Machine learning is the subfield of computer science th	25,832	34.7%
SQL	SQL (ESS-kew-EL or SEE-kwl, Structured Query Languag	19,421	2.8%
Data Analysis	Data analysis, also known as analysis of data or data ar	10,622	1.3%
Big Data	Big data is a term for data sets that are so large or com	10,148	0.8%
Predictive Models	Predictive modeling uses statistics to predict outcomes.	9,414	12.5%
Artificial Intelligence	Artificial intelligence (AI, also machine intelligence, MI)	8,874	24.8%
Data Mining	Data mining is the computing process of discovering pa	8,573	-6.7%
Natural Language Processing	Natural language processing (NLP) is a field of compute	7,431	22.8%
Tableau	Tableau Software (tab-LOH) is a software company he	7,258	28.2%
Deep Learning	Working experience of Deep Learning. Deep Learning is	7,123	84.0%
SAS	SAS (previously Statistical Analysis System) is a softwar	6,915	4.3%
Data Visualization	Working experience with the creation and study of the	6,480	18.2%
Statistics	Statistics is a branch of mathematics dealing with the c	5,601	-2.6%

Source: Labor Insight (Burning Glass Technologies); Occupation Analysis - Data Scientist; Nationwide, United States

Further, in the DMV region, a search using keywords associated with the program (machine learning, artificial intelligence, natural language processing, data visualization, data science, business intelligence, Python) shows a very high demand (88,881 job postings), a projected growth of 40.1% over the next ten years, and a Location Quotient at its highest level (Very High) as per Burning Glass[11] (See Figure 5 below).

[10] Burning Glass: Data accessed 28 October 2020
[11] Burning Glass: Data accessed 29 October 2020

Figure 5: Burning Glass Data Science Skills Analysis, based on DMV Job Postings

Skill Analysis
Skill Cluster: Analysis: Machine Learning, Information Technology: Artificial Intelligence, Analysis: Natural Language Processing (NLP), Analysis: Data Visualization, Analysis: Data Science, Analysis: Business Intelligence, **Skill:** Python

The market data consistently shows high job growth for Data Scientists and demonstrates that these roles are harder to fill than others. The 2020 LinkedIn Emerging Jobs Report[12] reports that "Data science is booming and starting to replace legacy roles. Unsurprisingly, data science is a field that is seeing continued growth on a tremendous scale, but our data shows data scientists may be augmenting responsibilities traditionally done by statisticians as some industries, like insurance, gear up for the future."

Students seeking employment as data scientists will see a strong nationwide demand for their skills. Figure 6 below shows top industries where data scientists are hired, and figure 7 shows major employers who are hiring data scientists. Hiring of data scientists is generally ongoing in all sectors, but the top employers are in the fields of professional, scientific, and technical services along with Finance and Insurance. Health care, retail and manufacturing are increasingly adding positions for graduates in the field of data science and analytics. The BS in Data Science responds directly to this large unmet demand in these industries.

[12] LinkedIn:https://business.linkedin.com/content/dam/me/business/en-us/talent-solutions/emerging-jobs-report/Emerging_Jobs_Report_U.S._FINAL.pdf

Figure 6: Burning Glass Data Science jobs by Industry and Employers

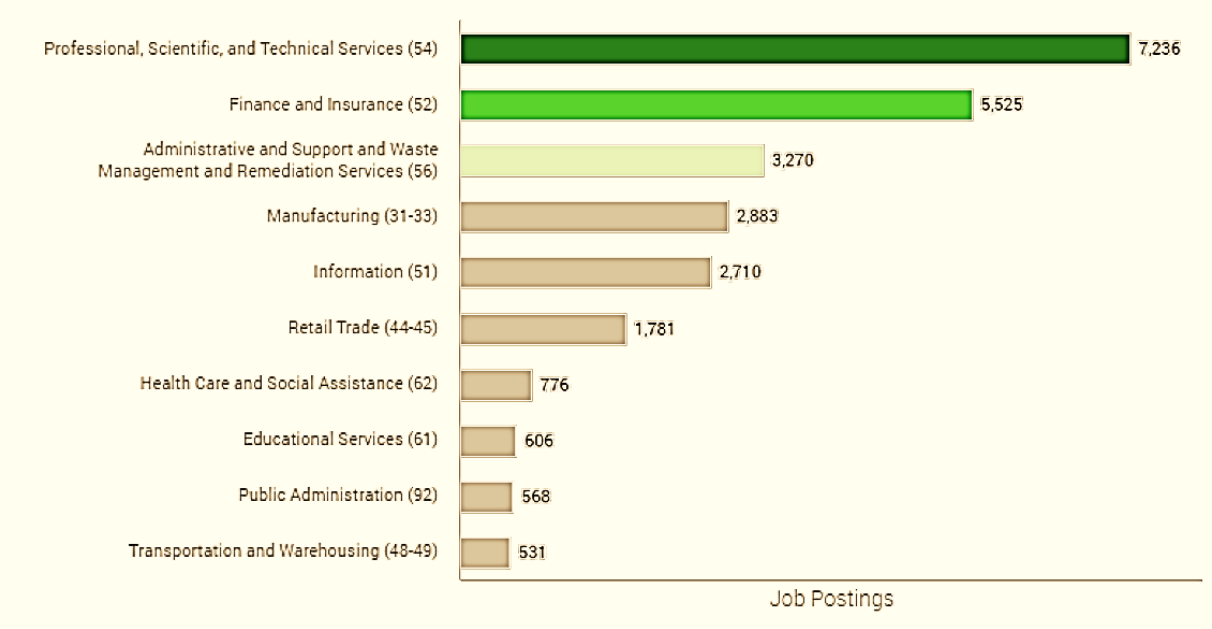
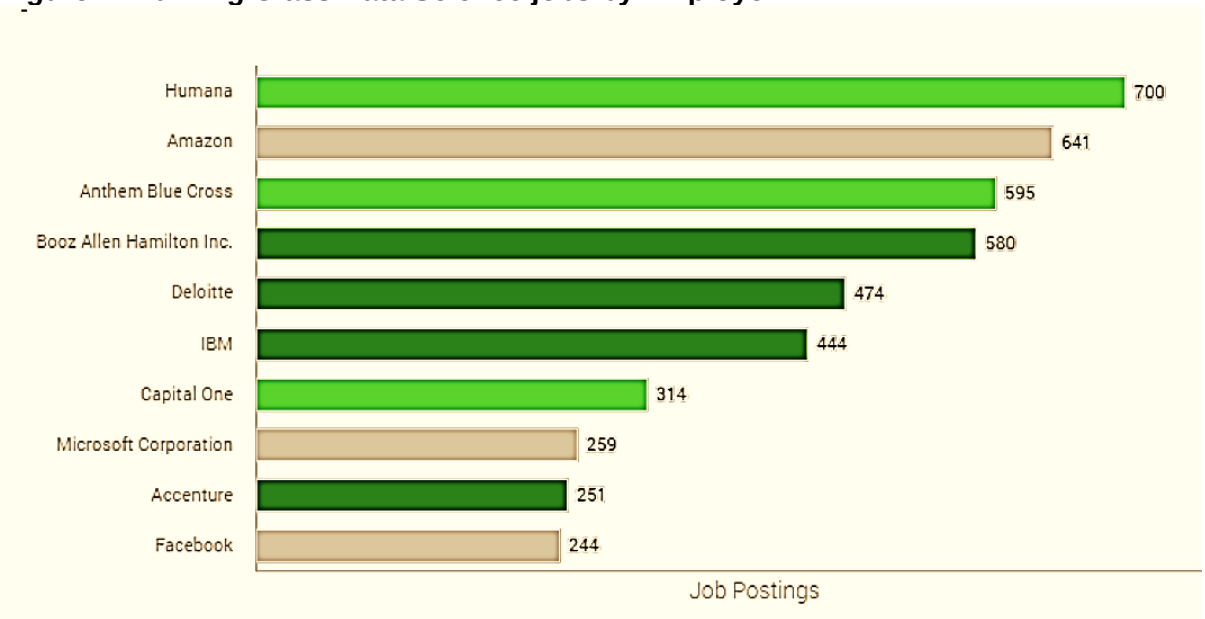


Figure 7: Burning Glass Data Science jobs by Employer



4. Provide data showing the current and projected supply of prospective graduates.

As the B.S. in Data Science is a newly introduced, multi-disciplinary classification of instructional program (CIP) under the 2020 revision of taxonomies, there are no pre-existing institutional degree-completion data to project prospective student demand. Moreover, traditionally, data science degrees have been awarded at the master's level; data science programs at the undergraduate level are relatively new for most schools across the country.

However, UMGC introduced the closely related Master of Science in Data Analytics in 2013, which has proved to be a popular offering for students, with 836 enrollments in 2019 and 829 enrollments in 2020. For a relatively new program, these enrollment numbers show durable prospective student demand, despite the advanced degree level, significant technical background and experience requirements, and a premium-program tuition rate. These are obstacles that the B.S. in Data Science program will not have.

Based on the totality of the market and job-demand data and the enrollment trends in technical fields at UMGC, our 5-year projected enrollment and graduate trend for the B.S. in Data Science are summarized in Table 1 below.

Table 1 Enrollment Projections

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

It is anticipated that approximately 50 degrees will be awarded each year after the degree is established and reaches steady state.

D. Reasonableness of Program Duplication:

1. **Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.**
2. **Provide justification for the proposed program.**

Ten years ago, the McKinsey Global Institute (MGI) and McKinsey's Business Technology Office[13] published ground-breaking research on the impact of big data on industries and employment. At the time, MGI estimated that by 2018 the United States would face a shortage of 140,000 to 190,000 people with "deep analytical skills," and highly specialized expertise in data science. The MGI report further identified that an additional 1.5 million professionals from across various content specialties would require "the know-how to use the analysis," the ability to use the results of data science in decision-making.

In the last decade, many universities have introduced courses and areas of concentration in data analytics to prepare managers and professionals in healthcare, business, marketing, finance and other fields for the use of the results of data science for decision-making. Fewer universities have tackled the task of preparing people with "deep analytical skills," by creating programs in Data Science and Data Analytics.

As the survey below illustrates, the existing programs tend to view the topic through specific lenses - e.g., a business management-based viewpoint or a mathematical-based viewpoint. In attempting to capture the diverse applications of data science, the approach has been to offer a variety of specializations within a major such as health care or economics. Perhaps as a consequence, the growing role of artificial intelligence and machine learning, as well as the important aspects of ethics and cybersecurity, have not been addressed in the core area of these programs. UMGC's proposed B.S. in Data

[13] Big data: The next frontier for innovation, competition, and productivity: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/big-data-the-next-frontier-for-innovation

Science program aims to address the "deep analytical skills" and data science expertise shortage, creating value and insights for decision-makers.

A review on December 7, 2020 of current bachelor's degree programs in data science on the Maryland Higher Education Commission website shows bachelor's degree programs in Data Science at four institutions in Maryland: Capitol Technology University, Salisbury University, Mount St. Mary's University, and Loyola University of Maryland. A fifth program in Integrative Data Analytics, offered by Goucher College, has a heavily math-based core, with either data science or economics as elective specializations. Tables 2 – 6 below compare and contrast UMGC's program with these programs.

Table 2: Comparison of UMGC Bachelor of Science in Data Science to Capitol Technology University (CTU)'s Bachelor of Science in Data Science

	UMGC Bachelor of Science in Data Science	**Capitol Technology University (CTU)'s Bachelor of Science in Data Science**
Degree Requirements and Structure (number of credits, a single required sequence vs. electives)	33 credits in the data science major, including 3 credits in cybersecurity; 7 credits in related requirements in math and statistics; 6 credits in related requirements in programming and information systems. All courses are required. No electives within the major.	42 credits in analytics (which includes 6 credits in programming); 33 credits in business management; 20 credits in math and science; Most courses are required; one elective in science
Delivery (onsite vs. online)	Online and asynchronous; no on-site requirements	Program requires on-site courses. Last two years are offered online.
Enrollment (full-time vs. part-time)	Over the past five years, approximately 75% of UMGC students registering for classes within the School of Cybersecurity and Information Technology did so on a part-time basis (6 credits per term). We expect this trend to continue.	Full-time and part-time students
Admissions Requirements/ Target Audience	UMGC is an open-admission institution.	High School Requirements: • at least a 2.2 grade point avg • SAT score of at least 800 or an ACT score of 17 (now optional to submit scores); • three years of math, including plane geometry and algebra II; • two years of science; and

		• two years of social science.
Primary Points of Differentiation in Requirements and Target Audience: The UMGC program is completely online and asynchronous. This provides extreme flexibility for working professionals and military affiliated learners around the world. UMGC is an open-admission institution.		
CIP Code	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.
Primary Points of Differentiation in CIP: No difference in CIP codes.		
Pedagogy and Learning Model	The curriculum is based on principles of competency- and performance-based learning. Authentic assessments are embedded throughout; students "learn by doing" through scenario-based projects grounded in real-world situations and problems and using interactive tools and case studies that incorporate applied learning.	CTU uses limited project-based learning in select classes; the overall approach is not competency-based.
Program Content	The UMGC program is broadly based, with courses in Data Science supplemented by courses in Mathematics, Business, Computer Science, Machine Learning and Ethics. The	The 42 credits of Capital Technology University's program in "Analytics" parallel's UMGC's curriculum; however, in contrast to UMGC, CTU's program is heavily rooted in business

	capstone is integrative, project-based and employer-centric. This major can be combined with many minors including business management, cybersecurity, health services management, gerontology, homeland security, political science, etc.	management, with 33 required credits in the major being devoted to business classes (in the "Business Management" area).
Primary Points of Differentiation in Pedagogy/Learning Model and Content: UMGC's program is focused on the theory and underlying technology of Data Analytics, and its application to *any* area where collection of data is involved. It uses a learning model based on the principles of competency- and project-based learning. The CTU program has a substantial emphasis on business-oriented courses. The overall approach is not competency-based; only select classes use project-based learning. UMGC's program is structured as a straight-line pathway, whereas CTU's programs allows for electives.		

Table 3: Comparison of UMGC Bachelor of Science in Data Science to Salisbury University's Bachelor of Science in Data Science		
	UMGC Bachelor of Science in Data Science	**Salisbury University's Bachelor of Science in Data Science**
Degree Requirements and Structure (number of credits, a single required sequence vs. electives)	33 credits in the data science major, including 3 credits in cybersecurity; 7 credits in related requirements in math and statistics; 6 credits in related requirements in programming and information systems. All courses are required. No electives within the major.	10-credit core in analytics; 16 credits in math; 8 credits in programming. All core courses are required; specialization within one of the following areas (14-20 credits, some elective choice): • Astrostatistics • Bioinformatics • Chemometrics • Computational Data Science • Geoanalytics • Mathematical Data Science
Delivery (onsite vs. online)	Online and asynchronous; no on-site requirements	On-site only
Enrollment (full-time vs. part-time)	Over the past five years, approximately 75% of UMGC students registering for classes within the School of Cybersecurity and Information Technology did so on a part-time basis (6 credits per term). We expect this trend to continue.	Full-time and part-time students

Admissions Requirements/ Target Audience	UMGC is an open-admission institution.	High School Requirements: • Standardized SAT or ACT test scores are required for applicants with below a 3.50 weighted cumulative grade point average. • Students wishing to enter college are encouraged to complete the college preparatory curriculum in high school.
Primary Points of Differentiation in Requirements and Target Audience: The UMGC program is completely online and asynchronous. This provides extreme flexibility for working professionals and military affiliated learners around the world. UMGC is an open-admission institution.		
CIP Code	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.
Primary Points of Differentiation in CIP: There is no difference in the CIP code. All new programs in the field are filled under the CIP 307001 established in 2020.		
Pedagogy and Learning Model	The curriculum is based on principles of competency- and performance-based learning and authentic assessments are embedded throughout; students "learn by doing" through scenario-based projects grounded in real-world situations and	

	problems and using interactive tools and case studies that incorporate applied learning.	
Program Content	The UMGC program is broadly based, with courses in Data Science supplemented by courses in Mathematics, Business, Computer Science, Machine Learning and Ethics. The capstone is integrative, project-based and company-centric. This major can be combined with many minors including business management, cybersecurity, health services management, gerontology, homeland security, political science, etc.	Salisbury University's program in heavily rooted in mathematics, with a small core in analytics. The application areas are highly specialized and also oriented towards mathematics and statistics.
Primary Points of Differentiation in Pedagogy/Learning Model and Content: UMGC's program is focused on the theory and underlying technology of Data Analytics, and its application to *any* area where collection of data is involved. In terms of program content, the SU program is heavily rooted in Mathematics. UMGC's program is structured as a straight-line pathway, whereas Salisbury's program includes electives.		

Table 4: Comparison of UMGC Bachelor of Science in Data Science to Mount Saint Mary's University's Bachelor of Science in Data Science

	UMGC Bachelor of Science in Data Science	**Mount Saint Mary's University's Bachelor of Science in Data Science**
Degree Requirements and Structure (number of credits, a single required sequence vs. electives)	33 credits in the data science major, including 3 credits in cybersecurity; 7 credits in related requirements in math and statistics; 6 credits in related requirements in programming and information systems. All courses are required. No electives within the major.	18 core credits in data science; 9 credits in computer science/programming; 7 credits in math; one data skills elective 15 credits in an application area (5 elective course choices): • Computational Science • Data Engineering • Operations Research • Analytics for Business
Delivery (onsite vs. online)	Online and asynchronous; no on-site requirements	On-site only
Enrollment (full-time vs. part-time)	Over the past five years, approximately 75% of UMGC	Full-time and part-time students

	students registering for classes within the School of Cybersecurity and Information Technology did so on a part-time basis (6 credits per term). We expect this trend to continue.	
Admissions Requirements/ Target Audience	UMGC is an open-admission institution.	Application Requirements: • High School Recommendation: 4 years of English, 3 years of mathematics, 3 years of science, 2 years of one foreign language, and 3 years of social studies/history. • Adult undergraduate applicants must have completed 12 credits with a 2.0 average and have three years of work experience.
Primary Points of Differentiation in Requirements and Target Audience: The UMGC program is completely online and asynchronous. This provides extreme flexibility for working professionals and military affiliated learners around the world. UMGC is an open-admission institution.		
CIP Code	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.
Primary Points of Differentiation in CIP: There is no difference in the CIP code. All new programs in the field are filled under the CIP 307001 established in 2020.		

Pedagogy and Learning Model	The curriculum is based on principles of competency- and performance-based learning and authentic assessments are embedded throughout; students "learn by doing" through scenario-based projects grounded in real-world situations and problems and using interactive tools and case studies that incorporate applied learning.	
Program Content	The UMGC program is broadly based, with courses in Data Science supplemented by courses in Mathematics, Business, Computer Science, Machine Learning and Ethics. The capstone is integrative, project-based and company-centric. This major can be combined with many minors including business management, cybersecurity, health services management, gerontology, homeland security, political science, etc.	As a liberal arts institution, Mount Saint Mary's University has a large core curriculum requirement (46-49 hours). A Minor in Data Science exists.
Primary Points of Differentiation in Pedagogy/Learning Model and Content: UMGC's program is focused on the theory and underlying technology of Data Analytics, and its application to *any* area where collection of data is involved. Its core consists of 33 credits. Mt. St. Mary's program has a much larger core. UMGC's program is structured as a straight-line pathway, Mt. St. Mary's program includes electives.		

Table 5: Comparison of UMGC Bachelor of Science in Data Science to Loyola University of Maryland's Bachelor of Science in Data Science

	UMGC Bachelor of Science in Data Science	**Loyola University of Maryland's Bachelor of Science in Data Science**
Degree Requirements and Structure (number of credits, a single required sequence vs. electives)	33 credits in the data science major, including 3 credits in cybersecurity; 7 credits in related requirements in math and statistics; 6 credits in related requirements in programming and information systems. All courses are	An interdisciplinary program of 15 courses (about 45 credits) from information systems, data science, math, statistics and programming. 3 course electives chosen from the above disciplines plus economics.

	required. No electives within the major.	Loyola offers an ethical data science course.
Delivery (onsite vs. online)	Online and asynchronous; no on-site requirements	On-site only
Enrollment (full-time vs. part-time)	Over the past five years, approximately 75% of UMGC students registering for classes within the School of Cybersecurity and Information Technology did so on a part-time basis (6 credits per term). We expect this trend to continue.	Full-time and part-time students
Admissions Requirements/ Target Audience	UMGC is an open-admission institution.	Admissions Target Audience: • Loyola weighs high school grades heavily in admissions decisions. • Students are encouraged to take rigorous coursework, such as honors or AP courses • Students accepted into the class of 2024 had an average GPA of 3.66.
Primary Points of Differentiation in Requirements and Target Audience: The UMGC program is completely online and asynchronous. This provides extreme flexibility for working professionals and military affiliated learners around the world. UMGC is an open-admission institution.		
CIP Code	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.	110401 Title: Information Science/Studies Definition: A program that focuses on the theory, organization, and process of information collection, transmission, and utilization in traditional and electronic forms. Includes instruction in information classification and organization; information storage and processing; transmission, transfer, and signaling; communications and networking; systems planning and design; human interfacing and use analysis; database development; information policy analysis; and related aspects of

		hardware, software, economics, social factors, and capacity.
Primary Points of Differentiation in CIP: UMGC application is under the CIP code 307001 that was defined in 2020 to reflect the evolving field of Data Science. Previously established related programs like Loyola University's used CIP codes that more closely reflect the main focus of their program, in this case, Information Systems.		
Pedagogy and Learning Model	The curriculum is based on principles of competency- and performance-based learning. Authentic assessments are embedded throughout; students "learn by doing" through scenario-based projects grounded in real-world situations and problems and using interactive tools and case studies that incorporate applied learning.	
Program Content	The UMGC program is broadly based, with courses in Data Science supplemented by courses in Mathematics, Business, Computer Science, Machine Learning and Ethics. The capstone is integrative, project-based and company-centric. This major can be combined with many minors including business management, cybersecurity, health services management, gerontology, homeland security, political science, etc.	The Loyola data science program concentrates on the analytical and computational skills required within the data science field.
Primary Points of Differentiation in Pedagogy/Learning Model and Content: UMGC's program is focused on the theory and underlying technology of Data Analytics, and its application to *any* area where collection of data is involved. The Loyola program is focused on analytical and computational skills. UMGC's program is structured as a straight-line pathway, Loyola's program includes electives.		

Table 6: Comparison of UMGC Bachelor of Science in Data Science to Goucher College's Bachelor of Science in Integrative Data Analytics		
	UMGC Bachelor of Science in Data Science	**Goucher College's Bachelor of Science in Integrative Data Analytics**

Degree Requirements and Structure (number of credits, a single required sequence vs. electives)	33 credits in the data science major, including 3 credits in cybersecurity; 7 credits in related requirements in math and statistics; 6 credits in related requirements in programming and information systems. All courses are required. No electives within the major.	4 credits in computer science and 20 credits in math and statistics are required. Some elective choice is available. Machine learning is an option. Two specializations are available: data science (16 credits) or economics (16 credits).
Delivery (onsite vs. online)	Online and asynchronous; no on-site requirements	On-site only
Enrollment (full-time vs. part-time)	Over the past five years, approximately 75% of UMGC students registering for classes within the School of Cybersecurity and Information Technology did so on a part-time basis (6 credits per term). We expect this trend to continue.	Full-time and part-time students
Admissions Requirements/ Target Audience	UMGC is an open-admission institution.	Admissions Target Audience: • 46% of Class of 2023 students were in the top 25% of their high school graduating class • 16 units of college prep coursework is recommended • Goucher has a separate admissions process, Goucher II, for adult undergraduates
Primary Points of Differentiation in Requirements and Target Audience: The UMGC program is completely online and asynchronous. This provides extreme flexibility for working professionals and military affiliated learners around the world. UMGC is an open-admission institution.		
CIP Code	307001 Title: Data Science Definition: A program that focuses on the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, data representation, data modeling, mathematics, and statistics. Includes instruction	300801 Title: Mathematics and Computer Science Definition: A program with a general synthesis of mathematics and computer science or a specialization which draws from mathematics and computer science.

	in computer algorithms, computer programming, data management, data mining, information policy, information retrieval, mathematical modeling, quantitative analysis, statistics, trend spotting, and visual analytics.	
Primary Points of Differentiation in CIP: UMGC application is under the CIP code 307001 that was defined in 2020 to reflect the evolving field of Data Science. Goucher College used CIP 300801code that more closely reflects the main focus of the program, in this case, Integration of Mathematics and Computer Science.		
Pedagogy and Learning Model	The curriculum is based on principles of competency- and performance-based learning. Authentic assessments are embedded throughout; students "learn by doing" through scenario-based projects grounded in real-world situations and problems and using interactive tools and case studies that incorporate applied learning.	
Program Content	The UMGC program is broadly based, with courses in Data Science supplemented by courses in Mathematics, Business, Computer Science, Machine Learning and Ethics. The capstone is integrative, project-based and company-centric. This major can be combined with many minors including business management, cybersecurity, health services management, gerontology, homeland security, political science, etc.	The Integrative Data Analytics major has three parts: Entry, Exploration and Specialization. The Entry and Exploration phases are heavily rooted in mathematics and statistics. A capstone is offered in the Data Science specialization. Machine learning is available as an option in the Exploration phase. Neither machine learning nor artificial intelligence are required for students taking the Economics specialization.
Primary Points of Differentiation in Pedagogy/Learning Model and Content: UMGC's program is focused on the theory and underlying technology of Data Analytics, and its application to *any* area where collection of data is involved. In terms of program content, UMGC's program offers a straight-line pathway, while Goucher's program has specializations. Several courses in machine learning and artificial intelligence are required in the UMGC data science program, whereas these topics appear as electives (only in the Core and Data Science Specialization areas), in Goucher's program.		

UMGC is aware of a recent proposal submitted to MHEC by The University of Maryland College Park (UMCP) to create a B.S. program in Data Science. It appears that this program seeks to serve a distinctly different population – students who would normally pursue UMCP programs such as Computer Science, Mathematics, or Statistics but who happen to be interested in the emerging field of Data Science. Such students would have to meet UMCP's entrance requirements. UMCP's program will draw upon courses in computer science, mathematics, statistics, and a required set of new data courses. The program seeks to combine scientific methods, processes, and algorithms, to extract knowledge from data. At this time, it appears that the program will be offered in-person.

UMGC's program, in contrast, is open-entry, offered online, and serves the needs of working-adult learners and world-wide students who are active-duty military, or veterans, and their families. The focus of the program is also different. UMGC's program seeks to train students who can transform the increasing amounts of data into usable forms; familiarize students with a variety of analytical tools available for the purpose of organizing large data sets; and help students acquire fundamental knowledge and skills in data science that will equip them to adapt to future changes in tools, technology, and the marketplace. Courses which address only the required fundamental knowledge of programming, mathematics and statistics are included within the program, apart from the other DATA courses.

UMGC carefully reviews letters of Intent from other University System of Maryland institutions that are distributed to USM schools prior to full proposals being submitted to MHEC so that any potential concerns about program duplication (or other matters) can be discussed and resolved collegially by the concerned institutions. It is our goal that new programs being proposed are not in competition with, or unnecessarily duplicative of existing programs. This is in keeping with guidelines outlined in the recently circulated letter (10/1/2020) from MHEC to University Presidents.

These guidelines (in Section 3 on Unreasonable program duplication) state that "Ordinarily, proposed programs in undergraduate core programs consisting of basic liberal arts and sciences disciplines are not considered unnecessarily duplicative". As noted earlier (see Section A), the emerging area of data science plays much the same role as any other discipline in science, in that the knowledge and skills addressed within data science have wide applicability in every other field of knowledge or activity where large amounts of data are collected and analyzed. It is worth noting here that in today's age of the Internet of Things (IoT), generation of large amounts of data is the norm. The data provided in Section C makes it clear that there is a tremendous current need, and fast-growing future need, both in the DMV area and nationwide, of professionals who hold a bachelor's degree with skills that are addressed within the data science discipline. This large, critical need needs to be met with the combined efforts of multiple institutions working in unison, each institution targeting different aspects of the program and/or market needs, and each having the capacity to scale its programs to meet these needs.

In summary, UMGC's online B.S. in Data Science has justifiable and useful points of differentiation from the other programs enumerated in this section. The proposal documents how 1) the proposed program responds directly to a well-sourced market demand that no single institution in Maryland or elsewhere can reasonably supply and, 2) the evidence presented throughout our proposal documents the specific student-type and delivery modality unique to UMGC.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBIs.

A search performed on December 7, 2020, of MHEC's inventory of approved academic programs in Maryland found no bachelor's degree programs in data science at HBIs in Maryland. This includes the four Historically Black Institutions in Maryland (Bowie State University, Coppin State University, University of Maryland Eastern Shore, and Morgan State University). UMGC's proposed program will, therefore, have no impact on high demand programs at HBIs.

F. Relevance to the identity of Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBIs.

A search performed on December 7, 2020, of MHEC's inventory of approved academic programs in Maryland found no bachelor's degree programs in data science at HBIs in Maryland. This includes the four Historically Black Institutions in Maryland (Bowie State University, Coppin State University, University of Maryland Eastern Shore, or Morgan State University). UMGC's proposed program will, therefore, have no impact on the uniqueness and institutional identities and missions of the HBIs.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10):

1. Describe how the proposed program was established, and also describe the faculty who will oversee the program.

Like many universities, UMGC began its first steps in data science at the master's level, with a Master of Science in Data Analytics in 2013. Data Science was initially viewed as primarily a graduate level discipline, given the complexity of the content and the techniques and tools utilized in the field. Since those early years, data analytics and data science concepts, tools and techniques have been widely adopted in all areas of the economy, all levels of government, and in the non-profit sector. This has created a rapidly emerging market of entry-level jobs accessible with a bachelor's degree. According to the market research presented in section C, 61% of data scientist and advanced analysis positions will be available to bachelor's degree holders, while 39% will require a master's degree or a PhD.

The B.S. in Data Science aims to prepare bachelor's-level professionals to enter this dynamic job market, leveraging the teaching and professional expertise of UMGC's existing master's program. The bachelor's program will align with the needs of employers via competency- and project-based teaching and learning approaches and will provide employment-ready data science skills to its graduates. The program is designed to provide critical foundational knowledge of the analysis of large-scale data sources from the interdisciplinary perspectives of applied statistics, computer science, data storage, and data representation and modeling, with the purpose of obtaining insights from data and making strategic data-driven recommendations that influence organizations' outcomes. The program's curriculum incorporates teaching, learning, and assessment strategies that focus on students' development of concrete, job-related knowledge and skills, while reinforcing their understanding of underlying concepts,

principles and theories. The program combines study in several technical disciplines to prepare highly qualified data scientists with strong career potential and aligns with the Association for Computing Machinery (ACM) Undergraduate Data Science Curriculum Recommendations.[14]

The proposed program will be taught entirely online in asynchronous mode and will allow UMGC to further support its mission to teach adult learners in Maryland, across the country, and around the world. This request aligns with UMGC's mission to offer high quality, workplace-relevant academic programs that expand the range of career opportunities to adult students. Specifically, the addition of the B.S. in Data Science diversifies credential options for our working adult and military-affiliated populations, responding to adult learners' need for a variety of pathways to credentials in higher education.

The proposed program will be hosted in the School of Cybersecurity and Information Technology's Department of Information Technology and will be managed concurrently with the Master of Science in Data Analytics by the Program Director, Dr. Elena Gortcheva.

2. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.

The Major consists of 11 courses (33 credits, see Section G.4.) plus related mathematics and computer programming courses. Some courses will be sequenced, requiring students to take them in a prescribed order.

Program Learning Goals are as follows:

1. Communicate effectively in writing and orally, meeting expectations for content, purpose, organization, audience, and format.
2. Implement all stages of data science methodology including data extraction, data cleaning, data load, and transformation.
3. Execute best practices, using diverse technologies, within data science, business intelligence, machine learning and artificial intelligence.
4. Analyze social, global and/or ethical issues and implications related to the use of existing and emerging data science, machine learning and/or artificial intelligence technologies.
5. Evaluate a business problem or opportunity to determine the extent data science can provide a viable solution and translate the business problem into a viable project to meet organizational strategic and operational needs.
6. Incorporate data security, data privacy and risk management best practices in the planning, development, and implementation of data science solutions.
7. Build and deploy the machine learning process throughout its life cycle in full compliance with best practices for tool evaluation, model selection, and model validation.
8. Leverage big data analytics and AI technology to create solutions for stream analytics, text processing, natural language understanding, AI and cognitive applications.

[14] http://dstf.acm.org/DSReportDraft2Full.pdf

9. Collaborate with team members to plan, evaluate, implement, and document data science solutions.

The first five courses in the program provide a foundation in the principles, concepts, and applications underlying data science and comprise an embedded and stackable certificate in Business Analytics. The Business Analytics certificate would be a readily accessible and highly marketable option for students from all three UMGC Schools.

The heart of the B.S. program is the set of six courses that follow. These are focused on building data science skills that include data manipulation, visualization, machine learning, AI, predictive modeling, and use of the appropriate technology to extract insights from data and provide recommendations to meet organizational strategic and operational needs. The program offers a project-based curriculum that integrates both required technical competencies and essential managerial skills. These skills are threaded throughout the curriculum and were identified through interactions with industry leaders and analysis of market trends and job skills. Technical skills are two-tiered – in the first tier, a strong foundation in statistical and machine learning algorithms and in the second tier, experience in technology and software tools needed to tackle real-world problems. This second tier is dynamic and changes with industry needs. Students gain experience in a variety of software packages and other tools that enable them to perform data preparation, mining, and visualization. The focus of the program is to successfully employ a variety of software and statistical tools to analyze data sets and solve business problems and, at the same time, analyze social, global, and/or ethical issues and implications related to the use of existing and emerging data science, machine learning, and/or artificial intelligence technologies.

The capstone course focuses on the comprehensive application of skills and knowledge acquired in the program to solve a real-world analytical problem. Software tools are used in one or more case studies mirroring the challenges that organizations are facing today. At the conclusion of the program, students will earn a B.S. in Data Science and a certificate in Business Analytics and be prepared for selected industry certifications.

Appendix C shows the mapping of the program learning goals to the core courses in the major.

3. Explain how the institution will:

a) provide for assessment of student achievement of learning outcomes in the program

b) document student achievement of learning outcomes in the program

UMGC approaches learning design from an “Understanding by Design” perspective, utilizing a backward design model. This approach begins with identifying the program learning goals that a student will achieve through the program of study. The program learning goals are mapped first to the Degree Qualification Program (DQP) to ensure that the set of learning goals are comprehensive and appropriate for the degree level. In addition, the program learning goals are mapped against UMGC institutional learning goals to validate that the program aligns with the university mission and institutional goals.

Once the program learning goals have been validated through mapping to the DQP and institutional learning goals, the program learning goals are mapped to the courses in the

program. This step ensures that all program learning goals are addressed in the curriculum and provide guidance in the development of the courses to ensure that each course contributes to the program learning goals without unnecessary duplication of outcomes across courses.

Using the mapping of institutional learning goals to courses, key assignments are identified in courses for use in assessing student achievement of program learning goals. Periodically, a random sample of student artifacts for these identified key assignments are collected and reviewed by faculty to assess how effectively students are meeting the program learning goals.

Using student learning assessment results along with non-direct measures of student learning including student retention and market and labor data, program directors produce an annual review of program quality. For new programs, these annual reviews are integrated into an Academic Program Review including external review after 5 years. After this initial review, programs continue the annual review every year with an Academic Program Review every 7 years.

In November 2020, UMGC licensed AEFIS as its assessment management system. AEFIS will be the central repository for program learning goals, assessment maps, and student artifacts. AEFIS integrates with the D2L LMS to allow student work to be duplicated from the LMS into AEFIS for assessment purposes. This process ensures that assessment review is independent of grades and evaluation within the class and allows for independent review of student work apart from the classroom faculty. AEFIS also holds annual program review reports.

4. **Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements**

    a) Related Requirements

CMIS 102 Introduction to Problem Solving and Algorithm Design (3 credits)
A study of techniques for finding solutions to problems through structured programming and step-wise refinement. The objective is to design programs using pseudocode and implement them in an appropriate programming language. Hands-on practice in debugging, testing, and documenting is provided. Topics include principles of programming, the logic of constructing a computer program, and the practical aspects of integrating program modules into a cohesive application. Algorithms are used to demonstrate programming as an approach to problem solving.

IFSM 201 Concepts and Applications of Information Technology (3 credits)
An introduction to data and the range of technologies (including hardware, software, databases, and networking and information systems) that provide the foundation for the data-centric focus of modern organizations. The objective is to apply knowledge of basic technical, ethical, and security considerations to select and use information technology (and the data that arises from technology) effectively in one's personal and professional lives. Discussion covers issues related to technology as a vehicle for collecting, storing, and sharing data and information, including privacy, ethics, security, and social impact. Applied exercises focus on the manipulation, analysis, and visualization of data and effective data communication strategies.

MATH 140 Calculus I (4 credits)
Prerequisite: MATH 108 or MATH 115. An introduction to calculus. The goal is to demonstrate fluency in the language of calculus; discuss mathematical ideas appropriately; and solve problems by identifying, representing, and modeling functional relationships. Topics include functions, the sketching of graphs of functions, limits, continuity, derivatives and applications of the derivative, definite and indefinite integrals, and calculation of area.

STAT 200 Introduction to Statistics (3 credits)
An introduction to statistics. The objective is to assess the validity of statistical conclusions; organize, summarize, interpret, and present data using graphical and tabular representations; and apply principles of inferential statistics. Focus is on selecting and applying appropriate statistical tests and determining reasonable inferences and predictions from a set of data. Topics include methods of sampling; percentiles; concepts of probability; probability distributions; normal, t-, and chi-square distributions; confidence intervals; hypothesis testing of one and two means; proportions; binomial experiments; sample size calculations; correlation; regression; and analysis of variance (ANOVA).

b) Program Requirements

DATA 220: Introduction to Data Analytics (3 credits)
Prerequisite: STAT 200. Practical introduction to the methodology, practices, and requirements behind data science to ensure data is relevant and properly manipulated to solve problems and address a variety of real-world projects and business scenarios. Focus is on the foundational statistical concepts applied to describing datasets with summary statistics, simple data visualizations, statistical inference and predictive analytics. Through probability, hypothesis testing, and linear model building, students will use data to draw conclusions about the underlying patterns that drive everyday problems.
.

DATA 300: Foundations of Data Science (3 credits)
Prerequisites: CMIS 102, IFSM 201, DATA 220. An examination of the role of data science within a business and society. The goal is to identify a problem, collect and analyze data, select the most appropriate analytical methodology based on the context of the business problem, build a model, and understand the feedback after model deployment. Practical emphasis is on the process of acquisition, cleaning, exploring, analyzing, and communicating data obtained from variety of sources. Assignments will require working with data in programming languages such as Python, wrangling data programmatically and preparing data for analysis, using libraries like NumPy and Pandas.

CSIA 300: Cybersecurity for Leaders and Managers (3 credits)
(Designed in part to help prepare for the EC-Council Secure Computer User [CSCU] certification.) Prerequisite: Any CMIS, CMSC, CMIT, CMST, CSIA, IFSM, or SDEV. Recommended: IFSM 201. A survey of the cybersecurity principles, practices, and strategies required by leaders and managers to become strategic partners in the establishment, management, and governance of an enterprise's cybersecurity program. The aim is to develop both an understanding of how cybersecurity supports key business goals and objectives and the essential skills necessary for success in a

leadership or managerial role. Topics include the fundamentals of cybersecurity practices and principles; enterprise IT governance processes and security controls; data security; the information life cycle; intellectual property protections; privacy laws and regulations; security education, training, and awareness; and the need for cooperation and collaboration between business units and the organization's cybersecurity program.

IFSM 330: Business Intelligence and Data Analytics (3 credits)
Recommended: IFSM 201. A hands-on, project-based introduction to databases, business intelligence, and data analytics. The aim is to design secure industry-standard databases and utilize business intelligence and data analytics techniques and technologies to support decision making. Topics include data and relational databases, SQL queries, and business intelligence tools, including alignment with business strategy.

DATA 331: Data Visualization (3 credits)
Prerequisites: DATA 220, DATA 330. A presentation of the fundamentals of data visualization principles in the context of business and data science. Practical focus on data visualization of different data types including time-series, multidimensional data, creating dynamic tables, heatmaps, infographs, and dashboards. Hands-on projects will require exploring data visually at multiple levels to find insights to create a compelling story and incorporating visual design best practices to better communicate insights to the intended audience, such as business stakeholders. Projects are selected from a wide range of content areas such as retail, marketing, healthcare, government, basic sciences, and technology.

CMSC 437: Machine Learning (3 credits)
Prerequisite: DATA 300. A hands-on introduction to the Machine Learning principles and methods that can be applied to solve practical problems. Topics include supervised and unsupervised learning with focus on linear regression, logistic regression, decision tree, naïve Bayes and clustering analysis. Focus is on using data from a wide range of domains such as healthcare, finance, marketing, and government to build predictive models, applied to make informed decisions. Additional topics include the handling of missing data, performing cross-validation to avoid overtraining, evaluating classifiers, and measuring precision.

DATA 440: Advanced Machine Learning (3 credits)
Prerequisites: CMSC 437, MATH 140. A project-based study of advanced concepts and applications in machine learning such as neural networks, support vector machines (SVM), ensemble models, deep learning, and reinforced learning. The emphasis is on building predictive models for practical business and social problems, developing complex and explainable predictive models, assessing classifiers and comparing their performance. All stages of the machine learning life cycles are developed, following industry best practices for selecting methods and tools to build ML models, including Auto ML.

DATA 445: Advanced Data Science (Big Data) (3 credits)
Prerequisites: DATA 331, DATA 437. A project-based introduction to the concepts, approaches, techniques and technologies for managing and analyzing large data sets in support of improved decision-making. The course will employ technologies such as Spark, Hive, Pig, Kafka, Hadoop, HBase, Flume, Cassandra, cloud analytics, container architectures, and streaming real-time platforms. Additional topics include how to identify the kinds of analyses to use with big data and how to interpret the results.

CMSC 447: Artificial Intelligence Solutions (3 credits)
(Designed to help prepare for the AWS Certified Machine Learning or Microsoft Designing and Implementing an Azure AI Solution exam.) Prerequisite: CMSC 437. A hands-on, project-based study of artificial intelligence and machine learning solutions to complex problems. Topics include natural language processing, computer vision, and speech recognition.

DATA 450: Data Ethics (3 credits)
Prerequisite: CMSC 437. Recommended: CSIA 300. A study of ethics within the context of data science, machine learning and artificial intelligence. The emphasis is on examining data and model bias, building explainable, fair, trustable, and accurate predictive modeling systems, and on reporting responsible results. Additional topics include the technology implications of human-centered machine learning and artificial intelligence on decision-making in organizations and government and the broader impact on society, including multinational and global effects.

DATA 495: Capstone
Prerequisites: DATA 440, DATA 445, DATA 450. The course requires completion of a major analytics project designed to apply the knowledge, technical skills, and critical thinking skills acquired during the degree program that can showcase the student's data science expertise to prospective employers. Projects are completed individually, including all phases of machine learning life cycles, and include a peer reviewed final report and presentation. Topics are selected from student-affiliated organizations or employers, special government/private agency requests, or other faculty approved sources in a wide range of domains such as healthcare, financial services, marketing, sciences and government.

5. **Discuss how general education requirements will be met, if applicable.**

All UMGC undergraduate students are required to complete 41 credit hours in general education requirements. These requirements include courses in writing and communications, arts and humanities, social and behavioral sciences, natural sciences, mathematics, technology, and research. See Appendix B for the Bachelor of Science in Data Science Degree Planning Course Sequence Sheet, which includes required major and related courses, and required and recommended General Education courses.

6. **Identify any specialized accreditation or graduate certification requirements for this program and its students**.

N/A

7. **If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**

N/A

8. **Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum,**

course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management systems, availability of academic support services and financial aid resources, and costs and payment policies.

UMGC maintains a comprehensive website that houses all updated information about its programs. Students will have access to degree requirements, course catalogs, course schedules, and other pertinent information about the program.

The website also provides specific and clear information about technology requirements for UMGC students, information and training on the learning management system, and other resources to maximize students' learning experience.

A variety of support services are available to students for academic assistance (Tutoring, Writing Center), as well as technical support and financial aid.

UMGC students are guided by the Student Handbook that is available online and serves as a general guide for all current and prospective students.

9. **Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.**

All Bachelor of Science in Data Science program-related communications (advertising, recruiting and admission materials) are done in conjunction with UMGC-wide institutional communication strategy, which adheres to the principle of truth in advertising. All written and electronic materials prepared for prospective students for purpose of recruitment will accurately and clearly represent the courses, the program, and services available.

H. Adequacy of Articulation

1. If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.

UMGC has a number of existing articulations with community colleges, both within the state of Maryland and nation-wide, in computing and IT, reflecting the national and international reach of our service capacity. UMGC has a flexible and convenient transfer policy – accepting up to 70 credits from community colleges – and we also offer a "completion scholarship," whereby students who complete their 2-year degree at a local community college are guaranteed admission to UMGC as well as a tuition rate which will allow recipients of the scholarship to complete the four-year degree for $12,000 or less. New articulations can easily be created between the proposed B.S. program and Data Science-related programs offered by community colleges, offering students from these community college a seamless pathway to a four-year degree in Data Science.

I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).

1. **Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach in the proposed program.**

UMGC's model employs full-time faculty (known as collegiate faculty) in faculty leadership roles, such as Department Chairs and Program Directors, with responsibility for the overall intellectual coherence and integrity of the program. Other collegiate faculty teach and serve in complementary roles that maintain and support the academic programs, providing input into the design and content of the program and their courses. This core group of full-time collegiate faculty will support the Adjunct faculty in teaching the program courses.

In keeping with UMGC's emphasis on workplace relevance, the Bachelor of Science in Data Science teaching faculty will be practicing professionals who teach part-time for UMGC. These adjunct faculty provide instruction for the majority of courses (which is true for all programs at all levels at UMGC). This model is responsible for one of UMGC's greatest strengths: scholar-practitioner faculty who have solid academic credentials and continue to work outside the university, providing a continuous infusion of current workplace knowledge, career-relevant perspectives, and maximum flexibility for adapting to changing student demand and rapidly changing industries and technologies. In this way, UMGC supports students in a learning experience that is practical and relevant to today's competitive and evolving global marketplace. Many adjuncts have considerable experience with UMGC. Collegiate and adjunct faculty both hold academic rank and title, based on their academic qualifications and professional experience, including teaching experience at UMGC. Since 1996 UMGC has held a MHEC-approved waiver of the Code of Maryland (COMAR) requirements for total credit hours taught by full-time faculty (Appendix A).

The centrality and appropriateness of UMGC's faculty model relative to its educational mandate and mission were reaffirmed by MHEC in its 2016 review of mission statements, as evidenced in the following excerpt from the Commission's report:

> UMUC intentionally seeks highly-qualified full-time and adjunct faculty who have hands-on experience in the disciplines they teach and who can leverage that experience to provide a richer learning experience for students. The university's mission to serve adult students is supported by adjunct faculty who are scholar-practitioners engaged daily in their profession. The ability to employ adjunct faculty is critical to UMUC's capacity to quickly deploy academic and continuing education programs in response to workforce-related needs. This entrepreneurship and flexibility in establishing new programs is particularly important to the university: given its history of very limited state support, the university's financial model is based on tuition revenues, and all programs must be self-supporting.[15]

Consistent with this model, UMGC has a substantial roster of faculty with expertise in areas related to Data Science. Teaching effectiveness is monitored by class observation, student course evaluations, and program-specific, student-level competency assessment. The School of Cybersecurity and Information Technology already has an active unit of faculty qualified and prepared to teach courses in the proposed program and we constantly recruit additional faculty.

[15] Source: Maryland Higher Education Commission (December 2015), Mission Statement Review: http://mhec.maryland.gov/institutions_training/Documents/acadaff/2016MissionStatementReview.pdf

The following is a partial list of faculty with their graduate degree title(s), academic title/rank, and the courses they will teach:

Name	Appointment Type and Rank	Graduate Degree(s), and Field	Status	Course(s) to be Taught
Elena Gortcheva	Program Director/ Collegiate Professor	PhD, Computer Engineering	Full-time	DATA 440, DATA 445, CMSC 447, CMSC437 DATA 450, DATA 495
Christopher Schultz	Collegiate Professor	PhD, Educational Thought and Sociocultural Studies; MBA; MS Computer Science	Full-time	IFSM 201, DATA 220, IFSM 330, DATA 331, DATA 450, DATA 495
TBD	Collegiate Faculty	TBD	Full-time	TBD
Caroline Beam	Adjunct Professor	PhD, Operations Research	Adjunct	DATA 300, DATA 331
Charles Knode	Adjunct Professor	PhD, Industrial Technology	Adjunct	DATA 440, DATA 450, CMSC 447, DATA 495
Solomon Britto	Adjunct Assistant Professor	DBA, Doctor of Business Administration	Adjunct	IFSM 201, DATA 220
Jon Brundage	Adjunct Professor	PhD, Information Technology	Adjunct	IFSM 201, DATA 220
Aaron Ferguson	Adjunct Professor	PhD, Applied Mathematics and Statistics	Adjunct	IFSM 201, DATA 220, IFSM 330, CMSC 437, DATA 440
Michele A. Washington	Adjunct Professor	PhD, Information Systems	Adjunct	IFSM 201, DATA 220
Edward Herranz	Adjunct Associate Professor	PhD, Computer Science	Adjunct	DATA 300, CMSC 437, DATA 447, DATA 445
Firdu Batti	Adjunct Associate Professor	PhD, Computer Science	Adjunct	DATA 300, CMSC 437, DATA 447, CMSC 447

Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidenced-based best practices, including training in:

a) Pedagogy that meets the needs of the students

UMGC is committed to providing pedagogy training in support of student learning throughout the faculty life cycle with the institution. FACDEV 411, our required New

Faculty Academic Orientation, is a two-week, facilitated online training that covers the history of UMGC, pedagogy of adult learning, facilitating online learning, and providing additional support for students through UMGC's Library, Effective Writing Center, and Office of Accessibility Services. Parallel required training courses exist for faculty teaching hybrid courses.

In addition, faculty members have access to just-in-time professional development opportunities such as our bi-monthly webinars; self-paced workshops on pedagogical and LMS-related matters; quick guides on online classroom support and technology; and a variety of Skillsoft courses.

b) The learning management system

UMGC provides multiple touchpoints to ensure thorough orientation to and continued education about our Learning Management System (LMS), Desire2Learn. Building on the materials provided in FACDEV 411, UMGC offers workshops on grading strategies; the integration of audio and video feedback to students; gradebook setup and rubrics; crafting powerful introductions; open educational resources (OERs) used in the classroom; and netiquette.

In addition, many webinars directly amplify the skills needed by faculty members to be successful in the online classroom, e.g., recursive feedback; scaffolding student learning; digital literacy; classroom assessment techniques; creating a more engaging classroom; etc.

c) **Evidenced-based best practices for distance education, if distance education is offered.**

Besides the strategies outlined above, UMGC has recognized the need to equip faculty more comprehensively with skills and abilities to enhance engagement and coaching, in order to improve student learning and retention.

To that end, UMGC has developed a coaching training that will be made available to all UMGC faculty in Feb. 2021, well before the proposed launch of the proposed new program (Spring 2022). Faculty teaching in this program will therefore benefit from this training. This new faculty training course, FACDEV 111—Coaching and Providing Feedback that Matters—will provide coaching skills to create an active and motivating presence in the classroom in order to establish helpful and supportive relationships with each student leading to persistence and academic success.

This addition to our training catalog will diminish the distance between faculty and students inherent in online courses by providing specific strategies and tactics to facilitate regular interaction and outreach and personalized and actionable coaching and feedback.

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12)

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program.

No new library resources are needed to serve the Bachelor of Science in Data Science. The UMGC Library provides access to a vast array of library resources and services to

UMGC students, faculty, and staff worldwide to meet their academic needs and includes a wide and varied collection of journal articles, reports, case studies, and, in some instances, complete books available electronically via a comprehensive selection of online library databases. Library services include instruction, reference, electronic reserves, and document delivery for materials not otherwise available in the library databases. The UMGC Library relies on distributed technology as its primary mechanism to provide online access to resources and services to UMGC's widely dispersed, working-adult student population.

The curated collection of online academic research databases available to UMGC faculty and students provides access to hundreds of thousands of full-text articles as well as reports, statistics, case studies, book chapters, and complete books in a wide range of subject areas. In addition, students have access to the full text of dissertations and theses via the *ProQuest Dissertations and Theses* database. The Library assists faculty and learning designers in providing links to Library materials directly in online classes.

The UMGC Library also offers other resources and services. UMGC students, faculty, and staff within the continental United States have access to more than ten million volumes in print from the 16-member University System of Maryland and Affiliated Institutions (USMAI) library consortium. The UMGC Library offers document delivery services to all UMGC students, faculty, and staff worldwide for a variety of materials, including journal articles and book chapters. UMGC's expanding collection of 75,000 electronic books (e-books) has significantly increased the ability to meet the needs of UMGC's global population.

The UMGC Library provides faculty and students with research assistance in creating search strategies, selecting relevant databases, and evaluating and citing sources in a variety of formats via its *Ask a Librarian*, which includes 24/7 chat and email. A guide to locating scholarly articles and using UMGC's library databases. The UMGC Library *OneSearch* tool allows users to simultaneously search for scholarly articles, books, and/or other research resources via a single search engine in most of the databases to which the UMGC Library subscribes, either directly or as additional resources.[16] In addition, UMGC faculty can request customized library instruction sessions for both on-site and online classes, and can also add UMGC Library tutorials and materials to their learning management system classrooms and refer students to them through the Web gateway.

A librarian liaison assigned to each academic department assists faculty with resource identification and other program needs. The Subject Guides area of the library's web site provides a listing of resource guides for each subject area, with each guide containing relevant databases, Web sites, books, and other resources along with technical and citation assistance.

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)

1. Provide an assurance that physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces

[16] Source: UMGC Library, 2020: http://sites.umgc.edu/library/index.cfm

for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences.

The proposed Bachelor of Science in Data Science will primarily be offered online using a distance education platform. Existing resources related to facilities, infrastructure, and equipment are adequate to meet the Bachelor of Science in Data Science needs.

2. **Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:**
   - **a) An institutional electronic mailing system, and**
   - **b) A learning management system that provides the necessary technological support for distance education**

UMGC has an internal email network that provides all incoming students and all faculty with consistent email domains @student.umgc.edu and @faculty.umgc.edu respectively. Students are encouraged but not limited to using this email address in all their communication with the university. Faculty are required to use their UMGC addresses for all their official UMGC communications.

UMGC's standard learning management system is Desire2Learn (D2L). All UMGC classes are taught using this system and all the students with appropriate technology and online access (referenced in section G8) have access to this system through their learning portal. Support is available for students and faculty through a 24/7 help desk and a large variety of online help resources on UMGC's website.

L. Adequacy of Financial Resources with Documentation (as outlined in COMAR 13B.02.03.14)

1. **Complete Table 1: Resources and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.**

Narrative Rationale

No new general funds are required for implementation of this program. The financial table that follows is based only on students entering the new program.

As shown in Tables 1 and 2 below, the program is expected to be self-supporting from inception. UMGC's existing base of FTE faculty and administrative and support staff will be utilized to support and serve the Bachelor of Science in Data Science.

For the resource category 2.e, note that only instate tuition is considered.

TABLE 1:RESOURCES					
Resource Categories	**Year1**	**Year2**	**Year 3**	**Year4**	**Year 5**
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c + g below)	$450,000	$675,000	$900,000	$1,125,000	$1,125,000
a. Number of F/T Students	0	0	0	0	0
b. Annual Tuition/Fee Rate	N/A	N/A	N/A	N/A	N/A
c. Total F/T Revenue (a x b)	N/A	N/A	N/A	N/A	N/A
d. Number of P/T Students	50	75	100	125	125
e. Credit Hour Rate	$300	$300	$300	$300	$300
f. Annual Credit Hour Rate	30	30	30	30	30
g. Total PIT Revenue (d x e x f)					
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
TOTAL (Add 1 - 4)	$450,000	$675,000	$900,000	$1,125,000	$1,125,000

2. **Complete Table 2: Program Expenditures and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each expenditure category.**

Narrative Rationale

The data below for faculty, staff, and technical support and equipment is based on UMGC's existing base of FTE faculty and administrative and support staff who will be utilized to support and serve the Bachelor of Science in Data Science, as well as existing technical support and equipment.

In category 1.b, the adjunct faculty salary is the median salary for an adjunct associate faculty member with a terminal degree at longevity step 11. In category 7, the expenditure listed is for course development.

TABLE 2: PROGRAM EXPENDITURES:					
Expenditure Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Faculty (b + c below)	$80,697.06	$121,045.60	$161,394.10	$201,742.70	$201,742.70
a. Number of FTE sections	18	27	36	45	45
b. Total Salary (Adjunct salary at $1371 per credit hours)*	$74,034	$111,051	$148,068	$185,085	$185,085
c. Total Benefits (9%)	$6,663.06	$9994.59	$13,326.12	$16,657.65	$16,657.65
2. Admin.Staff (b + c below)	$123,300.00	$123,300.00	$123,300.00	$123,300.00	$123,300.00
a. Number of FTE	1	1	1	1	1
b. Total Salary	$90,000	$90,000	$90,000	$90,000	$90,000
c. Total Benefits (37%)	$33,300.00	$33,300.00	$33,300.00	$33,300.00	$33,300.00
3. Support Staff (b+c below)	$34,250.00	$34,250.00	$34,250.00	$34,250.00	$34,250.00
a. Number of FTE	.5	.5	.5	.5	.5
b. Total Salary	$25,000	$25,000	$25,000	$25,000	$25,000
c. Total Benefits (37%)	$9,250.00	$9,250.00	$9,250.00	$9,250.00	$9,250.00
4. Technical Support and Equipment	$80,000	0	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)	$70,000	0	0	0	0
TOTAL (Add 1 – 7)	**$388,247.06**	**$278,595.59**	**$318,944.12**	**$359,292.65**	**$359,292.65**

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15).

1. Discuss procedures for evaluating courses, faculty and student learning outcomes.

UMGC has created an annual program review process that includes assessment of student learning as described earlier along with non-direct measures of student learning including student course evaluations, student retention and graduation rates, and student program surveys administered in capstone courses. As part of this process, external data is collected, including enrollment in related programs at other institutions and trends in labor markets. UMGC's mission for career relevant education requires that program learning goals and curriculum are maintained in the context of changing needs in labor markets and required skills for graduates.

As part of the annual program review, courses within the program portfolio are reviewed for course health. This includes student success rates within courses and course reenrollment rates (how many students in a course re-enroll in the following term). In addition, student course evaluations are administered every term for every course. Data are aggregated in academic dashboards at the course level to allow faculty to evaluate the effectiveness of course curriculum and delivery. When a course is scheduled for revision, faculty teaching the course are surveyed to provide input to the faculty and instructional designers revising the course.

UMGC is in the process of adopting Quality Matters for course evaluation. As that process rolls-out, courses will be reviewed on a regular basis against the Quality Matters rubric to ensure quality of course materials and design.

Full-time faculty are reviewed at least every two years. Part-time faculty are reviewed on a course/semester basis. The student course evaluation provides an opportunity for faculty to receive both quantitative and qualitative feedback on their teaching.

2. **Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.**

Faculty, administrators, and the Office of Academic Quality collaborate to implement and monitor assessment activities, review results, and make appropriate resource, curriculum, or other modifications. Annually, student performance across learning demonstrations is evaluated to determine where improvements may be required. Changes are made to curriculum and/or student support models. The process supports a continuous cycle of improvement.

Additional evaluation includes tracking of student retention, grade distributions and cost-effectiveness. Regular academic program reviews consider all factors related to academic quality, curriculum currency and relevance, student support and adequacy of facilities.

N. Consistency with the State's Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05).

1. **Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.**

UMGC seeks to reflect the diversity of the global community it serves. Cultural differences are recognized, valued, and considered essential to the educational process. UMGC provides an academic environment in which diversity is not only articulated as one of the institutional core values, but it is reflected in the university's ethnically and racially diverse student body and its proven record of providing higher education access to minority students. The university's Digital Teaching and Learning unit collaborates with UMGC's Office of Diversity and Equity to ensure a robustly inclusive curriculum that is built around UMGC's focus on project-, scenario-, and problem-based learning, which learning science has shown to more adequately respond to the learning approaches most effective for adult students. Additionally, the School of Cyber and IT is undertaking a focused initiative, in collaboration with the

Office of the Chief Digital Officer, to specifically enhance inclusion in the School's offerings, starting with the diversity of perspectives and identities reflected in the projects that anchor the School's curriculum.

O. Relationship to Low Productivity Programs Identified by the Commission:

1. **If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources and general operating expenses) may be redistributed to this program.**

N/A

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

1. **Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.**
2. **Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.**

University of Maryland Global Campus has been approved to offer distance education by the Middle States Commission on Higher Education (MSCHE) and maintains compliance with COMAR 13B.02.03.22. UMGC is approved to offer distance education as an alternative delivery method included within its scope of accreditation, as evidenced in the university's MSCHE Statement of Accreditation Status. Furthermore, among its many recognitions, as of 2016 UMGC had received five Sloan Consortium (now Online Learning Consortium) Excellence Awards for online program quality and three IMS Global Learning Consortium awards for technology integration in the classroom environment.

Historically, UMGC was an early provider of off-campus educational opportunities for students and one of the first universities in Maryland to develop online education. UMGC has been a leader among public institutions in providing quality and affordable online education and has been providing distance education to residents of the state of Maryland, to the nation's service members, and to those who live outside of Maryland for more than seventy years. Additionally, UMGC's Europe and Asia divisions offer hybrid and onsite classes to fulfill contract requirements and meet the needs of military students overseas. Stateside, all onsite classes, with the exception of an occasional accelerated offering, are in hybrid format, blending onsite and online delivery.

UMGC's distance education offerings are in compliance with C-RAC's 2011 Guidelines.

Appendix A

90.2.1.001

cc: LEL
Bob S.

MHEC
Creating a state of achievement

MEMORANDUM

Office of the Provost
UMUC
JAN 10 2005

DATE: January 6, 2005

TO: Dr. Nicholas H. Allen
Provost and Chief Academic Officer, UMUC

FROM: Michael J. Kiphart, Ph.D. MJK
Assistant Secretary for Planning and Academic Affairs

SUBJECT: UMUC Waiver of Full-Time Faculty and Library/Learning Resources Center

According to our records, UMUC's request for a waiver of full-time faculty and library/learning resource center went before the Education Policy Committee on January 16, 1996. The Education Policy Committee approved for the University a waiver of the definition of full-time faculty and library/learning resource center as provided for in the Commission's *Minimum Requirements for Degree-Granting Institutions*, and further, that the Commission instruct the Secretary of Higher Education to review the University at regular intervals to assure that the University was in compliance with the applicable provisions of the waiver to the minimum requirements.

On February 15, 1996, the matter went before the Commission and an amended recommendation was approved. The Commission approved for the University a waiver of the requirements for total credit hours taught by full-time faculty and for a waiver of the requirements for a minimum library collection for the Library/Learning Resource Center as provided for in the Commission's *Minimum Requirements for Degree-Granting Institutions*. Further, the Commission instructed the Secretary of Higher Education to review the University at regular intervals to assure that the University was in compliance with the applicable provisions of the waiver to the minimum requirements. The Commission also approved a recommendation that the Faulty Advisory Council and Student Advisory Council recommendations be referred to the University of Maryland System Board of Regents.

Enclosed are documents supporting the approval of the waiver. Should you require additional assistance, please contact David Sumler, Director of Academic Affairs – Planning and Policy, at 410-260-4533 or dsumler@mhec.state.md.us.

MJK:aaw
Enclosures

MARYLAND HIGHER EDUCATION COMMISSION
839 Bestgate Rd. • Suite 400 • Annapolis, MD 21401-3013
T 410.260.4500 • 800.974.0203 • F 410.260.3200 • TTY for the Deaf 800.735.2258 • www.mhec.state.md.us

xc: [illegible] files

Forward to Maury for appropriate action VR Comm. on Ed Policy

RECEIVED APR 30 1996 By VCAA

Parris N. Glendening
Governor

Edward O. Clarke, Jr.
Chairman

Patricia S. Florestano
Secretary of
Higher Education

April 23, 1996

RECEIVED

APR 29 1996

OFFICE OF THE CHANCELLOR
THE UNIVERSITY OF MARYLAND
SYSTEM

Mr. Lance W. Billingsley, Esq.
Chairman, Board of Regents
University of Maryland System
3300 Metzerott Road
Adelphi, MD 20783

Dear Mr. Billingsley:

At its February 15, 1996 meeting, the Maryland Higher Education Commission considered a request by University of Maryland University College for a waiver of the Commission's minimum requirements in the area of full-time faculty and library resources. The Commission has granted the waiver.

In the discussion of the waiver and related issues, both the Faculty Advisory Council and the Student Advisory Council to the Commission raised issues which the Commission felt were more appropriately addressed by the University of Maryland's governing board. Therefore, I am forwarding to you the resolutions submitted to the Commission by these two advisory councils, in addition to the relevant materials considered by the Commission in granting the waivers.

Consistent with the final recommendations of the Commission on this matter, I would appreciate a review of these issues by the Board of Regents. I would also appreciate receiving the results of that review when it is completed. Since the academic year is coming to a close, I realize that any reaction on the part of the Board of Regents may be delayed until next fall. In light of that schedule, could you please supply the Commission with the Board of Regents' position by November 1, 1996.

Sincerely,

Edward O. Clarke, Jr. (CT)

Edward O. Clarke, Jr.
Chairman

EOC:PSF:JAS:ds

Enclosures

cc: Dr. Patricia S. Florestano
√Dr. Donald N. Langenberg

16 Francis St., Annapolis, MD 21401-1781 | (410) 974-2971 | FAX (410) 974-3513
TTY for the Deaf: (800) 735-2258

Appendix B
UMGC Data Science Degree Planning Course Sequence Sheet
Bachelor of Science in Data Science

This sheet is designed to give an overview of the bachelor's degree requirements at UMGC. Every student's plan is unique to them based on their previous education. For full course descriptions and an overview of all requirements, please refer to the current UMGC catalog. A minimum of 30 credits must be earned at UMGC including at least half of the major/minor; 36 credits must be upper level including half of the credit in the major/minor. Please contact UMGC with all questions in regard to your official degree plan. Degree requirements may change based on the date of initial enrollment at UMGC.

Course Sequence	Term/ Session Taken	Recommended Course	Level	Course Note	Alternative Course(s)
1		LIBS150 (1)	GE	Recommended Research Gen Ed	CAPL 398A
2		PACE111 (3)T	GE	Required Research Gen Ed	Any PACE 111
3		WRTG111 (3)	GE	Recommended Communication Gen Ed	Any other WRTG
4		IFSM201 (3)	GE	Required Computing Gen Ed; Pre-req to Major	N/A
5		CMIS102 (3)	Elective	Related Required Course; Pre-req to Major	N/A
6		STAT200 (3)	GE	Required Math Gen Ed; Pre-req to Major	N/A
7		WRTG112 (3)	GE	Required Communication Gen Ed	N/A
8		DATA220 (3)	Major	Required Major Course	N/A
9		DATA300 (3)	Major	Required Major Course	N/A
10		IFSM330(3)	Major	Required Major Course	N/A
11		BIOL103 (4)	GE	Recommended Bio/Phys Sci Gen Ed with required LAB	Any other ASTR, BIOL, CHEM, GEOL, NSCI, NUTR, or PHYS with LAB
12		DATA331 (3)	Major	Required Major Course	N/A
13		MATH140 (4)	Elective	Related Required Course	N/A

14		BEHS103 (3)	GE	Recommended Beh/Soc Sci Gen Ed	Any other AASP (201 only), ANTH, ASTD, BEHS, CCJS (100, 105, 350, 360, 461 only), ECON, GEOG, GERO (except 342 and 351), GVPT, PSYC, SOCY, or WMST (200 only)
15		CMSC437 (3)	Major	Required Major Course	N/A
16		ARTH334 (3)	GE	Recommended HU/Arts Gen Ed	Any other ARTH, ARTT, ASTD, ENGL (except ENGL 281 and ENGL 384), GRCO, HIST, HUMN, MUSC, PHIL, THET, dance, literature, or foreign language
17		NUTR100 (3)	GE	Recommended Bio/Phys Sci Gen Ed	Any other ASTR, BIOL, CHEM, GEOL, NSCI, NUTR, or PHYS
18		SPCH100 (3)	GE	Recommended Communication Gen Ed	Any other WRTG/SPCH/COMM
19		HIST125 (3)	GE	Recommended HU/Arts Gen Ed	Any other ARTH, ARTT, ASTD, ENGL (except ENGL 281 and ENGL 384), GRCO, HIST, HUMN, MUSC, PHIL, THET, dance, literature, or foreign language
20		Elective (3)	Elective	Elective	
21		ECON103 (3)	GE	Recommended Beh/Soc Sci Gen Ed	Any other AASP (201 only), ANTH, ASTD, BEHS, CCJS (100, 105, 350, 360, 461 only), ECON, GEOG, GERO (except 342 and 351), GVPT, PSYC, SOCY, or WMST (200 only)
22		CSIA300 (3)	Major	Required Major Course	N/A
23		Elective (3)	Elective	Elective	
24		DATA450 (3)	Major	Required Major Course	N/A

25		Elective (3)	Elective	Elective	
26		CMSC447 (3)	Major	Required Major Course	N/A
27		WRTG393 (3)	GE	Recommended Communication Gen Ed	Any other Upper-level WRTG
28		Elective (3)	Elective	Elective	
29		DATA440(3)	Major	Required Major Course	N/A
30		Elective (3)	Elective	Elective	
31		Elective (3)	Elective	Elective	
32		DATA445 (3)	Major	Required Major Course	N/A
33		Elective (3)	Elective	Elective	
34		Elective (3)	Elective	Elective	
35		Elective (3)	Elective	Elective	
36		Elective (3)	Elective	Elective	
37		Elective (3)	Elective	Elective	
38		Elective (3)	Elective	Elective	
39		DATA495 (3)	Major	Required Major Course	N/A
40		Elective (3)	Elective	Elective	

Appendix C
Mapping of Program learning Goals for the B.S. program to core courses in the major

	DATA 220	DATA 300	IFSM 330	DATA 331	CSIA 300	CMSC 437	CMSC 447	DATA 440	DATA 445	DATA 450	DATA 495
1. Communicate effectively in writing and orally to diverse audiences, utilizing storytelling techniques, when appropriate, to convey the data science process and results.	X	X	X	X	X	X	X	X	X	X	X
2. Plan, design, and implement the data mining process (machine learning life cycles), including data extraction, data cleaning, data load, and transformation.	X	X				X		X			X
3. Demonstrate proficiency with diverse technologies used within data science, business intelligence, machine learning and artificial intelligence.	X	X	X	X		X	X	X	X	X	X
4. Analyze social, global and/or ethical issues and implications related to the use of existing and emerging data science, machine learning and/or artificial intelligence technologies.	X		X			X	X	X	X	X	X
5. Evaluate a business problem or opportunity to determine the extent data science can provide a viable solution and translate the business problem into a viable project to meet organizational strategic and operational needs.		X	X	X		X		X	X		X
6. Incorporate data security, data privacy and risk management best practices in the planning, development and implementation of data science solutions.					X	X	X	X	X	X	X
7. Evaluate the appropriate methods and technology for data science in specific organizational						X		X	X	X	X

contexts, including selecting a modeling approach, building a model using appropriate technology, validating the model, and deploying the model for prediction and analysis.											
8. Create solutions leveraging big data analytics and AI technology for stream analytics, text processing, natural language understanding, AI and cognitive applications.							X	X	X		X
9. Collaborate with team members to plan, evaluate, implement, and document data science solutions.							X		X	X	X