HARFORD
COMMUNITY COLLEGE

May 4, 2021

James D. Fielder, PhD
Maryland Higher Education Commission
6 N. Liberty Street, 10th Floor
Baltimore, MD 21201

RE: New Program Approval Request – Data Science A.S.

Dear Dr. Fielder:

Harford Community College is proposing an Associate of Science degree in Data Science. Data Science is a rapidly increasing field in the areas of business, industry, government, and marketing with an immediate need for skilled laborers. This new degree program is designed to support both transfer to bachelor's degree programs at four-year institutions and adequately prepare students for potential workforce entry upon completion.

Payment in the amount of $850 for MHEC approval will be arriving via U.S. Mail. All required materials have been submitted electronically.

Thank you for your consideration of this new program. Please contact Alison Amato at aamato@harford.edu with any questions.

Sincerely,

T. A. Sherwood
T. A. Sherwood (May 4, 2021 14:43 EDT)

Timothy Sherwood, PhD
Vice President for Academic Affairs

Office Use Only: PP#

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

Institution Submitting Proposal	Harford Community College

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 Date Submitted: 06/18/21

Department Proposing Program	Science, Technology, Engineering and Mathematics	
Degree Level and Degree Type	Associate of Science	
Title of Proposed Program	Data Science	
Total Number of Credits	60	
Suggested Codes	HEGIS: 519917	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://catalog.harford.edu/	
Preferred Contact for this Proposal	Name: Alison Amato	
	Title: Coordinator for Curriculum and Program Development	
	Phone: 4434122384	
	Email: aamato@harford.edu	
President/Chief Executive	Type Name: Theresa Felder, Ed.D.	
	Signature: [signature]	Date: Jun 18, 2021
	Date of Approval/Endorsement by Governing Board: June 9, 2021	

Revised 1/2021

New Program Proposal
Associate of Science in Data Science

A. Centrality to institutional mission statement 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.

Harford Community College is proposing an Associate of Science degree program in Data Science, which will consist of 60-62 credits. The requirements of the degree can be completed within 60 credits. However, the choice of some specific program electives may result in students completing 62 credits to earn the degree (see detail in Appendix A). The requirement to manage, analyze, and extract knowledge from data is universal across government, business and commerce, academia, and non-profit organizations. Additionally, new capabilities in data acquisition and interpretation have created novel ethical challenges.

Students that wish to take advantage of this emerging field will require the background to study advanced programming concepts, data organization skills, and mathematics typically required by universities. Additionally, there is an immediate need for skilled laborers with the proficiencies offered through this degree program. Thus, prospective students may find employment directly after completing this program of study or elect to transfer to obtain a Bachelor's or Master's degree in Data Science. Graduates of this program will demonstrate skills and knowledge in data literacy, data reporting, data organization, data analysis, and data visualization. Additionally, coursework will address ethical issues regarding data storage and data use. The ability of professionals in all sectors to make use of data depends on the availability of an educated workforce with appropriate expertise.

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

Harford Community College (HCC) was established in 1957 as an open-access institution. The college promotes graduation, transfer, individual goal attainment, and career and workforce development. Harford Community College's mission[1] reads Grow, Achieve, Aspire, Contribute. Several strategies have been articulated to support this mission.

Creation of this new Associate of Science degree in Data Science is in alignment with the 2019-2022 Harford Community College Strategic Plan, specifically, the first two strategies.

1) Establish relevant, flexible options for learning that respond to community needs for growth and prosperity.

2) Create an engaging and inclusive learning experience so ALL students can achieve their goals.

Data science is an emerging interdisciplinary field at the intersection of mathematics, statistics, and computer science, which continues to evolve. The field relies on processes and systems to derive insights and information from data.[2] All organizations are being challenged with escalating quantities of data that must be transformed into suitable and beneficial information. The proposed program is a degree with 59-61 credits designed to meet the growing need for professionals to acquire the knowledge and skills required to meet these data challenges, with preparation for success at the junior level at transfer institutions. The program will produce graduates who can respond to workforce demands, emerging needs, and work productively with the ever-increasing amounts of data in our exceptionally digitalized environment. Graduates will also acquire proficiency in data presentation and data visualization. The degree would be appropriate for an adult learner that desires to upskill or for entry-level students who desire direct entry into the workforce or students that wish to transfer to a four-year institution.

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.

HCC is committed to providing administrative, financial, and technical support for the proposed program. The STEM division has one full-time and two part-time regularly budgeted administrative assistants and the cost of instructional supplies and technical support are included in the operating budget on an ongoing basis.

Initially, as program enrollment is building, the DSCI courses will be taught by adjuncts or as overload for full-time faculty, which is paid at the adjunct rate. This newly proposed Data Science Associate degree will require additional funding in terms of salaries to teach the four core classes (those with the DSCI prefix) of the degree. As we anticipate only teaching 2-3 sections of DSCI courses per semester, the current adjunct salary budgets within the STEM division are adequate to meet the budgetary needs of these new programs. Other courses within the degree already exist and are offered on a regular basis at Harford Community College. As the program enrollment grows, related additional tuition and fee revenue will be allocated to the program.

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

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

The Data Science curriculum was designed to align with industry demands and the requirements of transfer institutions. Harford Community College has been collaborating with the EDC Oceans of Data

Institute on their National Science Foundation (NSF) sponsored **"**Mentoring to Support Designing and Launching of New Data Science Career Pathways at Community Colleges" grant, DUE Award # 1902568. Prior work of the EDC resulted in the publication of "Profile of the Data Practitioner"[3] which identifies the big data skills, knowledge and behaviors required in the workplace. The proposed Data Science curriculum was created in alignment with this instrument and the requirements of local industry. More information about how this project has manifested at four different community colleges is available here[4]. HCC convened a Data Science Advisory board meeting and presented the proposed curriculum to current local practitioners of data science. Advisory Board members agreed that the proposed curriculum was appropriate for either their industry or their four-year institution. This advisory board meeting was held on Oct. 30, 2020 and the following individuals participated.

INDIVIDUAL	**ROLE**	**INSTITUTION**
Pamela Pape-Lindstrom	Dean of STEM	Harford Community College, MD
Kelly Koermer	Dean of CEBAT	Harford Community College, MD
Chris Jones	Math Faculty	Harford Community College, MD
Stacey Broomall	Chief, BioDefense Branch	U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center
Roberto Cavazos	Director Risk Management & Cybersecurity Programs, Faculty Dept. of Information Systems & Decision Science	University of Baltimore, MD
Paul Hansford	Associate Professor & EDC Mentor	Sinclair Community College, OH
Lakshmi Inbamuthiah	Technical Program Manager	Amazon Web Services Academy
Chris Morrell	Prof. of Statistics, Director of Data Science Program	Loyola University, MD
Aitzaz Nathaniel	Data Architect, Solution Support Division	Army Shared Services Center AMC-CECOM, Software Engineering Center
Davlyn Williams	Technical Project Manager	Data Systems Analyst, Inc, Aberdeen, MD

The program will not require additional physical infrastructure, as the current classroom spaces in Aberdeen Hall and Fallston Hall are sufficient to meet the program needs.

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

This is not applicable as the 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

The need for the advancement and evolution of knowledge critical to social and economic progress is an essential driver in the creation of the Data Science curriculum. Problem solving, critical-thinking, and effective communication skills are required for the data scientist and are focal to the student learning objectives of the program. Many industries will require their current and future employees to gain skills in data literacy and data analysis, data presentation and visualization, and the ethics of data storage and use. The planned curriculum in the HCC Data Science associate degree will provide students the opportunity to gain these competencies.

b. Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education.

As an open access institution, HCC provides educational opportunities available for all students within Harford county and surrounding counties in MD, including military affiliated individuals and working adults, minority students, rural students, and other educationally disadvantaged students. HCC has developed strategies to address the eradication of the attainment gap including implementation of the My College Success Network (MCSN) and Soar2Success (S2S). Established in July 2014, these programs are a network of services, events, staff, and faculty geared toward empowering and supporting African American students.

In 2018, HCC joined Achieving the Dream (ATD), a network dedicated to improving student success, with a particular focus on academic goal attainment, personal growth, and economic opportunity for low-income students and students of color.

c. The need to strengthen and expand capacity of historically black institutions to provide high quality and unique educational programs.

As stated above, HCC is an open access institution and provides extensive student support services and affordable tuition rates for students that would wish to begin their studies at a two-year institution and then transfer to one of Maryland's four Historically Black Institutions, Bowie State University, Coppin State University, University of Maryland Eastern Shore, or Morgan State University. Presently, the HBIs do not offer degrees in data science, however the courses in the proposed degree would transfer, with the DSCI courses transferring in as elective courses.

2. Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education[5].

Data from the MHEC Data Book[6], indicate that in 2020 there was a strong student interest in similar disciplines in the state with students earning 5122 Bachelor's Degrees and 2459 Master's Degrees in computer science. Data Science is new enough at the undergraduate level to not yet be represented in the MHEC Data Book. Computer science and Data Science differ in that computer scientists create software, while data scientists apply software to identify trends and document significance through statistics and communicate these findings via the use of data visualization tools.

The addition of an Associate of Science degree in Data Science addresses several strategies outlined in the 2017-2021 Maryland State Plan for Post-Secondary Education[5], which has identified specific goals and strategies to reduce the amount of personal debt associated with college enrollment. The Data Science Associate of Science program supports the following goals and strategies:

Goal 1: "ACCESS" The program serves Goal 1 in the State Plan in that it is designed to support HCC's overall mission as an open access institution with excellent and affordable educational programs. HCC administers its academic programs to meet the goals of effectiveness and efficiency by employing data-driven decision-making that ensures that academic programs are broadly accessibleand offer high quality education at an affordable cost.

Goal 2: "SUCCESS: Promote and implement practices and policies that will ensure student success." The Data Science associate degree allows students to enter directly into the workforce or transfer to a four-year institution. The cost to complete a four-year degree is greatly reduced by completing the first two years of course work at HCC. Having a two-year degree also gives students the opportunity to work in the field of data science while completing their baccalaureate degree.

This approach could provide financial stability for the students. The chart below outlines the cost comparison of the first two years at HCC when compared to other 4-year institutions with undergraduate Data Science degrees in the state of Maryland. Students attending HCC for the first two years compared to a 4-year intuition will save between $10,836-$89,860 over the 2 years.

Institution	Rate	Cost 2020-2021	Cost Per 30 Credits Plus Fees	Savings Over 2 Years By Going To HCC
Harford Community College	In-County	$159 Per Credit Plus Fees	$4770	
University of Maryland	In-state	Full-time tuition	$10,966	$12,392
Salisbury University	In-state	Full-time tuition	$10,188	$10,836
Loyola University	Not applicable	Full-time tuition	$49,700	$89,860

"Strategy 6: Improve the student experience by providing better options and services that are designed to facilitate prompt completion of degree requirements" recommends the creation of "focused pathways" that demonstrate the "fastest way to obtain an associate degree by taking specific courses in a specific sequence" The data science program utilizes this framework to create a clear path to graduation, by identifying the courses that a student should take each semester to ensure completion of prerequisites for courses later in the pathway. Please see Appendix A for course sequence.

"Strategy 9: Strengthen and sustain development and collaboration in addressing teaching and learning challenges" to encourage the incorporation of Open Educational Resources (OERs) into programs to offset the cost of college. The HCC OER initiative actively encourages, supports, and sustains the use of OERs and low-cost, assessable formats for all courses as appropriate without compromising quality of content. The STEM division encourages the use of OERs or low-cost materials when feasible to reduce student debt burden.

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 proposedprogram.
2. Present data and analysis projecting market demand and the availability ofopenings in a job market to be served by the new program.
3. Discuss and provide evidence of market surveys that clearly provide quantifiableand reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.

Data Science is an emerging field and the number of jobs that require skills in this discipline projected to be 2,727,000 in 2020[7] and is considered one of the fastest growing occupations[8] .

Data from the US Bureau of Labor Statistics[9], indicates high demand in the state of Maryland jobs for in Data Science and related occupations such as computer and information analysts, and software developers and programmers. Overall, the state of Maryland has a high "location quotient" relative to the 50 states as of May 2019[9], with the Baltimore-Columbia-Towson area having a mean annual wage of $124,710 in this sector.

Additionally, the closely related occupation of "statisticians" is listed as one of the ten fastest growing occupations, with a projected percent change of 34.% from 2019-2029 in the United States.[10]

As stated by the United States of Labor Statistics, the employment of all computer and information research scientists is expected to rise 19 percent by the year 2026, which is deemed much faster than the average for all professions. As demand for new and improved technology increases in the data science field, the demand for qualified data scientists will rise. The rapid growth in data collection will result in a heightened need for data-mining services.

	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2019	2029		
United States[11] Computer and information research scientists	32,700	37,700	15%	5,000
Maryland Computer and information research scientists (https://www.onetonline.org/link/localtrends/15-1221.00?st=MD&g=Go)	1,140	1,450	27%	270
United States[12] Data Scientists (15-2051.00)	33,200	43,400	31%	3,600
Maryland-Data Scientists (15-2051.00) (https://www.onetonline.org/link/localtrends/15-2051.00?st=MD&g=Go)	190	210	11%	20

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

As the Associate of Science of 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 available to project prospective student demand. Data Science degrees at two-year colleges are relatively new across the country, which is why the NSF has funded the work of the EDC described above.

Based on information learned from networking with other community colleges across the country in the **"**Mentoring to Support Designing and Launching of New Data Science Career Pathways at Community Colleges" project sponsored by EDC, our 5-year projected enrollment and graduate trends for the Associate of Science in Data Science are summarized below.

Data Science Enrollment Projections

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Enrollment	20	25	30	35	40

HCC is also proposing a certificate in Data Science that is being submitted to MHEC via separate documentation and the proposed data science courses specific to the A.S. are also part of the certificate

program. The projected enrollments include students enrolled in both the certificate and the proposed A.S. degree.

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.

Presently, Montgomery Community College has a certificate in Data Science and a Data Science Discipline Option in the General Studies Associate of Arts degree. Howard Community College has a non-credit certificate in Data Analysis.

Institution	Program	Degree	Key Differences
Montgomery College	Data Science Discipline Option	General Studies Associate of Arts	This program is greater than 60 miles away from HCC. Degree consists of courses in the certificate plus general education requirements. The HCC degree requires more programming and computer sciences credits than the Montgomery College degree.
Montgomery College	Data Science Certificate	Data Science Certificate	This program is greater than 60 miles away from HCC. Montgomery College Certificate is only 16 credits.

Recent guidance (10/1/2020) from MHEC stated that "Ordinarily, proposed programs in undergraduate core programs consisting of basic liberal arts and sciences disciplines are not considered unnecessarily duplicative". As described above, the emerging discipline of data science occupies the same role as any other subject in science. The content information and competencies encompassed within data science has wide applicability in all fields where large amounts of data are collected and analyzed, such as finance, insurance, or health care. The information on job growth and job outlook provided above clearly illustrates a tremendous current need for individuals with skills of data analysis and data presentation and communication. This sizable and fundamental educational need will only be met with the combined efforts of multiple institutions of higher education.

2. Provide justification for the proposed program.

Ten years ago, the McKinsey Global Institute (MGI) and McKinsey's Business Technology Office[13] published novel research on the impact of big data on career outlook and industry. Upon publication,

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 1.5 million additional professionals from diverse content specialties would require"the know-how to use the analysis," the ability to use the results of data science in decision-making.

This new Data Science degree will allow students to prepare for middle-skills or higher-level jobs at Aberdeen Proving Ground and with employers in industries such as health sciences, insurance, banking, and finance throughout the Susquehanna Region. By providing knowledge and training in the emerging data science discipline, HCC will be able to develop and sustain a pipeline of skilled data practitioners to industry partners in Harford County and beyond.

The student learning objectives of the Data Science degree align with competencies consistent with those identified at the national level via the EDC Oceans of Data[3] and Big Data Career Pathways[4] project described earlier.

E. Relevance to High-demand Program 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 February 27, 2021 found no 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). Therefore, HCC's proposed program will have no impact on high demand programs at HBIs in the state of Maryland.

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 February 27, 2021 found no 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). Therefore, HCC's proposed program will have no impact on the institutional identities and missions of the HBIs in the state of Maryland.

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.

Research regarding the creation of the Data Science degree program was performed by administrators and full-time faculty within the STEM division of Harford Community College. Additionally, HCC has been working closely with project personnel of the **"**Mentoring to Support Designing and Launching of New Data Science Career Pathways at Community Colleges" NSF funded project to develop our curriculum as described above.

The Data Science associate degree program was developed in accordance with the College's Curriculum Manual and included assessment of data to support enrollment, consultation with other divisions, and analysis of course transferability to the College's top transfer institutions. Four new courses have been proposed and approved by the curriculum workgroup, including: DSCI 101-Introduction to Data Science, DSCI 102-Statistics with Programming Applications, DSCI 103-Data Management and Database Systems, and DSCI 201-Data Visualization. The STEM Division faculty, HCC curriculum workgroup HCC Deans, the Vice President of Academic Affairs, the President of the College, and the Board of Trustees have approved the Associate of Science in Data Science degree. The Data Science A.A.S. degree program will be overseen by full-time faculty in Mathematics and Computer Science (see Section I) in collaboration with the Dean of STEM, Dr. Pamela Pape-Lindstrom.

2. Describe education objections and learning outcomes appropriate to the rigor, breadth, and modality of the program.

The Associate of Science in Data Science degree consists of four data science courses, a minimum of four credits of math (with additional math courses recommended as electives) a course in Python, two computer science courses, an ethics course and general education courses for a total of 60-62 credits. The DSCI 102-Introductory Statistics with Programming Applications course is a prerequisite for the DSCI 201-Data Visualization course. Also, the DSCI 101-Introduction to Data Science course is a pre-requisite for the DSCI 103-Data Management and Database Systems course.

The planned modality for the DSCI courses is remote, synchronous online learning for initial DSCI offerings. This will allow place bound students to participate and also provide real-time interaction for students that need extra support. The synchronous class sessions will be recorded and made available online if there are students that cannot meet at the specific course times. As enrollment in the program grows, we will consider adding in-person instruction on campus, if students demonstrate a preference for face-to-face instruction. The PHIL (ethics) courses are offered online asynchronously, or face-to-face. The CIS 229 (Python) course is offered in an asynchronous online format. Many of the general education

courses are offered either on campus or online asynchronously. Offering courses with these various modalities will meet the needs of multiple types of learners.

Program Learning Outcomes

Students who successfully complete the Associate of Science in Data Science will be able to:

1. Perform problem solving and computational tasks in the discipline of data science.
2. Create computer code and scripts to collect, prepare, and organize data.
3. Apply and critically evaluate data analysis techniques.
4. Interpret and communicate findings in multiple forms.
5. Assess the ethical implications to societies of data-based research and analysis.

3. Explain how the institution will:

1. provide for assessment of student achievement of learning outcomes in the program.
2. document student achievement of learning outcomes in the program.

Assessment of student program learning outcomes will be implemented throughout the four DSCI courses. Formative, summative, and authentic assessments will be employed. Using the mapping of institutional learning goals to courses, key assignments will be identified in courses for use in assessing student achievement of program learning goals. All course learning outcomes will be assessed once every four years per HCC guidelines. Student artifacts for these identified key assignments are collected and reviewed by faculty to assess how effectively students are meeting the program learning goals. Data regarding student achievement of the learning outcomes is collated and archived via a learning management system-integrated software solution. This software allows for documenting and archiving data for learning outcomes for each course, and archives and documents data regarding student achievement of program goals.

The following recommended sequence of course completion demonstrates how the courses will achieve the DSCI program learning outcomes.

Course	Program LOs
DSCI 101 Introduction to Data Science	Program goals 1,2,3,4
CIS 229 Python Programming Language	Program goals 1,2,3,4
PHIL 205 or PHIL 221 Ethics or Business Ethics	Program goal 5
DSCI 102 Statistics with Programming Applications	Program goals 1,2,3,4
DSCI 103 Data Management and Database Systems	Program goals 1,2,3,4
DSCI 201 Data Visualization	Program goals 1,2,3,4

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

DSCI 101 Introduction to Data Science (3 credits)

The course provides students with a survey of both theoretical and practical aspects in the field of data science. Course topics include an overview of the data science field, data manipulation and flow, artificial intelligence and machine learning, testing, sorting, preparing, and cleaning data sets, and cross-validation. Students will develop skills in relevant programming and scripting languages such as R and Python and be able to make inferences using results from data summaries.

Upon satisfactory completion of this course, the student will be able to:

1. Define data science and describe the current and emerging role of data science in society.
2. Obtain, sort, clean, and transform data sets.
3. Develop programs and scripts in R and Python to manipulate data.
4. Summarize and communicate findings and inferences from data operations.

DSCI 102 Introductory Statistics with Programming Applications (GM) (4 credits)

This course provides the student with the fundamental concepts and methods of statistical analysis while employing programming and scripting skills. Course topics include graphical and numerical representations of data, probability and data distributions, parameter estimation, and hypothesis testing. R programming language will be used to collect, prepare, and organize data throughout the semester. Students cannot earn credit for both MATH 216 and DSCI 102.

Upon satisfactory completion of this course, the student will be able to:

1. Define statistical terminologies; demonstrate ability to think critically about data described in scientific and media reports.
2. Perform data organization and analysis to produce descriptive statistics.
3. Explain relationships between two variables; describe associations between bivariate data and construct and utilize the equation of the least-squares regression line.
4. Perform elementary probability calculations and solve problems by applying appropriate standard probability distributions, including discrete, binomial, uniform, and normal distributions.
5. Model sampling distributions of proportions and means, including verifying the necessary conditions.
6. Solve problems involving parameter estimation, perform hypothesis testing for one and two population means and proportions.
7. Use programming languages such as R and Python to manipulate large sets of data and to carry out basic statistical modeling and analysis.

DSCI 103 Database Management and Database Systems (3 credits)

This course provides a foundation of database concepts. Topics include definitions and operations related to database systems as well as processes of database design. Students will be able to develop tables, forms, reports, and queries from a database. Entity-relationship (ER) diagrams and database normalization are also explored. Prerequisite: DSCI 101 or a grade of C or better in a previous high school or college-level programming course.

Upon satisfactory completion of this course, the student will be able to:

1. Identify database terminology and concepts and describe the importance of databases in the field of Data Science.
2. Perform operations on a database.
3. Create and perform basic queries and modifications on a database.
4. Construct an ER diagram using and convert the ER diagram into relational database tables.

DSCI 201 Data Visualization (3 credits)

This course provides students with a study of the graphical representation of data and how to use visualization to aid understanding of big data for fields such as science, engineering, medicine, and the humanities. Students will learn how to design, build, and evaluate visualizations for different types of data, disciplines, and domains. The course emphasizes design and practical applications of data visualization.

Upon satisfactory completion of this course, the student will be able to:

1. Clean and manipulate raw data and prepare the data for analysis.
2. Describe the different ways to visualize data and data visualization tools.
3. Use data visualization tools to analyze data and produce reports.
4. Complete the steps to design and implement a dashboard.

CSI 131 Computer Science I (4 credits)

This is the first course in a sequence of two courses in computer science utilizing the syntax and semantics of the C programming language with emphasis on applications for Science, Mathematics and Engineering disciplines. The course provides an introduction to the principles of program design and development using procedural programming techniques. The course will provide an introduction to the following topics: life cycle program development, modularization, simple algorithm analysis, aggregated derived data types and sequential and random file processing. Usually offered in spring semester. Prerequisite/Corequisite: MATH 203. Note: Computer Science students completing CIS 111 cannot receive credit for CSI 131.

Upon satisfactory completion of this course, the student will be able to:

1. Develop algorithms through top down structured design.
2. Work independently to solve.

3. Design, code, test, and debug a program written in C.
4. Execute selection & repetition structures and functions in C programming language.
5. Use arrays to store, sort and search lists and tables.
6. Demonstrate basic sorting.
7. Create and use pointers and strings.
8. Design programs to solve real world applications.

CSI 132 Computer Science II

The second in a two-course sequence in computer science utilizing the syntax and semantics of the object-oriented C++ programming language. Topics include classes, dynamic data structure, overloading, inheritance, stream input/output and file processing. Usually offered in fall semester. Prerequisites: CSI 131. Corequisite: MATH 204.

Upon satisfactory completion of this course, the student will be able to:

1. Identify and examine Abstract Data Types.
2. Explain information processing concepts including data storage and file processing.
3. Analyze the relationship between linked lists and other complex data structures: queues and stacks.
4. Analyze the difference processing times for sorting and searching algorithms.
5. Design medium scale applications to solve for real-life programming requirements.
6. Examine techniques for developing programs in an object-oriented environment.
7. Identify basic theories for traversing graphs.

CIS 229 Python Programming Language (4 credits)

This course in computer programming uses the Python language, which is a general purpose, object-oriented programming language, ideal for rapid prototype development, scripting, and cross-language software development. The student learns how to define, solve, code, test, and document programming problems using Python.

Upon satisfactory completion of this course, the student will be able to:

1. Design, write, and test programs using a Python compiler.
2. Document and review programs written in Python.
3. Write algorithm-based solutions to a variety of classical computer science problems.
4. Examine and analyze the syntax of the Python programming language.
5. Construct programming solutions to problems using both procedural and object-oriented methodology.

Choose PHIL 205 or PHIL 221.

PHIL 205 Ethics (GH) (3 credits)

This introductory course in philosophical ethics encompasses the prominent ethical theories of Western philosophy and considers the application of ethics to modern cases and current situations. This course acquaints students with the major philosophical ethical thinkers in Western philosophy and their ethical theories. It gives students the philosophical perspectives and skills needed to recognize, understand, and apply these theories to contemporary issues in an intelligent and effective way by applying the theories to ethical cases.
Upon satisfactory completion of this course, the student will be able to:

1. Develop abilities in critical thinking through exposure to theoretical ethical principles, ethical systems, moral guides, and philosophical analyses.
2. Through ethics case studies, recognize and define problems, recognize, interpret, and evaluate relevant data.
3. Draw theoretical and applicable conclusions to ethical cases.
4. Develop abilities to recognize the need for investigation, devise methods for such investigations, and appraise and evaluate the effectiveness and application of these methods.

PHIL 221 Business Ethics (GH) (3 credits)
This course serves as an introduction to the philosophical study of ethics and the applied sub discipline of business ethics by covering pertinent ethical theories and applies them to cases drawn from the several business ethics fields. Students will gain philosophical understanding and ethical techniques necessary to identify and deal with such issues in theory and practice.

Upon satisfactory completion of this course, the student will be able to:

1. Develop abilities in critical thinking through exposure to theoretical ethical principles, ethical systems, moral guides, and philosophical analyses.
2. Through bioethics case studies, recognize and define problems, recognize, interpret, and evaluate relevant data.
3. Draw theoretical and applicable conclusions to bioethical cases.
4. Develop abilities to recognize the need for investigation, devise methods for such investigations, and appraise and evaluate the effectiveness and application of these methods.

ENG 101

This course is designed to This course is designed to develop mature writing skills in the essay form, including the documented essay. Through writing a series of essays in a variety of modes, such as argumentative essay, the process analysis, the research paper, and the summary analysis, students achieve proficiency in presenting and supporting their own ideas and incorporating the ideas of others into their essays. Prerequisites: ENG 012, ENG 018, ENG 060 or a qualifying score on the writing assessment.

Upon satisfactory completion of this course, the student will be able to:

1. Write unified papers. This objective involves the development of a purposeful organization pattern based on a clearly stated, well-focused, and worthwhile thesis statement, which is firmly adhered to in the essay.
2. Write coherent papers. This skill involves providing transitions between ideas and in other ways showing relationships between parts of the essay.
3. Provide support. This objective involves giving sufficient specific evidence to convince the reader of the validity of the thesis.
4. Communicate rationally. This objective involves the use of basic principles of logic.
5. Construct sentences that are grammatically and mechanically correct.
6. Use language accurately and concisely.
7. Collect, use, and document evidence from sources other than personal experience, including written sources.

Select one from Math 109, Math 203, Math 212.

Math 109 Precalculus Mathematics (GM) (4 credits)
This course will provide students with concepts and skills necessary for the study of calculus. It includes a study of algebraic and transcendental functions including their properties, inverses, graphs, equations, and applications. Additionally, the study of angles and triangles, trigonometric functions, and analytic trigonometry with applications is included. Prerequisite: Math 103 or permission of the instructor.

Upon satisfactory completion of this course, the student will be able to:

1. Evaluate, graph and apply algebraic and transcendental functions and their inverses.
2. Evaluate, graph, and apply angles using circular functions and right triangle trigonometric functions.
3. Formulate mathematical models and solve applied problems.
4. Analyze functions and describe the analysis analytically, numerically, graphically and verbally.
5. Use technology to explore and identify key characteristics of functions, equations, and statements.

Math 203: Calculus I (GM) (4 credits)
This course is an introduction to calculus with analytic geometry. It includes a study of functions, limits, differentiation, integration, and applications of differentiation and integration. Prerequisite: MATH 109 or MATH 101 and MATH 103, or equivalent.

Upon satisfactory completion of this course, the student will be able to:

Evaluate limits analytically, numerically and graphically. (General Education Goal #2 & #4) 2. Define derivatives of functions using limits. (General Education Goal #4) 3. Evaluate derivatives of functions either explicitly or implicitly. (General Education Goal #4) 4. Apply the theory of derivatives to solve real world problems. (General Education Goal #2, #3, #4) 5. Evaluate anti-derivative of functions and solve problems related to integration. (General Education Goal #4) 6. Utilize a computer algebra system such as MATLAB to explore and reinforce concepts, and as an efficient tool to solve complex problems. (General Education Goal #2)

Math 212 Calculus with Applications (GM) (3 credits)
This course is designed for students in the social and management sciences. Differential and integral calculus with emphasis on differentiation techniques and the use of calculus in the above fields form an important part of the course. Exponential and logarithmic functions, partial derivatives are included. Technology will be utilized to enhance understanding of the concepts and their applications related to their future career. This course is not open to math, chemistry, engineering, or physics majors. Prerequisites: Math 101 or Math 111 or Math 103 or Math 109 or STEM Divisional Math Placement Exam.

Upon satisfactory completion of this course, the student will be able to:

1. Demonstrate the relationship between functions and their graphs.
2. Evaluate limits algebraically and apply to real world problems.
3. Interpret and use derivatives to solve real world problems involving calculus.
4. Use the definite integral to find area under curves and area between two curves. Use the basic ideas of calculus for functions of more than one variable to solve optimization problems.
5. Use appropriate technology to obtain the solution of mathematical problems.
6. Use appropriate technology to obtain the solution of mathematical problems.

Program Electives (choose to complete 60 credits)

Econ 101 Macroeconomics (GB) (3 credits)

Macroeconomics is an introduction to economic principles with emphasis on the analysis of aggregate income and employment. Topics include theory of income and employment, role of money and banking system, monetary and fiscal policies, and the problems of economic growth and fluctuations. Students completing ECON 101 or 102 cannot earn graduation credit for ECON 107. Pre-req: Eligibility for ENG 101.

Upon satisfactory completion of this course, the student will be able to:

1. Define key economic concepts, using appropriate economic terminology while demonstrating comprehension of the interrelationship of key concepts.
2. Explain the organization and debate the operation of the two economic systems; the market system and the command system.
3. Apply supply and demand methodology to the aggregate economy.
4. Calculate and compare the measurement methods of national income accounting.
5. Demonstrate an understanding of the meanings and methods of measuring, and the consequences of, inflation and unemployment.
6. Discuss and debate the different government fiscal policy options and their effects on the economy.
7. Describe the organization of the Federal Reserve and evaluate the impact of the Federal Reserve's monetary policy tools on the economy.
8. Discuss and debate how the major schools of macroeconomic thought have approached problems in the aggregate economy.

9. Develop the theory of international trade and an understanding of the U.S. economy's relationship with the global economy.

Econ 102 Microeconomics (GB) (3 credits)

Microeconomics deals with resource allocation under the price system, price and output determination when markets are characterized by perfect and imperfect competition, and price and employment determination in the resource market. Current problems of poverty, environment, energy and urbanization are analyzed. Students completing ECON 101 or 102 cannot earn graduation credit for ECON 107. Prereqs: Eligibility for ENG 101 and college-level math.

Upon satisfactory completion of this course, the student will be able to:

1. Define key economic concepts, using appropriate economic terminology while demonstrating comprehension of the interrelationship of key concepts.
2. Apply supply and demand methodology to households and businesses.
3. Apply the concept of ?elasticity? to households and businesses. Based on supply and demand data of a business market predict the behavior of buyers and sellers in that market.
4. Demonstrate and apply several profit maximization and cost minimization techniques to business decisions for both the short run and long run.
5. Recognize, compare and contrast the characteristics and behaviors of companies within differing competitive environments - ranging from very competitive to noncompetitive. Illustrate how market power affects a firm's decision relating to price and output levels.
6. Explain and debate the economic role and activities of government in respect to resource allocation, market failures, and its relationship to the private markets.
7. Demonstrate an understanding of and methods of measuring resource optimization in the private sector market context.
8. Explore complex current social problems, such as poverty and income inequality in the U.S. and apply cost/benefit analysis to a range of solutions.
9. Develop the theory of international trade and an understanding of the balance of payments and exchange rate problems/solutions.

Math 204 Calculus II (GM) (4 credits)

This course continues the study of calculus with analytic geometry. It includes logarithmic, exponential, inverse, and hyperbolic functions, techniques of integration, improper integrals, infinite series and conic sections. Prerequisite: MATH 203.

Upon satisfactory completion of this course, the student will be able to:

1. Compute and estimate integrals (both definite and indefinite) using various techniques of integration.
2. Apply the definite integral to various area and surfaces of revolution problems.
3. Model and estimate using first order ordinary differential equations.
4. Solve and understand problems involving polar and parametric equations.

5. Recognize the need for analytical geometry in calculus.
6. Utilize various techniques and tests to determine the convergence and divergence Infinite Series.

Math 206 Calculus III (4 credits)

This course provides students with the basic concepts of the calculus of vector functions. Topical categories include partial derivatives and multiple integrals with applications, line and surface integrals, and Green's Theorem. Prerequisite: MATH 204.

Upon satisfactory completion of this course, the student will be able to:

1. Solve problems related to vectors and vector operations and three dimensional coordinate systems.
2. Solve problems related to vector functions and space curves.
3. Solve problems related to applications of partial derivatives, max and min values.
4. Use techniques and applications of multiple integrals.
5. Solve problems related to vector fields and applications.

Math 210 Discrete Structures (3 credits)

This course develops the basic mathematical background and maturity for use in later Computer Science courses. Topics include proof by induction, axiomatic definition, sets, graphs, programs and recursion. Prerequisite: MATH 203 or permission of instructor.

Upon satisfactory completion of this course, the student will be able to:

1. Apply the foundations of logic principles, quantified statements, and their applications (particularly in Computer Science).
2. Formulate elementary mathematical proof and proof by mathematical induction.
3. Perform operations on sets and illustrate set theory through element argument.
4. Employ counting principles and the binomial theorem.
5. Demonstrate knowledge of recursion through recursive sequences and recurrence relations.
6. Identify and create diagrams pertaining to Graph Theory.

Math 217 Linear Algebra (4 credits)

This course presents basic concepts of linear algebra. Included are systems of linear equations, vector space, matrices, determinants, linear transformations, eigenvalues, and eigenvectors. Prerequisite: MATH 203. Usually offered in spring semester.

Upon satisfactory completion of this course, the student will be able to:

1. Present basic concepts of matrices and matrix algebra.

2. Apply solution methods of linear systems for various problems.
3. Define and apply linear transformation theory.
4. Find eigenvalues and eigenvectors and apply them to problems.
5. Analyze vector spaces.
6. Use MATLAB or other numerical software for computational linear algebra.
7. Develop knowledge of the central ideas of linear algebra and their applications in science, engineering, economics, computer science and other technical fields.

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

HCC students must complete a minimum of 60 credits of college-level work to be eligible for the Associate of Science (AS) degree. In accordance with COMAR 13B.06.01.03, of the 60 credits, at least 28-36 credits must fulfill the HCC's General Education core requirements. The distribution of the 28- 36 General Education credits must meet the following specifications at HCC:

- 6 credits of Behavioral/ Social Sciences (GB)
- 3 credits of English Composition (GE)
- 6 credits of Arts/ Humanities (GH)
- 7 to 8 credits of Biological/ Physical Laboratory Science (GL/ GS)
- 3 to 4 credits of Mathematics (GM)
- 3 to 9 credits of General Education Electives (GB, GH, GM, GS, GI)

The DSCI associate degree program includes General Education courses as follows:

Behavioral/ Social Sciences (GB):6 credits required

- GB Elective (6 credits)

Composition (GE): 3 credits required

- ENG 101, English Composition (3 credits)

Arts/ Humanities (GH) – 6 credits required

- PHIL 205 or PHIL 221 (3 credits)
- GH Elective (3 credits)

Biological/ Physical Laboratory Science (GL/ GS): 7-8 credits required

- Biological/Physical Laboratory Science (GL) (4 credits)
- Biological/Physical Laboratory Science (GS) (3 credits)

Mathematics (GH) – 3-4 credits required

- DSCI 102 Introductory Statistics with Programming Applications (GM) (4 credits)

General Education Elective (GB, GH, GM, GS, GI): 3 – 9 credits required

Physical Education Elective: 1 credit required

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 student with clear, complete, and timely information on the curriculum, course and degree requirements, nature of the 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.

HCC maintains a comprehensive website that conveys all information about its programs. Students will have access to program requirements, college catalogs, course schedules (which list course modalities) and other relevant information about the program. Following a 2017 comprehensive review of business processes, HCC has begun implementation of projects designed to enhance the student experience. Improvements to workflow provide students with clear, complete, and timely information. For example, the college has adopted new catalog and curriculum software that integrates with both the current Enterprise Resource Planning (ERP) solution and the degree-auditing and tracking tool provides students with real time information regarding curriculum, course, and degree requirements.

HCC regards faculty interactions with the students as paramount to academic success. All full time faculty maintain at least five reasonably distributed office hours per week during the academic semester. Faculty office hours are posted in the syllabus and in the learning management system. As the COVID-19 pandemic has restricted on campus interactions, faculty meet with students for office hours via videoconferencing platforms such as Zoom or Teams.

STEM faculty utilize technology navigation concurrent to student usage during face-to-face course instruction, generate video tutorials for online course delivery, and serve as tech support through virtual and onsite assistance. This technology meets the educational needs of HCC's diverse student population and effectively addresses skill disparities that might otherwise pose a barrier to learning. All HCC courses are required to use the Blackboard Learning Management System (LMS) to provide links to academic support services, financial aid resources, and college policies regarding tuition costs and payment regardless of instructional delivery mode.

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.

Harford Community College's Office of Communications generates promotional materials for academic programs that are used in advertising, recruiting, and admission. Office of Communications staff work closely with staff in Academic Affairs and Student Affairs & Institutional Effectiveness to ensure the accuracy of promotional materials. An annual review process of program brochures has been established to coincide with the release of each academic catalog, as well as a line of communication for any programmatic changes that may occur outside of the annual review cycle.

H. Adequacy of Articulation

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

The Associate of Science degree in Data Science is designed to be transferable to four-year institutions. HCC had preliminary conversations with Loyola University, as this degree was under creation. Also, once the program is approved, we will work with Salisbury University to create an articulation agreement. The curriculum for the DSCI program was created to allow for flexibility when it comes to transfer and, therefore, does not make it more difficult for a student to transfer to one institution vs. another. When the program is approved, we will pursue articulation agreements with the private and public four-year institutions that offer Data Science baccalaureate degrees in the DMV region.

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.

Harford Community College (HCC) employs highly qualified faculty in all disciplines. All full-time and adjunct faculty have an earned master's degree in the discipline in which they teach or a closely related discipline if the disciplinary area is newly emerging, such as data science.

FACULTY NAME	DEGREES EARNED	STATUS	COURSES OF INSTRUCTION
Annemarie Colino	B.A. Mathematics/Economics, Wells College, Aurora, NY. M.S. Mechanical Engineering, Cornell University, Ithaca, NY. M.S. of Applied Science in Data Science, Univ. of Notre Dame, South Bend, IN.	Adjunct	DSCI 101, DSCI 102, DSCI 201

Mark Dencler	B.S. in Computer Science, Towson University M.S. in Computer Science with focus in Software Security, Towson University	Full-time	CIS 229, DSCI 101, DSCI 103, DSCI 201
Chris Jones	B.S., Computer Science, Towson University, Towson, MD. M.S., Applied and Industrial Mathematics, Towson University, Towson, MD.	Full-time	DSCI 101, DSCI 102, DSCI 103
Nick Schoeb	M.S. Computer Science - Software Engineering, Towson University, Towson, MD. B.M. Music - Composition and Theory, Towson University, Towson, MD. A.A. Music, Harford Community College, Bel Air, MD.	Adjunct	DSCI 103

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

a). Pedagogy that meets the needs of the students

b) The learning management system

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

Harford Community College provides ongoing pedagogical training for full-time and adjunct faculty. In summer 2019, 40 full-time and adjunct faculty participated in the Mobile Summer Scientific Teaching Institute, now called the National Institute on Scientific Teaching. Additionally, HCC hosts the Center for Excellence in Teaching and Learning (CETL), which offers comprehensive professional development and training for all who are engaged in the teaching and learning process at HCC. CETL is intentionally designed to be both a digital and physical hub for innovation, collaboration, and learning transformation through a variety of events and resources in order to:

- Create faculty teaching and learning communities of practice;
- Celebrate innovation in instruction and scholarship;
- Offer on-going basic and advanced learning management system training;
- Provide resources, facilities and technology to foster experimentation; and
- Offer opportunities for faculty to gain additional knowledge and hone skills related to technology and pedagogy.

All distance learning courses are reviewed through a collaborative internal review process based upon standards developed at the College through the shared governance process and approved by Faculty Council. Faculty are required to employ evidence-based practices in course design.

When adjuncts are newly hired at HCC, they complete a Teaching Online Academy in Blackboard which produces a certificate documenting successful completion (the training includes summative assessments on which faculty must earn a minimum score). This training teaches about the specifics of the Blackboard Learning Management System and also includes best practices in online instruction. All

courses at HCC are web enhanced (supported by a Blackboard site) regardless of course modality. Faculty are required to post syllabi, contact information and maintain student grades in Blackboard for all courses (not just online or distance learning courses).

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.12)

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within existing institutional resources.

The HCC Library is a 25,734 square foot facility located centrally on campus. It is open seven days per week for student access. The library's website provides 24-hour free access to the catalog, databases, subject guides, tutorials and other resources. Borrowing privileges are available for all students, as well as county residents 18 years or older. The library focuses its collection on a mixture of print, electronic, and video resources to meet the informational and curricular needs of the HCC community. Students have access to full-text journal, magazine and newspaper articles through the College's subscription databases. Streaming video collections are available through two databases, Films on Demand and Alexander Street Press. Students have access to unlimited resources through the Inter-Library Loan Service, which can deliver titles from almost any academic library in the country.

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 resources at HCC offer sufficient space and learning technology to support education. The 352-acre campus has a physical plant of 21 buildings including a performing arts center, an observatory, a 3,000-seat arena and athletic center and six classroom buildings.

Students enrolled in the program have access to the HCC Learning Center for tutoring services in math, science, writing, study skills and test taking skills. Additionally, the Test and Assessment Center, Academic Advising and Transfer Services, and Career Services are all resources of the college that may be utilized by individual students or groups of students. For some courses in the STEM division, the HCC Learning Center provides tutors via the Supplemental Instruction program that are directly embedded in the course and work with the faculty member to assist students during class time.

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 support for distance education.

All faculty and credit-earning students are provided with an institutional e-mail account that integrates with the learning management system. Open-access, comprehensive student support for the learning management system is provided in module format and includes "how to" video and print tutorials, an eLearning Help Desk, links to student services, and tips for success in an online learning environment. HCC also provides a tuition free online student success course to students taking online courses for the first time. Faculty are assigned an eLearning point-of-contact for technical support, a learning management system "trouble-shoot" guide, and access to Help Desk dedicated line. Student support services including advising and tutoring are available online. Online courses are reviewed for accessibility issues. HCC uses online authentication and proctoring.

Information and Technology Services (ITS) at HCC provide technology support for desktop, laptop and tablet devices provided by the college, classroom computers and instructional technology such as SMART Boards, LCD projectors, and DVDs. Wireless access is available throughout the HCC campus. Open-access computer labs located in the library offers a wide selection of computer software and applications for student use, including multimedia production and digital editing capabilities. A resource help desk, staffed by eLearning personnel, is available in the library and specifically designed to help students with online resources.

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

Complete Table 1 and rationale:

HCC is also proposing a certificate in Data Science that is being submitted to MHEC via separate documentation and the proposed data science courses specific to the A.S. are also part of the certificate program. The projected enrollments include students enrolled in both the certificate and the proposed A.S. degree.

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	$0	$0	$0	$0	$0
2. Tuition/Fee Revenue (c + g below)	$0	$0	$0	$0	$0

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
a. Number of F/T Students	20	25	30	35	40
b. Annual Tuition/Fee Rate	$4290	$4290	$4290	$4290	$4290
c. Total F/T Revenue (a x b)	$85,800	$107,250	$128,700	$150,150	$171,600
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	$133	$133	$133	$133	$133
f. Annual Credit Hour Rate					
g. Total P/T Revenue (d x e x f) [1]	$0	$0	$0	$0	$0
3. Grants, Contracts & Other External Sources	$0	$0	$0	$0	$0
4. Other Sources Consolidated Service Fee	$0	$0	$0	$0	$0
TOTAL (Add 1 – 4)	$85,800	$107,250	$128,700	$150,150	$171,600

[1] $133/credit x 30 credits=$3990 + average of $300 in course fees =$4290.

a. Complete Table 2

Rationale. For the first three years, as program enrollment is building, the DSCI courses will be taught by adjuncts or as overload for full-time faculty, which is paid at the adjunct rate. In years 4 and 5 projected enrollment may allow the hiring of an additional full-time faculty member, so the costs have been increased to reflect that possibility. An ongoing equipment cost is added each year, equipment is budgeted in the operating budget on an ongoing basis. Library resources are budgeted in the operating budget on an ongoing basis. Expenses such as professional development, travel, memberships, office supplies communications, data processing, and equipment maintenance are budgeted in the operating budget on an ongoing basis.

Expenditure Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Faculty (b + c below)					
a. # FTE	<1	<1	<1	1	1
b. Total Salary	$9253	$18,706	$18,706	$53,060	$54,121
c. Total Benefits	$861	$1742	$1742	$19,119	$19,119
2. Admin. Staff (b + c below)	$0	$0	$0	$0	$0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	$2000	$2000	$2000	$2000	$2000
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$0	$0	$0	$0	$0
7. Other Expenses	$0	$0	$0	$0	$0
TOTAL (Add 1 – 7)	$12,114	$22,448	$22,448	$74,179	$75,240

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.

Faculty are evaluated annually by the STEM division dean using the following core components: instruction observations, syllabus, final examinations, assessment instruments or strategies used to evaluate course objectives and academic outcomes, data reports and written critiques of student surveys of instruction, participation records of college assignments, professional development activities, and college and community service activities.

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.

HCC has a systematic plan for evaluation of all degree programs (program review-has a college-wide template of required data and analysis) and courses that will be applied to the DSCI program. The College supports the review of curriculum as a significant component of an overall educational effectiveness plan. Program reviews lead to program and course improvements that are based on sustained information gathering and analysis and provide insight for needed resources and ensure superior educational programs that meet student and community needs. Program reviews assess how well the program has achieved its objectives and suggests potential approaches to enhance this effort and address and fulfill accreditation requirements as prescribed by Middle States.

The program evaluation process includes faculty and staff within and outside of the program, students, advisory board members, representatives from resource areas in the college, and other communities of interest. Data regarding student satisfaction is acquired by administering student surveys. This clearly defined program review process provides a consistent framework for evaluating a program's educational effectiveness and includes the use of a comprehensive data management system to systematically collect and report student learning outcome assessments and collaboration with the Office of Institutional Research, Planning, and Effectiveness for data regarding student retention and completion, faculty and student satisfaction, and program cost-effectiveness. All programs and their options/tracks, including A.A.S. (career), certificate, A.A. /A.S./A.F.A. (transfer) degree programs, and programs such as General Education, Information Literacy and Distance Learning are evaluated every three to five years on a planned cycle.

N. Consistency with the State's Minority Student Achievement Goals (as outlines 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.

HCC has a history of promoting diversity and creating an environment that is open and inclusive for students, visitors, and employees. HCC embraces differences, respects intellectual and academic freedom, promotes critical discourse, and encourages socio-cultural and global awareness.

HCC has developed strategies to address the eradication of the attainment gap including implementation of the My College Success Network (MCSN) and Soar2Success (S2S). Established in July 2014, these programs are a network of services, events, staff and faculty geared toward empowering and supporting African American students.

In 2018, HCC joined Achieving the Dream (ATD), a network dedicated to improving student success, with a particular focus on academic goal attainment, personal growth, and economic opportunity for low-income students and students of color.

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.

This proposed program is not directly related to an identified low productivity program.

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.

HCC is an approved institution of the National Council for State Authorization Reciprocity Agreement (NC-SARA). As a NC-SARA institution, HCC is approved to offer distance learning courses to students who reside in other NC-SARA approved states. At this point in time, HCC is unable to admit students from California, as California is not a participating member of NC-SARA.

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

HCC complies with C-RAC guidelines for the Evaluation of Distance Education. The College's eLearning Department and the Distance Learning Committee (DLC) ensure online learning offered by HCC aligns with the College's mission to provide accessible, innovative, and learner-centered education to promote individual goal attainment, as well as career and workforce development. Both the DLC and eLearning have worked together to develop a formal Quality Matters review for courses as well as an internal review process for all new and existing online classes at HCC to ensure a high quality and rigorous educational experience for all online students.

All full and part-time faculty are provided Blackboard course sites for each of their courses and are required to complete Blackboard basic training or demonstrate competency through a "Blackboard Veterans" quiz developed internally. In addition to the required training, course syllabi, contact information, and college closing information must be included on all course sites. To further facilitate student success in online learning environments, the DLC developed and implemented common nomenclatures for online course menus to standardize terminology used in courses across campus. An "Online Readiness Check" was also developed as a tool to assess the readiness of students interested in enrolling in online courses.

The eLearning department also provides professional development training that focuses on enhancing online instruction for all faculty throughout the year. Workshops and training sessions range in level and content to adequately provide faculty with relevant information and experiences, as well as facilitate continual growth in online instruction. In response to the COVID-19 pandemic which forced virtually all instruction online, the HCC eLearning staff have updated the online professional development training in Blackboard, resulting in a very robust professional development sequence. The current available training includes the Blackboard basic training (described above), the Teaching Online Academy, the Teaching Online Academy: Next Level, Quality Assurance training and Quality Matters training.

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12. https://www.onetonline.org/link/localtrends/15-2051.00?st=MD&g=Go)
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

Appendix A: Harford Community College Catalog Page

Data Science (AS)

Award: Associate of Science in Data Science
No. of credits required: 60
For more information: *Contact Chris Jones , cjones@harford.edu; Admissions, 443-412-2109; or stem@harford.edu*

Program Description

This program provides students with a background in computer science, mathematics, and information systems necessary for a further study of data science at the Bachelor's degree level. Data Scientists utilize computer programming and scripting, database management, data analysis, statistical interpretation, data preparation and cleaning, and quantitative analysis to solve problems as a business or data mining analyst, data or machine learning engineer, and managers in the field of data science.

Program Goals

Upon successful completion of this program of study students will be able to:

1. Perform problem solving and computational tasks in the discipline of data science.
2. Create computer code and scripts to collect, prepare, and organize data.
3. Apply and critically evaluate data analysis techniques.
4. Interpret and communicate findings in multiple forms.
5. Assess the ethical implications to societies of data-based research and analysis.

Diversity Requirement

To satisfy the diversity requirement: Associate degree students must complete one 3-credit diversity course (D). It is recommended that students select one of the 3-credit (GB), (GH), (GI) course electives from those that also appear on the approved list of diversity course graduation requirements.

Degree Requirements
Recommended Course Sequence

FIRST SEMESTER		CREDITS
ENG 101	English Composition (GE)	3
DSCI 101	Introduction to Data Science	3
CIS 229	Python Programming Language	4
MATH 203	Calculus I (GM)	4

Behavioral/Social Science Elective (GB)		3
	Credits	**17**
SECOND SEMESTER		
DSCI 102	Introductory Statistics with Programming Applications (GM)	4
DSCI 103	Database Management and Database Systems	3
Program Elective[1]		3
Arts/Humanities Elective (GH)		3
Physical Education Elective		1
	Credits	**14**
THIRD SEMESTER		
CSI 131	Computer Science I	4
ECON 101	Macroeconomics (GB)	3
or ECON 102	Microeconomics (GB)	
Program Elective[1]		3
Biological/Physical Lab Science Elective (GL)		4
	Credits	**14**
FOURTH SEMESTER		
DSCI 201	Data Visualization	3
PHIL 205	Ethics (GH)	3
or PHIL 221	Business Ethics (GH)	
Program Elective[1]		3
General Elective[2]		3
Biological/Physical Science Elective (GS)		3
	Credits	**15**
	Total Credits	**60**

[1] Students may choose a 4-credit program elective.

[2] Students may choose any transferrable course to satisfy the general elective course requirement.

Program Elective (choose to complete 60 credits)

		CREDITS
CSI 132	Computer Science II	4
ECON 101	Macroeconomics (GB)	3
ECON 102	Microeconomics (GB)	3
MATH 204	Calculus II (GM)	4
MATH 206	Calculus III	4
MATH 210	Discrete Structures	3
MATH 217	Linear Algebra	4

General Education Degree Requirements

Note: The following codes identify courses which satisfy the General Education Degree Requirements:

Behavioral/Social Science (GB)
English Composition (GE)
Arts/Humanities (GH)
Interdisciplinary and Emerging Issues (GI)
Biological/Physical Laboratory Science (GL)
Mathematics (GM)
Biological/Physical Science (GS)

EMPLOYMENT INFORMATION

The United States of Labor Statistics reports that the employment of all computer and information research scientists is expected to rise 19 percent by the year 2026, which is deemed much faster than the average for all professions. As demand for new and improved technology increases in the data science field, the demand for qualified data scientists will rise. The rapid growth in data collection will result in a heightened need for data-mining services.

Appendix B: Best Practices for HCC Online Courses

Faculty Presence

Faculty should have an active presence that encourages student involvement in the online course environment. Courses that adhere to this practice will typically include several of the following:

- Expectations of availability and turn-around time are clear
- There is evidence that instructors will regularly engage with students in various course activities.
- Faculty intends to provide frequent and substantial feedback
- A personable faculty introduction is included
- A welcome is clearly visible upon first logging into the course

Start-Up Information & Navigation

Course navigation guidance, including start-up information, is readily available. The course is well organized and easy to navigate. Courses that adhere to this practice will typically include several of the following:

- A location, clearly evident upon logging into the course, labeled "start here," includes information the student should view prior to starting the course selected by the instructor such as welcome letter, syllabus, instructor information, student expectations/tips for success, etc.
- The syllabus is complete and easy to access
- Navigation is clear, simple, and user friendly
- The course schedule is summarized in one location
- Organization and sequencing of the course content is logical and clear
- Required instructional materials are easily located
- Links to other parts of the course and external sources are accurate and up to date
- FAQs or help for technological issues are available

Content

Instructional rigor is equal to that of a face-to-face course. It is delivered to address different learning styles and reinforced through various tools. Courses that adhere to this practice will typically include several of the following:

- Instructional content should include more than one of the following: readings, online lectures, videos, simulations, case studies, games, discussion forums, study guides, practice problems, pretests, homework, etc.
- Activities promoting a sense of engagement and community are included, such as scavenger hunt, ice breakers, collaborative exercises, discussion boards, etc.
- The pace of the course is appropriate to the course content and level
- Clear information and instructions are provided regarding the access of required course materials
- Appropriate media supports course content and adds interest
- Any materials which are not required are clearly marked as optional
- Written material is professional and uses language appropriate to the course topic and level

- Copyright ownership is followed and clearly documented
- All course components are visually and functionally consistent with each other

Active Learning

The course provides a variety of opportunities for interaction that support active learning. Courses that adhere to this practice will typically include several of the following:

- The course includes activities which provide opportunities for students to interact with the teacher, with each other, and with the content
- Activities are included which do not have a single right answer
- Challenging tasks are presented
- Sample cases and assignments are used as a template
- Expectations for student participation in the course activities are clear
- Activities and assessments encourage students to apply, analyze and evaluate course content
- Students are encouraged to create new understandings as demonstrated on course assessments
- Students have input to the learning environment, for example, due dates, assessment formats, course content, etc.

Assessment

Various forms of assessment occur throughout the course, in accordance with the HCC attendance policy, and measures student achievement of Student Learning Objectives and/or competencies. Courses that adhere to this practice will typically include several of the following:

- Forms of assessment should include more than one of the following: quizzes, papers, discussions, self-checks, projects, tests & exams, presentations, case studies, labs, skill assessments, etc.
- Assessments clearly align with Student Learning Objectives
- Instructions, student expectations, and grading standards are clearly stated, this may include the provision of sample assignments
- The course grading policy and grading calculations are stated clearly
- The gradebook is visible to students and there are clear instructions on how students can access their grades and feedback, preferably using the Blackboard Grade Center
- The gradebook is current

Accessibility

Course design reflects a commitment to accessibility and usability throughout the course. Courses that adhere to this practice should include the following:

- Course content is in compliance with the Americans with Disabilities Act
- The course design facilitates readability (e.g., color, font, use of white space, length, background, etc.)
- Necessary technology is easily obtainable
- Course media is easy to view and operate
- Technology used in the course supports achievement of the Student Learning Objectives

- Hardware and software requirements are clearly stated and students are given information about downloading necessary software
- Information directing students to methods of accessing institutional support services; including technology, accessibility, and academic support is included