



Office Use Only: PP#

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

Institution Submitting Proposal	Montgomery College
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Each action below requires a separate proposal and cover sheet.

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|--|--|
| <input checked="" type="radio"/> New Academic Program
<input type="radio"/> New Area of Concentration
<input type="radio"/> New Degree Level Approval
<input type="radio"/> New Stand-Alone Certificate
<input type="radio"/> Off Campus Program | <input type="radio"/> Substantial Change to a Degree Program
<input type="radio"/> Substantial Change to an Area of Concentration
<input type="radio"/> Substantial Change to a Certificate Program
<input type="radio"/> Cooperative Degree Program
<input type="radio"/> Offer Program at Regional Higher Education Center |
|--|--|

Payment Submitted: <input checked="" type="radio"/> Yes <input type="radio"/> No	Payment Type: <input type="radio"/> R*STARS # <input checked="" type="radio"/> Check #	Payment Amount: \$850	Date Submitted: 08/15/2022
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Department Proposing Program	Academic Affairs		
Degree Level and Degree Type	Associate of Science		
Title of Proposed Program	Data Science		
Total Number of Credits	60		
Suggested Codes	HEGIS: 5199.18	CIP: 52.1301	
Program Modality	<input type="radio"/> On-campus	<input type="radio"/> Distance Education (<i>fully online</i>)	<input checked="" type="checkbox"/> Both
Program Resources	<input checked="" type="radio"/> Using Existing Resources	<input type="radio"/> Requiring New Resources	
Projected Implementation Date	<input checked="" type="radio"/> Fall	<input checked="" type="radio"/> Spring	<input type="radio"/> Summer Year: 2022 2023
Provide Link to Most Recent Academic Catalog	URL: montgomerycollege.edu/catalog		BCC
Preferred Contact for this Proposal	Name:	Ms. Betsy Leonard	
	Title:	Planning and Support Specialist	
	Phone:	(240) 567-8043	
	Email:	betsy.leonard@montgomerycollege.edu	
President/Chief Executive	Type Name:	Dr. Jermaine F. Williams	
	Signature:	<i>Jermaine F. Williams</i>	Date: 08/08/2022
	Date of Approval/Endorsement by Governing Board:	12/13/2021	

Revised 1/2021



OFFICE OF THE PRESIDENT

August 1, 2022

Dr. James D. Fielder Jr.
Secretary of Higher Education
Maryland Higher Education Commission
6 North Liberty Street
Baltimore, MD 21201

Dear Dr. Fielder:

Montgomery College respectfully requests approval of the following academic program action:

Creation of the data science associate of science, HEGIS 5199.18, CIP 52.1301, effective spring 2023.

Montgomery College is prepared to offer the new data science associate of science. The program provides an excellent opportunity for students wanting to increase their data literacy, improve their marketability, and/or prepare for a career in a data science field. Students will use mathematics, statistics, and data science skills to tackle structured and unstructured data, solve multifaceted problems, consider ethical implications, and make data-driven recommendations. Through hands-on experiences using a variety of ubiquitous data tools and technology, students will learn to build the skills necessary to explore, analyze, visualize, and communicate about large data sets. Additionally, students will explore ethical implications of the use of data in the data lifecycle. The program prepares students who ultimately plan to work in the data science or data analytics field or upskill prior degree work to incorporate data science skills within their current careers. The program can be completed in both an on-campus and online format.

Montgomery College actively pursues pathways for students to earn an associate's degree at Montgomery College, then transfer to a four-year university for successful completion. The program has formal pathways with two four-year institutions and another in progress. The new associate of science will be implemented with existing institutional resources.

The associated fee of \$850 for a new academic program will be sent to the Maryland Higher Education Commission via U.S. mail.

Thank you for your time and consideration of this request. Please contact Dr. Carolyn Terry, associate senior vice president, at carolyn.terry@montgomerycollege.edu or 240-567-4226 if you have questions.

Sincerely,

A handwritten signature in cursive script that reads "Jermaine F. Williams".

Dr. Jermaine F. Williams
President

Montgomery College Data Science Associate of Science

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.

Montgomery College is prepared to offer the new data science associate of science effective spring 2023. The ability to access and analyze data, and communicate findings and conclusions is a critical, in-demand skill across disciplines and job sectors. The 60-credit program provides an excellent opportunity for students wanting to increase their data literacy, improve their marketability, and/or prepare for a career in a data science field. It is also suitable for those who wish to advance their professional careers by supplementing their work experience or an existing college or graduate degree with data science knowledge. Students will use mathematics, statistics, and data science skills to tackle unstructured data, solve multifaceted problems, consider ethical implications, and make data-driven recommendations. Through hands-on experiences with a variety of the most commonly used data tools and technology, students will develop the skills necessary to explore, analyze, visualize, and communicate about large data sets. Additionally, students will explore the ethical implications of the use of data in the data lifecycle. The program prepares students who ultimately plan to work in the data science or data analytics field or to upskill prior degree work to incorporate data science skills within their current careers.

Montgomery College's data science faculty actively pursue articulated academic agreements that provide students with clearly-defined pathways for successful completion and transfer:

- Montgomery College and Coppin State University (CSU) formalized a [transfer pathway](#) from Montgomery College's data science associate of science to CSU's data science bachelor of science as an addendum to the original articulation agreement between the institutions.
- Montgomery College and University of Maryland (UMD) at the Universities at Shady Grove formalized a transfer pathway from Montgomery College's data science associate of science to UMD's information science bachelor of science as an addendum to the original articulation agreement between the institutions.
- Montgomery College and University of Maryland Global Campus have a transfer pathway in progress from Montgomery College's pending data science associate of science to University of Maryland Global Campus' bachelor of science in data science.

Students can complete the required coursework for the two-year associate of science in both an on-campus and online format. Credits from the College's data science certificate can be applied to the new data science degree.

This program supports Montgomery College's [mission](#), which is to empower our students to change their lives, to enrich the life of the community, and to hold ourselves accountable. Montgomery College is serving the needs of our students and our community by training competent professionals to help meet the diverse needs of our citizens and community and also address the needs of Montgomery County, the state of Maryland, and beyond. Furthermore, the data science program holds itself accountable through curriculum and workforce alignment, program assessment, faculty evaluations, and student feedback through evaluations.

Montgomery College's [vision statement](#) focuses on both academic excellence as well as opportunity. This vision characterizes the institution as both agile and relevant as it meets the dynamic challenges facing our students and community. The vision is supported through the

implementation of a program that leads to well-paying jobs for our graduates as well as a trained data science workforce for our community.

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

Student success is at the heart of all planning at Montgomery College. The [MC2025 Strategic Plan](#) is a five-year working document that includes strategic goals that shape the future of the College and objectives and outcomes to measure success. Every program at the College aligns to one or more goals in the strategic plan. The data science program aligns to the following College strategic goals:

Goal I: Empower Students to Start Smart and Succeed. The newly-developed associate of science provides pathways to complete the required coursework for students interested in upskilling with data science as well as for students interested in transferring. It also allows students more course options, as well as the flexibility to tailor their program to their area of interest or chosen transfer institution. Access to program coursework is available through in-person and online course offerings. Student success is enhanced through the availability of open educational resources, z-course options, on-campus career recruitment events, community partnerships to encourage internship opportunities, and individual advising for students. The goal of the new program is to provide students a seamless transition to a bachelor program while providing exposure to data science coursework and career opportunities early in the academic program.

Goal III: Fuel the Economy and Drive Economic Mobility. Students enrolled in the new data science program will be provided opportunities to gain experiential and community learning, including internships, mentorships, real-world projects, and experimental joint learning spaces. The data science associate of science includes 30 credits of discipline-specific coursework. Embedded within the discipline coursework is a 4-credit semester-long capstone project ([DATA 205](#)) which allows students to work with local government and/or industry partners through the use of real-world data. A combination of academic and practical instruction, collaboration with local business partners, and use of industry-standard best practices provide individuals with knowledge and skills that are necessary for success in this profession.

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.)

The proposed data science associate of science will be implemented with existing institutional resources from the Mathematics, Statistics, and Data Science Department and the Computer Science Department. The two full-time faculty, two part-time faculty, and one support staff position are sufficient to meet the requirements of the new program. No additional resources or faculty are needed at this time.

4. Provide a description of the institution's commitment to:

a) ongoing administrative, financial, and technical support of the proposed program

Montgomery College has a commitment to excellence and innovation. The administration has always been supportive of cutting-edge, relevant programs. This program proposal is proceeding with the full support of the department chair, dean, and provost under which this program was developed. The program also has the full support of the offices of the senior vice president for academic affairs and Montgomery College president, as well as the Board of Trustees.

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

Montgomery College is committed to provide all students an opportunity to complete their program of study. Students may elect to graduate from a program by meeting the curriculum requirements as outlined in any catalog in effect during their enrollment, provided they graduate within seven years of the chosen catalog. Since courses and programs may be discontinued at the discretion of the College, the College and administering academic department will provide all students affected by such decisions with assistance in choosing appropriate courses and programs for completion.

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**

The data science associate of science provides students with entry-level knowledge and skills for immediate employment and a firm foundation for continuing their education to the bachelor's level and beyond. Individuals with an associate of science in data science can find entry-level employment in data entry, database management, data science, and data analytics.

According to the U.S. Bureau of Labor Statistics, data scientists and mathematical scientists are reported in the [Top 10 Fastest Growing Occupations](#) with the highest rate of change between 2020 and 2030 (Appendix A). The table projects a growth rate of 31.4 percent for data scientists and mathematical science occupations. With the benefits of data becoming more numerous and widespread, demand for data science and analytics talent is projected to continue to grow.

Montgomery College has a stellar track record of reaching and supporting minority and disadvantaged populations. The list below includes a sample of the College's many programs and outreach efforts:

- [Combat2College](#) provides veterans, active-duty service members, and reservists with specialized academic support, resources, and services.
- The [Federal TRIO program](#) is a grant-funded program designed to help students from disadvantaged backgrounds remain in school until graduation or transfer to a four-year college or university.
- The [Challenge Program](#) offers courses to help adults with developmental disabilities function more independently at home, at work, and in the community.
- [ACES \(Achieving Collegiate Excellence and Success\)](#) helps historically underrepresented populations earn a baccalaureate degree. This program is a collaboration of Montgomery County Public Schools, Montgomery College, and the Universities at Shady Grove.
- [Boys to Men \(BTM\)](#) is a mentoring program aimed specifically at the retention of men of color at Montgomery College by providing an open space for members to express their interests, values, and beliefs and connect with members of the MC community to build a network.
- The [MC Mentoring Network](#) includes mentoring programs such as:

- a. the [Advancing Latino Male Achievement \(ALMA\)](#) which provides holistic academic and personal guidance, support, and development for Hispanic/Latino/Native American males;
- b. the [International Buddy Program](#) which offers support to students classified as immigrants, non-immigrants, or F-1/International Visa holders; and
- c. the [Mentoring Project for Women](#) which targets cross cultural, African American, and Latina first year and continuing students.

2. Provide evidence that the perceived need is consistent with the [Maryland State Plan for Postsecondary Education](#).

The [2017-2021 Maryland State Plan for Postsecondary Education](#) lists several strategies to meet the goals of access, success, and innovation to support student success with less debt.

Montgomery College also has many strategies designed to ensure student success with less debt. The following opportunities and services provide an improved student experience and facilitate degree completion of the data science associate of science:

Strategy 4: To ensure equal educational opportunities for all Marylanders, Montgomery College implemented the Achieving the Promise Academy ([ATPA](#)) program, a collegewide program that provides academic support for any Montgomery College student through embedded classroom support and one-on-one individual academic coaching through graduation or transfer. ATPA coaches are embedded in many of the data science program's first-year courses.

Strategy 6: To improve the student experience by providing better options and services designed to facilitate prompt completion of degree requirements, the data science associate of science provides a clearly-defined pathway for students entering the program and increased faculty access through targeted advising. The primary goal is to improve student completion and increase transfer under this designated pathway. Additionally, providing open educational resources for all data science courses relieves students of the financial burden of buying textbooks. Offering Blackboard-enhanced online and structured remote (blended) options can save students transportation time and cost, as well as provide scheduling flexibility for working students or students with essential personal commitments. Embedding robust program advising and recruitment events and partnerships with community and professional organizations encourages students to seek mentorships, internships, and potential employment in local profit, non-profit, and government organizations with data science careers.

Strategy 8: In support of developing new partnerships between colleges and businesses to improve workforce readiness, the Mathematics, Statistics, and Data Science Department employs authentic, project-based assessments relevant to tasks that graduates actually perform on the job; such projects serve as both the means of instruction and assessment of learning in the program.

In addition to the outreach to high school programs, data science faculty actively pursue pathways for students to earn an associate's degree at Montgomery College, then transfer to a four-year university for successful completion. The program has formal pathways with two four-year institutions and another in progress. Please see Section H.1 for further information.

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.

A defining characteristic of the 21st century is the imperative for data-informed decision making. Accordingly, organizations are hiring employees with the hard skills needed to create

high quality data science products and the soft skills critical both to effectively communicate about the data and consider the ethical implications of those products. The data science program is designed to meet the growing need for highly skilled professionals who can keep pace with the demand for data science expertise.

The curriculum provides resources that are applicable and relevant for students entering data science and data analytics careers in business, industry, government or not-for profit entities. Data science is an umbrella term; the educational requirements for data science positions vary depending on the student’s career path. The educational requirement for an entry-level data scientist or data analyst position is typically an associate’s degree or certificate, while other mid-to high-level positions such as senior data scientist, mathematician, or statistician require a bachelor or even a master’s degree. Completion of the data science associate of science provides the minimum college credits and curriculum required to apply to many entry-level positions, such as data entry, database management, data science, and data analytics. The program also provides greater flexibility to students planning to transfer to a four-year institution.

2. Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.

According to [EMSI data](#) on Montgomery College’s [data science program page](#), there are 183 filled positions for data scientists in Montgomery County with a projected job growth of four percent over the next year. The salary range for a data scientist in Montgomery County is \$62,683 to \$183,048, with a median salary of \$106,113. There were 138 job postings in May 2022 and 107 job postings for April 2022. The Employment tab estimates a projected job growth of 22.5 percent over the next seven years for data scientists in the County. In addition, many jobs today include data analysis as one of many skills sought in a prospective employee.

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.

EMSI data in Section C.2 shows a growing need for professionals in the region for data science and data analytics occupations. The following sources reiterate the anticipated need for employees in the data science field:

- According to LinkedIn’s [2020 Emerging Jobs Report](#), data scientist topped the emerging jobs list for three years running. In 2020, data scientist was the third highest emerging job in the United States with a 37 percent annual growth rate.
- [Glassdoor](#) ranks data scientist in the top three positions from 2016 to 2022 in the Best Jobs in America list at a median wage of \$120,000 with 10,071 open positions nationwide in 2022.
- As stated in Section B.1 and Appendix A, the U.S. Bureau of Labor Statistics’ employment projection from 2020 to 2030 for the [2020 Fastest Growing Occupations](#) shows data science as the number nine occupation with a median annual wage of \$100,480 and growth rate of 31 percent.

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

The table below reflects the projected number of graduates for new data science associate of science. The projections are extrapolated from a combination of past certificate completion rates and students currently enrolled in Montgomery College’s general studies STEM associate of arts with a data science concentration.

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Graduates	4	8	13	18	24

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.

Numerous data science programs exist throughout the State of Maryland:

- Carroll Community College has a [lower division certificate](#) and an [associate's degree](#) in data science, both of which prepare students for immediate professional placement or provide a foundational base for continued study in a bachelor's program.
- Community College of Baltimore County has an associate's degree in data science that prepares students for employment in one of the fastest growing professions.
- Harford Community College has a [lower division certificate](#) in data science for students wanting to increase their data literacy and/or prepare for a career in data science. They also offer an [associate's degree](#) in data science that provides students with a background in computer science, mathematics, and information systems necessary for further study of a data science bachelor degree.
- Capital Technology University of Maryland has a data science [bachelor of science](#) that provides key preparation for a career as a data scientist or machine learning engineer.
- Coppin State University has a [bachelor's degree](#) in data science that prepares students to interpret business data in the 21st century, to compete in the marketplace with combined business and data science skills, and to apply these insights to answer business questions and solve business problems.
- Loyola University of Maryland has a [bachelor's degree](#) in data science that prepares students to perform analyses and make predictions using disparate sources of data.
- Mount St. Mary's University has a [bachelor's degree](#) in data science that prepares students to be uniquely equipped to provide scientific perspective and solutions to the complex problems facing humanity.
- Salisbury University has six optional [bachelor](#) areas of concentration in data science that prepare students with the skills necessary to meet the demands of this ever-expanding field.
- University of Maryland Global Campus has a [bachelor's degree](#) in data science that is designed to meet the growing need for highly skilled professionals who can transform data into actionable insights.
- University of Maryland, College Park has a [bachelor's degree](#) in data science that enables students to acquire the broad variety of skills needed to be successful data scientists.

Although comparable programs exist at other community colleges in Maryland, none have the same focus as Montgomery College's data science program or nearby proximity to businesses within the 270 corridor or Washington, DC metropolitan area. For these reasons, program duplication is reasonable for this degree. The new data science associate of science fulfills the increased need for a transfer program in Montgomery County.

2. Provide justification for the proposed program.

In an increasingly data-driven world, data science is a new type of literacy. It combines tools and techniques for acquiring information and preparing it for analysis that can help reveal cause and effect, predict outcomes, and communicate insights to different audiences. The field requires individuals with creativity, curiosity, training in scientific methods, and journalism/storytelling, in addition to knowledge of math and statistics.

Montgomery College currently offers a lower division [certificate in data science](#). The Mathematics, Statistics, and Data Science Department is pursuing the associate of science to increase transferability to local four-year institutions such as Coppin State University, the University of Maryland College Park, and other potential four-year institutions within the University System of Maryland. The curriculum exposes students to important coursework in data science and data analytics while incorporating key General Education courses needed for transfer. Students can complete the required coursework for the program in both an on-campus and online format.

The new data science degree will be implemented with existing institutional resources in the Mathematics, Statistics, and Data Science Department and the Computer Science Department. This new degree will not create any additional expenses for the College. Highly qualified faculty, equipment, and library resources are already in place as the courses are currently being offered within the department.

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.

The mission and strategic goals of Coppin State University (CSU) are programmed towards educating all students, especially African American and minority student populations. Montgomery College and CSU formalized a [transfer pathway](#) from Montgomery College's data science associate of science to CSU's data science bachelor of science as an addendum to the original articulation agreement.

Bowie State University has a data analytics initiative which includes creating new courses and integrating the data science and analytics modules into existing courses. This could eventually lead to an undergraduate certificate in data science and analytics, for which there is a possibility of an articulation agreement with Montgomery College's data science program.

The Department of Information Sciences and Systems at the Graves School of Business at Morgan State University is preparing a proposal to offer a master of science in data analytics and visualization, for which there is a possibility of a 2 + 2 + 2 articulation agreement with Montgomery College's data science program.

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.

Through consideration of social justice and ethical issues, the data science courses at Montgomery College attempt to make significant strides in addressing complex social problems and improving the quality of life for people within Montgomery County, the state of Maryland, and national and global communities.

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 describe the faculty who will oversee the program.

As stated in Section D.2, Montgomery College offers a certificate in data science. The Mathematics, Statistics, and Data Science Department is pursuing the associate of science to increase student transfer opportunities to four-year institutions and help fill the need for data science workers in the Washington, DC metropolitan area. The creation of this program will also help Montgomery College identify and establish additional articulation agreements with other four-year institutions.

Four dedicated faculty positions (full-time and part-time) sufficiently support the data science program. The department chairs and dean oversee the program.

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

Following are the program outcomes and the courses supporting those outcomes:

Upon completion of this program, students will be able to:	Courses
Assess different analysis and data management techniques and justify the selection of a particular model or technique for a given task.	DATA 101 , DATA 110 , DATA 201 , DATA 205 , MATH 217
Execute analyses of large and disparate datasets and construct models necessary for these analyses.	DATA 101 , DATA 110 , DATA 201 , DATA 205 , MATH 117 , MATH 217
Demonstrate competency with programming languages and environments for data analysis.	CMSC 206 , DATA 101 , DATA 110 , DATA 201 , DATA 205
Summarize and communicate findings of complex analyses in a concise way for a target audience using both graphics and statistical measures.	COMM 108 , COMM 112 , DATA 101 , DATA 110 , DATA 201 , DATA 205 , GEOG 130 , GEOG 240 , GEOG 260 , MATH 181 , MATH 117 , MATH 217 , MATH 264 , MATH 284
Understand, evaluate, and apply ethical principles and practices in the data lifecycle.	DATA 101 , DATA 110 , DATA 201 , DATA 205 , PSYC 102 , PHIL 140

3. Explain how the institution will:

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

Program learning outcomes will be assessed through course projects, writing assignments, and the capstone project in the program’s required program courses ([DATA 101](#), [DATA 110](#), [DATA 201](#), and [DATA 205](#)).

b) document student achievement of learning outcomes in the program

There are several comprehensive and multifaceted assessment processes for all disciplines across the college. Montgomery College’s [Office of Assessment](#) supports the College’s mission and vision by providing leadership in the areas of assessment and evaluation. This is achieved by:

- Providing leadership, guidance, and data support for the College’s assessment of student learning outcomes for programs.
- Coordinating a comprehensive system of program reviews for academic areas.
- Collecting, analyzing, and distributing reports and information to the College about assessment results.
- Consulting with administrative areas, disciplines, and academic programs on assessment and evaluation projects.

Following is an overview of assessment processes at Montgomery College:

Assessment Type	Purpose	Cycle
General Education Outcomes Assessment	To examine student acquisition of General Education competencies.	Once every three years
Program Assessment	To assess student attainment of the program's student learning outcomes for the purpose of discovering what is working well and where improvements can be made to increase student learning.	Once every three years
Program Review (also referred to as the College Area Review)	To examine the current alignment and relevance of a program's curriculum and success with retaining and matriculating students.	Once every five years
Administrative Assessment	To review an administrative area's success with achieving outcomes and institutional priorities.	Once every five years

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

Program Title: Data Science Associate of Science

The degree provides an excellent opportunity for students wanting to increase their data literacy, improve their marketability, and/or prepare for a career in a data science field. It is also suitable for those who wish to advance their professional careers by supplementing their work experience or an existing college or graduate degree with data science knowledge. Students will use mathematics, statistics, and data science skills to tackle unstructured data, solve multifaceted problems, consider ethical implications, and make data-driven recommendations. Through hands-on experiences using a variety of the most ubiquitous data tools and technology, students will learn to build the skills necessary to explore, analyze, visualize, and communicate about large data sets. Additionally, students will explore ethical implications of the use of data in the data lifecycle.

Course	Title	Credits
Semester One		
ENGL 101	Introduction to College Writing *	3
MATH 181	Calculus I (MATH)	4
PSYC 102	General Psychology (BSSD)	3
COMM 108 or COMM 112	Foundations of Human Communication (GEEL) OR Business and Professional Speech Communication (GEEL)	3
MATH 117 or MATH 217	Elements of Statistics Biostatistics	3
Semester Two		
ENGF	English Foundation (ENGF)	3
PHIL 140	Intro to the Study of Ethics (HUMD)	3
GEOG 130	Global Geography (BSSD) (GCP)	3
DATA 101	Introduction to Data Science	3
DATA 110	Data Visualization and Communication	3

Course	Title	Credits
Semester Three		
NSLD	Natural Sciences Distribution with Laboratory (NSLD) **	4
DATA 201	Statistical Methods in Data Science	3
MATH 264	Applications in Linear Algebra ‡	4
Elective	Program Elective †	4
Semester Four		
ARTD	Arts Distribution (ARTD)	3
NSLD	Natural Sciences Distribution with Laboratory ** (NSLD)	4
DATA 205	Capstone Experience in Data Science	4
Elective	200-Level Program Elective †	3
Total Credits		60

* [ENGL 101](#)/ENGL 101A, if needed for [ENGL 102](#)/[ENGL 103](#) or program elective.

** Students are strongly encouraged to take two consecutive lab sciences courses. Examples include [CHEM 131](#)/[CHEM 132](#), [PSCI 101](#)/[PSCI 102](#), [PHYS 203](#)/[PHYS 204](#).

‡ [MATH 284](#) may be substituted for [MATH 264](#)

† Program Electives: [MATH 165](#), [MATH 182](#), [CMSC 140](#), [CMSC 203](#), [CMSC 206](#), [GEOG 240](#), and [GEOG 260](#). Department strongly recommends [CMSC 206](#) and [GEOG 240](#). [CMSC 206](#) provides programming skills in Python; [GEOG 240](#) provides foundational knowledge of Geographic Information Systems (GIS). Not all program elective options transfer to all institutions. Please consult a data science program advisor or the transfer institution before selecting program elective courses.

Outcomes:

- Assess different analysis and data management techniques and justify the selection of a particular model or technique for a given task.
- Execute analyses of large and disparate datasets and construct models necessary for these analyses.
- Demonstrate competency with programming languages and environments for data analysis.
- Summarize and communicate findings of complex analyses in a concise way for a target audience using both graphics and statistical measures.
- Understand, evaluate, and apply ethical principles and practices in the data lifecycle.

Program Title: [Data Science Certificate](#)

This certificate will provide students with experience in the field of data science including such areas as data management, data analysis, data collection, and data visualization. It is suitable for students who wish to begin work in the field, for those who wish to supplement their existing coursework with additional experiences in these data science areas, and for students who have obtained a bachelor's or other degree in any number of analytical and scientific fields and wish to upgrade or update their skills and training.

Course	Title	Credits
MATH 117 or MATH 217 or BSAD 210	Elements of Statistics or Biostatistics or Statistics for Business and Economics	3
DATA 101	Introduction to Data Science	3
DATA 110	Data Visualization and Communication	3
DATA 201	Statistical Methods in Data Science	3
DATA 205	Capstone Experience in Data Science	4
	Total Credits	16

Outcomes:

- Assess different analysis and data management techniques and justify the selection of a particular model or technique for a given task.
- Execute analyses of large and disparate datasets and construct models necessary for these analyses.
- Demonstrate competency with programming languages and environments for data analysis.
- Summarize and communicate findings of complex analyses in a concise way for a target audience using both graphics and statistical measures.

List of Courses with Title, Semester Credit Hours, and Course Descriptions:

General Education/Course Designators:

- [ARTD](#): Arts Distribution
- [BSSD](#): Behavioral and Social Sciences Distribution
- [ENGE](#): English Foundation
- [GCP](#): Global and Cultural Perspectives Requirement
- [GEEL](#): General Education Elective
- [HUMD](#): Humanities Distribution
- [MATE](#): Mathematics Foundation
- [NSLD](#): Natural Sciences Distribution with Laboratory
- CE: Credit Available by Examination
- (R Only): Rockville Campus Only

[COMM 108 - Foundations of Human Communication](#) – 3 semester hours ([GEEL](#))

A survey course that covers communication theory and develops communication skills for personal and professional relationships in interpersonal, group, and public settings. Course content includes practice in the application of the principles of listening, verbal and nonverbal communication, group dynamics, and public speaking. Assessment Level(s): [ENGL 101/ENGL 011](#), [READ 120](#). Three hours each week.

[COMM 112 - Business and Professional Speech Communication](#) – 3 semester hours ([GEEL](#))

A study of communication theory as applied to business and organizational environments. Emphasis on development of effective communication skills for professional situations including team building, interviewing, public speaking, and accommodating diverse perspectives. Assessment Level(s): [ENGL 101/ENGL 011](#), [READ 120](#). Three hours each week.

[CMSC 140 – Introduction to Programming](#) – 3 semester hours (Elective)

Introduces programming and problem solving using a contemporary programming language. Topics include principles of procedural programming, software development and debugging techniques, control structures, data types, functions, one-dimensional arrays, and file processing. Using a computer, students complete required lab assignments. Students with no prior technical background are highly recommended to also take CMSC 110. Assessment Level(s): [ELAI 990](#) or [ENGL 101/ENGL 011](#), [MATH 050](#), [READ 120](#). Three hours each week.

[CMSC 203 – Computer Science I](#) – 4 semester hours (Elective)

Fundamental computer concepts. Studies methods of object-oriented program development and design. The course also covers language systems and semantics, structured program verification, different language paradigms, and documentation techniques. Students use a structured, high-level object-oriented programming language and learn to use both text-oriented and Windows-based user interfaces. Designing and implementing solutions to intermediate-level programming assignments are an integral part of the course.

PREREQUISITE(S): A grade of C or better in [CMSC 140](#) or consent of department. PRE- or COREQUISITE(S): [MATH 181](#). Four hours each week.

[ENGL 102 – Critical Reading, Writing and Research](#) – 3 semester hours ([ENGF](#))

Studies in argumentation and research. A second of two sequential freshman composition courses, this course is designed to help students learn to identify, critically read, analyze and evaluate, and write arguments using logic and appropriate rhetorical techniques. Students construct thesis-driven academic essays, synthesizing and incorporating the words and ideas of others and using formal documentation. Students learn to identify audience as well as employ effective tone, word choice, and sentence patterns. To comply with Maryland state requirements for English Foundation (ENGF), [ENGL 102](#) must be completed with a final grade of C or better for a student to graduate with an associate's degree. PREREQUISITE(S): A grade of C or better in [ENGL 101/ENGL 011](#) or consent of department. Three hours each week.

[ENGL 103 – Critical Reading, Writing and Research in the Work Place](#) – 3 semester hours ([ENGF](#))

Studies in argumentation and research in the workplace. A second of two sequential freshman composition courses, this course is designed to help students understand the processes and products associated with writing used in technology and business. Emphasis will be on the writing process, including writing to different audiences and supporting claims persuasively with appropriate evidence and detail. Students will write a variety of reports, documentation, and proposals, employing a range of stylistic options. The course will include an introduction to the rules for integrating visual aids into technical documents and a major research project focusing on developing an appropriate research question, conducting scholarly research, and incorporating information into writing with the proper conventions of citation. To comply with Maryland state requirements for English Foundation (ENGF), [ENGL 103](#) must be completed with a final grade of C or better for a student to graduate with an associate's degree.

PREREQUISITE(S): A grade of C or better in [ENGL 101/ENGL 011](#) or consent of department. Three hours each week.

[GEOG 130 – Global Geography](#) – 3 semester hours ([BSSD](#))

Examination for the general student of global regions, patterns, trends, and geographic relationships which together form a basis for comprehending the mosaic of world affairs. An introduction to geographic facts and development of skills needed to appraise critical topics and issues normally covered in college-level disciplines. Assessment Level(s): [ENGL 101/ENGL 011](#), [MATH 050](#), [READ 120](#). Three hours each week.

[GEOG 240 – Introduction to Cartography](#) – 3 semester hours (R-Only) (CE) (Elective)

General introduction to cartography's history, theory, and use of maps. Study of various types of maps, charts, and plans, mapscales, coordinates, and projections. Techniques, methods, problems of design, compilation, and construction of maps and graphics. Map symbolization and representation of topographic, hydrographic, geographic, and other phenomena. Fundamental concepts as applicable to mapping, surveying, and aerial photography. Techniques and methods of presenting data in graphic forms. Assessment Level(s): [ENGL 101/ENGL 011](#), [MATH 050](#), [READ 120](#). Two hours lecture, two hours laboratory each week.

[GEOG 260 – Introduction to Geographic Information Systems](#) – 3 semester hours (R Only) (CE) (Elective)

Geographic information systems (GIS) integrates the application of spatial data handling procedures with the study of geographic problems. The course utilizes computer software designed for the study of environmental problems based upon data compiled from maps and remote sensing imagery. This course will serve as a basic introduction to the concepts and techniques of GIS. The problems used for study in this course are selected to provide real-world examples suitable for solution through the use of GIS. PREREQUISITE(S): [GEOG 240](#) or consent of program coordinator. Two hours lecture, two hours laboratory each week.

[MATH 117 - Elements of Statistics](#) – 3 semester hours

An introductory non-calculus statistics course to serve a variety of students who need a working knowledge of statistics. Descriptive analysis and treatment of data, probability and probability distributions, statistical inferences, linear regression and correlations, chi-square, and some nonparametric statistics. Preexisting statistical computer programs may be used for some applications. PRE- or COREQUISITE(S): Appropriate score on mathematics assessment test, a grade of C or better in [MATH 050](#) or [MATH 092](#), or concurrent enrollment in [MATH 017](#), or consent of department. Assessment Level(s): [ENGL 101/ENGL 011](#) or AELW 940/[ELAI 990](#), [READ 120](#) or AELR 930/[ELAR 980](#). Three hours each week.

[MATH 165 – Precalculus](#) – 4 semester hours (Elective)

An examination of topics from advanced algebra, trigonometry, conics, and functions and applied problems. This course is designed to prepare students for [MATH 181](#). PREREQUISITE(S): A grade of C or better in [MATH 050](#) appropriate score on mathematics, assessment test, or consent of department. PRE- or COREQUISITE(S): MATH 098. Assessment Level(s): [ENGL 101/ENGL 011](#) or AELW 940/[ELAI 990](#), [READ 120](#) or AELR 930/[ELAR 980](#). For computation of tuition, this course is equivalent to five semester hours. Five hours each week.

[MATH 181 – Calculus I \(MATF\)](#) – 4 semester hours

[MATH 181](#) and [MATH 182](#) are intended primarily for students of the physical sciences, engineering, and mathematics. An introduction to major ideas of single variable calculus including limits, derivatives, and integrals of algebraic and transcendental functions; applications. PREREQUISITE(S): A grade of C or better in [MATH 165](#), appropriate score on mathematics assessment test, or consent of department. Assessment Level(s): [ENGL 101/ENGL 011](#) or AELW 940/[ELAI 990](#), [READ 120](#) or AELR 930/[ELAR 980](#). For computation of tuition, this course is equivalent to five semester hours. Five hours each week.

[MATH 182 – Calculus II](#) (CE) – 4 semester hours (Elective)

A continuation of [MATH 181](#). Further differentiation and integration of transcendental functions. Methods of integration with applications, indeterminate forms, improper integrals, Taylor's formula; infinite series; polar coordinates. PREREQUISITE(S): A grade of C or better in [MATH 181](#) or equivalent, or consent of department. For computation of tuition, this course is equivalent to five semester hours. Five hours each week.

[MATH 217 – Biostatistics](#) – 3 semester hours

A course in statistical methods for students in biology and the health sciences. The course will explore foundational concepts and applications in descriptive and inferential statistics including: conditional probability, sampling distribution, estimation, odds ratios, formal probability distributions (e.g., binomial, Gaussian and Poisson), confidence intervals, hypothesis testing (e.g., t-tests, Wilcoxon Signed-Rank Test, ANOVA, chi-square tests), correlation, simple and multiple linear regression, relative risk, and logistic regression. Coursework will rely heavily on technology in order to focus on the applications of statistical concepts and methods within the health sciences and biology areas. PRE- or COREQUISITE(S): [MATH 150](#) or [MATH 170](#) or [MATH 181](#) or consent of department. Three hours each week.

[MATH 264 – Applications of Linear Algebra](#) – 4 semester hours

For students who wish to focus on the practical applications of Linear Algebra. A wide range of applications are discussed and coursework will rely heavily on technology in order to focus on the applications of concepts and methods. The main topics include matrix calculations and determinants, vector spaces over the real numbers, orthogonality, linear transformations, eigenvalues, eigenvectors, graphical explorations of vectors, and inner products. Applications incorporating problem solving are presented in the context of real-world situations with an emphasis on model creation and interpretation. PREREQUISITE(S): A grade of C or better in [MATH 150](#) or [MATH 181](#) or consent of department. Assessment Level(s): [ENGL 101](#)/ENGL 101A or AELW 940, [READ 120](#) or AELR 930. Four hours lecture each week.

[MATH 284 – Linear Algebra](#) – 4 semester hours (Elective)

Basic concepts of linear algebra including vector spaces, linear equations and matrices, determinants, linear transformations, similar matrices, eigenvalues, and quadratic forms. PREREQUISITE(S): A grade of C or better in [MATH 182](#) or consent of department. For computation of tuition, this course is equivalent to five semester hours. Five hours each week.

[PHIL 140 – Introduction to the Study of Ethics](#) – 3 semester hours ([HUMD](#))

Covers contemporary ethical issues in public policy and personal conduct. Topic areas may include bioethics and medicine; inequality and discrimination; justice and punishment; information ethics; environmental ethics; or other areas. Practical issues in these areas will be discussed in relation to ethical theories. Various ethical perspectives will be critically examined. Assessment Level(s): [ENGL 101](#)/[ENGL 011](#), [READ 120](#). Three hours each week.

[PSYC 102 – General Psychology](#) – 3 semester hours ([BSSD](#))

Introduction to the fields and research methods of psychology, including such topics as biological bases of behavior, human development, perception, learning, mental disorder, and social behavior. Assessment Level(s): [ENGL 101](#)/[ENGL 011](#), [READ 120](#). Three hours each week.

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

Each two-year plan of study includes General Education requirements, program requirements, and program electives. General Education requirements are interspersed with program requirements for each program.

The following General Education courses are required for students to graduate with the data science associate of science and meet the external standards set forth in COMAR and Montgomery College's institutional requirements.

General Education Requirements	COMAR Credits	College Credits	Program Credits	Program Courses
English Foundation (ENGE)	3	3	3	ENGL 102 or ENGL 103
Mathematics Foundation (MATF)	3	3	4	MATH 181
Arts Distribution (ARTD)	3	3	3	Elective
Humanities Distribution (HUMD)	3	3	3	PHIL 140
Behavioral and Social Sciences Distribution (BSSD)	6	6	6	PSYC 102 and Elective
Natural Sciences Distribution with Lab (NSLD)	8	8	8	Electives
Communications, Health, Arts or Humanities Distribution (GEEL)	3	3	3	COMM 108 or COMM 112
Total	29	29	30	

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

There are no specialized accreditation or graduate certificate requirements for this program and its students.

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

There are no written contracts with other institutions or non-collegiate organizations for this program.

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 system, availability of academic support services and financial aid resources, and costs and payment policies.

Montgomery College's online catalog helps students quickly locate and save details about the current schedule of classes, courses, and programs. The catalog is dynamic, meaning a live document that reflects changes in real time. The online catalog is located on the official policies page of the College's website at montgomerycollege.edu/catalog.

To determine program-specific information, students can view the program advising guide aligned with any program in the catalog. These guides directly link to the catalog so they reflect real-time information. They are meant to supplement the advising process and should be used in conjunction with the Montgomery College catalog and other College resources. The program advising guide for the [data science certificate](#) and [general studies STEM with a data science concentration](#) are already published. Upon approval, the new data science associate of science program advising guide will be displayed on Montgomery College's online catalog.

Students may find general information such as availability of academic support services, financial aid resources, tuition rates, and payment policies by using the search function at montgomerycollege.edu.

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.

Upon approval, the new data science associate of science will be published in the College catalog. The Office of the Senior Vice President for Academic Affairs oversees publication and maintenance of the online catalog.

Advertising and recruitment for the data science associate of science will occur at College events such as new student orientation, major-specific fairs, guest speaker series, symposia, college recruitment fairs, and networking opportunities from outside agencies and organizations. The Office of Communications oversees publication of electronic and hard copy marketing materials.

H. Adequacy of Articulation

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

Montgomery College's data science faculty actively pursue articulated academic agreements that provide students with a clearly-defined pathways for successful completion and transfer:

- Montgomery College and CSU formalized a [transfer pathway](#) from Montgomery College's data science associate of science to CSU's data science bachelor of science as an addendum to the original articulation agreement between the institutions (Appendix B).
- Montgomery College and University of Maryland (UMD) at the Universities at Shady Grove formalized a transfer pathway from Montgomery College's data science associate of science to UMD's information science bachelor of science as an addendum to the original articulation agreement between the institutions.
- Montgomery College and University of Maryland Global Campus have a transfer pathway in progress from Montgomery College's pending data science associate of science to University of Maryland Global Campus' bachelor of science in data science.

The Mathematics, Statistics, and Data Science Department is also considering additional transfer pathways with the following four-year institutions (also noted in Section E.1):

- Bowie State University has a data analytics initiative which includes creating new courses and integrating the data science and analytics modules into existing courses. This could eventually lead to an undergraduate certificate in data science and analytics, for which there is a possibility of an articulation agreement with Montgomery College's data science program.
- The Department of Information Sciences and Systems at the Graves School of Business at Morgan State University is preparing a proposal to offer a master of science in data analytics and visualization, for which there is a possibility of a 2 + 2 + 2 articulation agreement with Montgomery College's data science program.

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 this program).

Montgomery College appoints faculty who are experienced educators and working professionals in the field of mathematics, statistics, and data science. The current faculty continue to engage in professional development opportunities and community partnerships in

the region to improve curriculum development and design. Furthermore, because of the College's close proximity to the Washington, DC metropolitan area, numerous active data science practitioners serve as part-time faculty as well as guest speakers.

Following is a list of faculty with terminal degree title and field, academic title/rank, and the course(s) each faculty member will teach:

Name	Terminal Degree	Academic Title	Courses Taught
Rachel Saidi	MS in statistics	FT Faculty	DATA 110 , MATH 117 , MATH 165 , MATH 181 , MATH 182 , MATH 217
Celia Evans	PhD in mathematics	FT Faculty	DATA 101 , MATH 117 , MATH 165 , MATH 181 , MATH 182 , MATH 284
Rebin Mohamed	PhD in mathematics	FT Faculty	MATH 181 , MATH 182 , MATH 264 , MATH 284
Abdirisak Mohamed	PhD in mathematics	PT Faculty	DATA 101 , DATA 201 , MATH 117 , MATH 182
Michael Iapalucci	MBA	PT Faculty	DATA 101 , DATA 205

2. 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

Montgomery College offers faculty numerous in-person and online course offerings for best practices in pedagogy, content delivery, and course assessment. The College also offers an educational assistance program (EAP) that provides faculty funds to support graduate and doctoral coursework and professional conferences and workshops.

Data science faculty maintain active memberships in many professional organizations related to the discipline, such as the [American Statistical Association](#), the [Mathematical Association of America](#), and the [Academic Data Science Alliance](#). Faculty attend conferences and continuing education programs through these and other professional organizations.

b) The learning management system

Montgomery College's E-Learning, Innovation, and Teaching Excellence ([ELITE](#)) department offers many online and in-person training sessions for the College's learning management system (Blackboard), as well as Quality Matters training and semester-long training to prepare faculty for distance education courses.

In summer 2020, all full and part-time faculty were instructed in the best practices for implementing structured remote instruction through the learning management system. Faculty are also encouraged to use the learning management system to help support their in-person and structured remote courses.

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

ELITE offers numerous training opportunities in distance education pedagogy and instructional technology. A team of instructional designers works closely with individual faculty, academic departments, and committees to design and deliver faculty professional development. In addition, all online instructional faculty are required to complete Blackboard training prior to teaching in the online setting.

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.

The various library resources are adequate to support the proposed program as Montgomery College currently offers all courses in the data science associate of science. Students have ready access to a supply of current and relevant books, journals, periodicals, and other reference materials needed to meet the requirements of the curriculum.

The Montgomery College library has three locations with comfortable facilities conducive to academic work. Library services are available 73 hours per week. The library supports the academic goals of the College's students and employees through group instruction sessions, personal research consultations, and online support. Available technology includes computers, printers, charging stations, high-speed scanners, laptops, tablets, One Button Studios for easy video creation, and collaborative workstations for group projects. Web-delivered subscription databases cover academic disciplines, including data science. The library also provides course-specific series taught at the College. For example, [O'Reilly Online Learning Database](#) provides countless books on data science, programming, and data engineering.

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

Physical facilities and equipment are adequate to support the proposed program as Montgomery College currently offers all courses in the new data science associate of science. The program will be implemented with existing resources.

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

Upon admission, every student receives a Montgomery College email account; this is the primary method for receiving correspondence and information from various College offices and departments. The College utilizes Blackboard as its learning management system. Additionally, Montgomery College promotes distance learning by providing access to online counseling, advising, library resources, tutoring, and more.

Students enrolled in the data science associate of science can complete all required courses in a on campus or online setting.

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.

TABLE 1: PROGRAM RESOURCES

1. Reallocated Funds:

- Reallocated funds include faculty, administrator, and administrative staff salaries currently supporting the data science certificate program as well as the general studies STEM associate of arts with a data science concentration. The same positions will support the new data science associate of science.

2. Tuition and Fee Revenue:

- The credit hour rate is based on [2021 in-county tuition](#) and includes both tuition and fees. The first credit hour is \$201 (\$132 plus minimum \$50 consolidated fee and other fees); the rate is \$177.40 for two or more hours.
- Full-time enrollment is equivalent to 30 credit hours for the academic year; part-time enrollment is equivalent to 15 credit hours for the academic year.

3. Grants and Contracts:

- No grants or external funding needed to implement this program.

4. Other Sources:

- No additional funds needed to implement this program.

5. Total Year:

- Program resources reflect a conservative projection of full-time and part-time student enrollment over five years.

Table 1: Program Resources					
Resource Categories	Year 1 (2022-23)	Year 2 (2023-24)	Year 3 (2024-25)	Year 4 (2025-26)	Year 5 (2026-27)
1. Reallocated Funds	\$192,927	\$197,756	\$202,719	\$207,820	\$221,165
2. Tuition/Fee Revenue (c + g below)	\$7,983	\$16,398	\$25,245	\$34,524	\$44,235
a. Number of F/T Students	1	2	3	4	5
b. Annual Tuition/Fee Rate	\$5,322	\$5,466	\$5,610	\$5,754	\$5,898
c. Total F/T Revenue (a x b)	\$5,322	\$10,932	\$16,830	\$23,016	\$29,490
d. Number of P/T Students	1	2	3	4	5
e. Credit Hour Rate	\$177.40	\$182.20	\$187.00	\$191.80	\$196.60
f. Annual Credit Hour Rate	15	15	15	15	15
g. Total P/T Revenue (d x e x f)	\$2,661	\$5,466	\$8,415	\$11,508	\$14,745
3. Grants, Contracts & Other External Sources	\$0	\$0	\$0	\$0	\$0
4. Other Sources	\$0	\$0	\$0	\$0	\$0
TOTAL (Add 1 - 4)	\$200,910	\$214,154	\$227,964	\$242,344	\$265,400

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.

TABLE 2: PROGRAM EXPENDITURES**1. Faculty (# FTE, Salary, and Benefits):**

- The faculty below currently support the data science certificate program as well as the general studies STEM associate of arts with a data science concentration. The same faculty will support the new data science associate of science. Part-time faculty are hired as needed per semester.
- Faculty salaries based on an annual increase of 2.75 percent.
- Benefits include 7.65 percent for FICA and \$9,000 per FTE for insurance.

Name	Appointment/Status	Program Time
Rachel Saidi	Full-time Professor	60%
Celia Evans	Full-time Professor	60%
Rebin Muhammad	Full-time Professor	25%
Abdirisak Mohamed	Part-Time Faculty	25%
Michael Iapalucci	Part-Time Faculty	25%

2. Administrative Staff (# FTE, Salary, and Benefits):

- Multiple administrative staff support the data science program. All serve the Mathematics, Statistics, and Data Science Department as a whole and are not exclusive to the data science program.
- Administrative staff salaries based on an annual increase of 3 percent.
- Benefits include 7.65 percent for FICA and \$9,000 per FTE for insurance.

Name	Appointment/Status	Program Time
Ben Nicholson	Department Chair	5%
Milton Nash	Dean	5%

3. Support Staff (# FTE, Salary, and Benefits):

- Multiple support staff support the data science program. All serve the Mathematics, Statistics, and Data Science Department as a whole and are not exclusive to the data science program.
- Support staff salaries based on an annual increase of 3 percent.
- Benefits include 7.65 percent for FICA and \$9,000 per FTE for insurance.

Name	Appointment/Status	Program Time
Christina Roskovich	Administrative Aide II	5%

4. Equipment:

- No additional equipment needed to implement this program.

5. Library:

- No additional library resources needed to implement this program.

6. New and/or Renovated Space:

- No additional facilities needed to implement this program.

7. Other Expenses:

- No other expenses anticipated to implement this program.

8. Total Year:

- Expenditures include faculty, administrator, and administrative staff salaries currently supporting the data science certificate program and general studies STEM associate of arts with a data science concentration. The same positions will support the new data science associate of science.

Table 2: Program Expenditures					
Expenditure Categories	Year 1 (2022-23)	Year 2 (2023-24)	Year 3 (2024-25)	Year 4 (2025-26)	Year 5 (2026-27)
1. Faculty (b + c below)	\$174,281	\$178,591	\$183,019	\$187,570	\$192,245
a. Number of FTE	1.95	1.95	1.95	1.95	1.95
b. Total Salary	\$145,593	\$149,597	\$153,711	\$157,938	\$162,281
c. Total Benefits	\$28,688	\$28,994	\$29,309	\$29,632	\$29,964
2. Admin. Staff (b + c below)	\$15,197	\$15,626	\$16,067	\$16,522	\$16,991
a. Number of FTE	0.10	0.10	0.10	0.10	0.10
b. Total Salary	\$13,281	\$13,679	\$14,090	\$14,512	\$14,948
c. Total Benefits	\$1,916	\$1,946	\$1,978	\$2,010	\$2,043
3. Support Staff (b + c below)	\$3,450	\$3,540	\$3,632	\$3,728	\$3,826
a. Number of FTE	0.05	0.05	0.05	0.05	0.05
b. Total Salary	\$2,786	\$2,870	\$2,956	\$3,045	\$3,136
c. Total Benefits	\$663	\$670	\$676	\$683	\$690
4. Technical Support and Equipment	\$0	\$0	\$0	\$0	\$4,276
5. Library	\$0	\$0	\$0	\$0	\$3,826
6. New or Renovated Space	\$0	\$0	\$0	\$0	\$0
7. Other Expenses	\$0	\$0	\$0	\$0	\$0
TOTAL (Add 1 – 7)	\$192,927	\$197,756	\$202,719	\$207,820	\$221,165

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.

The College assesses and reviews programs on a regular basis based on the information noted in section G.3. All courses and programs at Montgomery College have clearly stated learning outcomes. The program learning outcomes align with and support the student learning outcomes of the individual courses that form a degree’s curriculum. The program assessment process involves assessment planning, data collection, review of results, action plan development and implementation, and reassessment. The cyclical loop is closed by using the assessment results to improve teaching and learning experiences.

College faculty undergo an extensive and comprehensive evaluation process in compliance with the agreements between the College and the Montgomery College Chapter of American Association of University Professors (full-time faculty) and the Service Employees International Union (part-time faculty). This process includes student evaluations, self-evaluations, peer reviews, classroom observations, department chair reviews, and dean evaluation. The evaluation schedule varies from annually to every five years, depending on the faculty contract type and contract year. Evaluations determine if faculty members demonstrate high-quality performance in their teaching assignments, seek professional growth in their teaching area, are

available to students, meet special objectives from preceding evaluations, and demonstrate substantial progress in service to their campus, College, and/or community. The purpose of a performance review is to promote the highest quality teaching techniques, to ensure knowledge of subject matter, to encourage professional growth and development of faculty, to assess strengths and weaknesses in faculty performance, and to assess service to the College community.

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.

All programs at Montgomery College go through an academic program review every five years to determine program viability. The academic program review ensures all programs effectively use the College's instructional resources, support the College's mission, and serve the needs of students and the College community. The data science associate of science will go through the academic program review process as all other programs at Montgomery College.

Montgomery College is proud to be selected as an [Achieving the Dream \(ATD\)](#) institution. ATD is a nationwide network of higher education institutions committed to systemic change to increase student success and completion, especially among disadvantaged students. As an ATD institution, Montgomery College works to build a culture of evidence that uses data to make informed decisions for student success. One example of the College's use of data is the [Student Success Score Card](#), which is a summary of indicators used to track student achievement. The academic program review process and the Student Success Score Card provide actionable information to help the College assess and improve its focus on achievement and the success of every student.

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.

Montgomery College is committed to creating a welcoming and inclusive environment for all students. As a whole, the Montgomery College community promotes an equity and inclusion focus where radical inclusion—or deeply rooted values of welcoming all individuals seeking higher education or continuing education—is an essential element of the College's fabric. The College's steadfast commitment to radical inclusion creates an inclusive, respectful learning environment that fosters critical thinking and civil discourse.

The data science program is committed to serving Montgomery College's diverse student body and promoting equity and inclusion by: (1) increasing the recruitment of women and minority students to promote diversity in the student body and data science professions as a whole, (2) providing a safe forum for students to debate controversial ethical and social topics related to data science, and (3) providing a curriculum designed to promote student success, retention, completion, and access to career opportunities.

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.

Not applicable. This program is not related to low-productivity programs identified by the Maryland Higher Education Commission.

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.

Montgomery College received Commission approval to provide distance education programs. Montgomery College currently offers numerous degrees and certificates with a fully online delivery option, all of which have been approved by the Commission.

2. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.

Students can complete the required data science coursework in both an on-campus and online format.

The Middle States Commission on Higher Education is the accrediting body for Montgomery College. The College follows the appropriate guidelines and adheres to the national standards and integrity for our distance education programs. Montgomery College received a positive outcome at the 2018 reaccreditation.

Appendix A – Projected Fastest Growing Occupations 2020-2030 U.S. Bureau of Labor Statistics

Table 1.3A Fastest growing occupations, 2020 and projected 2030, excluding occupations with above average cyclical recovery⁽¹⁾ (Numbers in thousands)

2020 National Employment Matrix title	2020 National Employment Matrix code	Employment, 2020	Employment, 2030	Employment change, 2020-30	Percent employment change, 2020-30	Median annual wage, 2021 ⁽²⁾
Total, all occupations	00-0000	153,533.80	165,413.70	11,879.90	7.7	\$45,760
Wind turbine service technicians	49-9081	6.9	11.7	4.7	68.2	\$56,260
Nurse practitioners	29-1171	220.3	335.2	114.9	52.2	\$120,680
Solar photovoltaic installers	47-2231	11.8	17.9	6.1	52.1	\$47,670
Statisticians	15-2041	42	56.9	14.9	35.4	\$95,570
Physical therapist assistants	31-2021	93.8	126.9	33.2	35.4	\$61,180
Information security analysts	15-1212	141.2	188.3	47.1	33.3	\$102,600
Home health and personal care aides	31-1120	3,470.70	4,600.60	1,129.90	32.6	\$29,430
Medical and health services managers	Nov-11	429.8	569.4	139.6	32.5	\$101,340
Data scientists and mathematical science occupations, all other	15-2098	63.2	83	19.8	31.4	\$100,480
Physician assistants	29-1071	129.4	169.5	40.1	31	\$121,530
Epidemiologists	19-1041	7.8	10.2	2.3	29.6	\$78,830
Logisticians	13-1081	191	247.3	56.4	29.5	\$77,030
Speech-language pathologists	29-1127	158.1	203.5	45.4	28.7	\$79,060
Animal trainers	39-2011	60.2	77.4	17.2	28.5	\$31,280
Computer numerically controlled tool programmers	51-9162	27.1	34.5	7.4	27.4	—
Genetic counselors	29-9092	2.4	3.1	0.6	26.2	\$80,150
Crematory operators and personal care and service workers, all other	39-9098	80.5	100.5	19.9	24.8	\$29,610
Operations research analysts	15-2031	104.1	129.7	25.6	24.6	\$82,360
Actuaries	15-2011	27.7	34.5	6.8	24.5	\$105,900
Health specialties teachers, postsecondary	25-1071	242.7	301.6	58.9	24.3	\$102,720
Forest fire inspectors and prevention specialists	33-2022	3	3.7	0.7	23.9	\$42,600
Interpreters and translators	27-3091	81.4	100.7	19.3	23.7	\$49,110
Athletic trainers	29-9091	30	37	7	23.4	\$48,420
Respiratory therapists	29-1126	135.1	166.2	31.1	23	\$61,830
Substance abuse, behavioral disorder, and mental health counselors	21-1018	327.5	402.6	75.1	22.9	\$48,520
Food preparation and serving related workers, all other	35-9099	71.2	87.4	16.2	22.8	\$29,120
Nursing instructors and teachers, postsecondary	25-1072	72.6	88.9	16.3	22.4	\$77,440
Woodworkers, all other	51-7099	9.5	11.6	2.1	22.2	\$35,610
Phlebotomists	31-9097	129.6	158.4	28.8	22.2	\$37,380
Software developers and software quality assurance analysts and testers	15-1256	1,847.90	2,257.40	409.5	22.2	—

Footnotes:

⁽¹⁾ Data excludes occupations that had a decline in wage and salary employment greater than the decline for all occupations from 2019 to 2020 (approximately 6%). These excluded occupations may have fast growth rates that do not reflect structural growth but only cyclical recovery.

⁽²⁾ Data are from the Occupational Employment and Wage Statistics program, U.S. Bureau of Labor Statistics. Wage data cover non-farm wage and salary workers and do not cover the self-employed, owners and partners in unincorporated firms, or household workers.

Note: Data is unavailable for values denoted with a "—".

Source: Employment Projections program, U.S. Bureau of Labor Statistics

Appendix B – Transfer Pathway with Coppin State University

Suggested Transfer Pathway Montgomery College A.S. in Data Science to Coppin State University B.S. in Data Science

Year One – Montgomery College

Fall Semester	Cr
ENGL 101 Introduction to College Writing*	3
MATH 181 Calculus I (MATF)	4
PSYC 102 General Psychology (BSSD) **	3
COMM 108 or Foundations of Human Communication (GEEL) OR COMM 112 Business and Professional Speech Communication (GEEL)	3
MATH 117 or Elements of Statistics OR MATH 217 Biostatistics	3
Total Credits	16

(Courses may be taken in any order)

Spring Semester	Cr
ENGF English Foundation	3
PHIL 140 Intro to the Study of Ethics (HUMD)	3
GEOG 130 Global Geography (BSSD) (GCP) **	3
DATA 101 Intro to Data Science	3
DATA 110 Data Visualization and Communication	3
Total Credits	15

Year Two – Montgomery College

Fall Semester	Cr
NSLD Natural Sciences Distribution with Laboratory (NSLD) ‡	4
DATA 201 Statistical Methods in Data Science	3
MATH 264 Applications in Linear Algebra ***	4
Program Elective †	4
Total Credits	15

Spring Semester	Cr
ARTD Arts Distribution (ARTD)	3
NSLD Natural Sciences Distribution with Laboratory (NSLD) ‡	4
DATA 205 Capstone in Data Science	4
200-Level Program Elective † (CMSC 206 Recommended)	3
Total Credits	14

Apply to graduate from MC with an Associate of Science in Data Science

* ENGL 101/ENGL 101A, if needed for ENGL 102/ ENGL 103 or program elective.

** Behavioral and Social Science Distribution (BSSD) courses must come from different disciplines. Contact department advisor for transfer requirements for specific schools.

*** Students may substitute MATH 284 for MATH 264

‡ Students are strongly encouraged to take two consecutive lab sciences courses. Examples include BIOL 105/106 or CHEM 131/132 or PSCI 101/102 or PHYS 203/204

† Program Electives: strongly recommended CMSC 206 and GEOG 240; CMSC 206 will provide students with programming skills in Python and GEOG 240 provides foundational knowledge of Geographic Information Systems (GIS); other program electives may include MATH 165, MATH 182, CMSC 140, CMSC 203, GEOG 130, GEOG 260. Not all program elective options transfer to all institutions. Please consult a data science program advisor or the transfer institution before selecting program elective courses.

Year Three – Coppin State University

Fall Semester	Cr
ACCT 201 Principles of Financial Accounting	3
BDSC 340 Operations Management	3
BUSI 310 Business Law	3
DSCI 310 Data Science Programming	3
ECON 211 Principles of Economics I	3
Total Credits	15

Spring Semester	Cr
ACCT 202 Principles of Managerial Accounting	3
BUSI 320 Fundamentals of Intl. Business	3
ECON 212 Principles of Economics II	3
MGMT 305 Business Communications	3
MISY 341 Small Systems Software	3
Total Credits	15

Year Four – Coppin State University

Fall Semester	Cr
DSCI 375 Time Series Modeling and Forecasting	3
DSCI 420 Machine Learning	3
FINM 330 Business Finance	3
MGMT 320 Principles of Management	3
MKTG 310 Principles of Marketing	3
Total Credits	15

Spring Semester	Cr
BUSI 495 Seminar in Business Strategy & Policy	3
DSCI 356 Data Science Cloud Computing	3
DSCI 490 Data-driven Decision Making	3
MISY 360 Database Mgmt. Principles	3
General Elective (Recommended: Any COSC, MATH, or MISY course)	3
Total Credits	15

Data Science A.S.

GENERAL EDUCATION: FOUNDATION COURSES					
	Course	Hours	Grade		
Critical Reading, Writing, and Research (ENGF) or Critical Reading, Writing, and Research in the Workplace (ENGF) *	ENGL 102 or ENGL 103	3			
Elements of Statistics (MATF)	MATH 117	3			
GENERAL EDUCATION: DISTRIBUTION COURSES					
	Course	Hours	Grade		
Arts Distribution (ARTD)		3			
Intro to Study of Ethics (HUMD)	PHIL 140	3			
General Psychology (BSSD) **	PSYC 102	3			
Behavioral & Social Sciences Distribution (BSSD) ** Recommended GEOG 130 (GCP)		3			
Natural Sciences Distribution with Lab (NSLD)		4			
Natural Sciences Distribution with Lab (NSLD)		4			
Foundations of Human Communication (GEEL) or Business and Professional Speech Communication (GEEL)	COMM 108 or COMM 112	3			
PROGRAM REQUIREMENTS					
	Course	Hours	Grade		
Introduction to Data Science	DATA 101	3			
Data Visualization and Communication	DATA 110	3			
Statistical Methods in Data Science	DATA 201	3			
Capstone Experience in Data Science	DATA 205	4			
Calculus I *	MATH 181	4			
Applications in Linear Algebra	MATH 264	4			
Program Elective †		3			
Program Elective †		3			
Program Elective †		4			
Has student completed the Global Perspectives requirement? <table border="0" style="display: inline-table; vertical-align: middle;"> <tr> <td style="padding: 0 10px;">Yes</td> <td style="padding: 0 10px;">No</td> </tr> </table>		Yes	No	Overall GPA of 2.0 is required to graduate Total Credits: 60	
Yes	No				

Apply to graduate from Montgomery College with an A.S. in Data Science

Rhoe, Angela M

From: Lewis, Leontye <llewis@coppin.edu>
Sent: Tuesday, March 29, 2022 11:15 PM
To: Gregory, Sadie; Rhoe, Angela M
Subject: RE: Data Science Articulation Draft with MC A.S. in Data Science

This is great news. Thank you both for all that you do.

Sincerely,

Leontye

Leontye L. Lewis, Ed.D.
Provost and Vice President for Academic Affairs
Division of Academic Affairs
Coppin State University
HHSB 218
2500 W. North Avenue
Baltimore, Maryland 21216
410-951-1297 (Office)
llewis@coppin.edu



From: Gregory, Sadie <SrGregory@coppin.edu>
Sent: Monday, March 28, 2022 12:57 PM
To: 'Rhoe, Angela M' <angela.rhoe@montgomerycollege.edu>
Cc: Lewis, Leontye <llewis@coppin.edu>
Subject: FW: Data Science Articulation Draft with MC A.S. in Data Science

Good Afternoon,

I approve. We will add the attached to our Articulation Agreement and move forward with posting on are website.

Thanks for your awesome leadership and support. Looking forward to implementing our Agreement.

Sadie

From: Rhoe, Angela M <angela.rhoe@montgomerycollege.edu>
Sent: Monday, March 28, 2022 11:58 AM
To: Gregory, Sadie <SrGregory@coppin.edu>
Subject: FW: Data Science Articulation Draft with MC A.S. in Data Science

Good Morning, Sadie:

This email is to confirm our approval of the Data Science pathway. We can simply make an addendum to our current MOU and update our websites if you approve.

Angela

Angela M. Rhoe
Director of Strategic Alliances
Montgomery College
9221 Corporate Blvd
Rockville, MD 20850
(240) 567-3217 (office)

From: Saidi, Rachel <rachel.saidi@montgomerycollege.edu>
Sent: Wednesday, March 09, 2022 4:14 AM
To: Gregory, Sadie <SrGregory@coppin.edu>; Ha, Lidan <LHa@coppin.edu>; Iqbal, Gazi Md Daud <gigbal@coppin.edu>; Nash, Milton H <milton.nash@montgomerycollege.edu>; Rhoe, Angela M <angela.rhoe@montgomerycollege.edu>
Subject: Fw: Data Science Articulation Draft with MC A.S. in Data Science

Good Morning Sadie, Lidan, Gazi, Milton, and Angela,

Thank you very much, Sadie and your colleagues, for your prompt attention to creating the transfer pathway.

I reviewed the documents you included, and they look great to me, but I also wanted to include Milton Nash, our Dean of Math, Statistics, and Data Science as well as loop Angela Rhoe, our director of Academic Alliances, back into the conversation.

Your years 3 and 4 really seem to complement our years 1 and 2 well. I think students who follow this path will be well prepared in this career field.

I look forward to hearing thoughts from Milton and Angela.

Warm regards,
Rachel Saidi

Rachel Saidi (She/Her)
Associate Professor
Data Science Program Coordinator
Department of Mathematics, Statistics, and Data Science
Montgomery College - Rockville Campus - SC 354 C
<https://www.montgomerycollege.edu/academics/programs/data-science/index.html>

"Finding the question is often more important than finding the answer." — John Tukey

From: Gregory, Sadie <SrGregory@coppin.edu>
Sent: Tuesday, March 8, 2022 5:26 PM
To: Saidi, Rachel <rachel.saidi@montgomerycollege.edu>