Salisbury
UNIVERSITY
A Maryland University of National Distinction

OFFICE OF THE PROVOST
1101 Camden Avenue
Salisbury, Maryland 21801-6860
410-543-6020
1-888-543-0148
TTY 410-543-6083
FAX 410-548-2587
www.salisbury.edu

August 1, 2019

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

Dear Secretary Fielder,

On behalf of President Charles A. Wight, the faculty, and the entire Salisbury University (SU) community, I am requesting approval to add a new instructional program at SU. Our institution is seeking permission to offer a Bachelor of Science in Data Science. The complete proposal for a new instructional program is attached for your review.

If you have any questions, please contact me at 410 548-3374.

Sincerely,

Karen L. Olmstead, Ph.D.
Provost and Senior Vice President
for Academic Affairs

Enclosure

kg

cc Dr. Charles A. Wight, President, Salisbury University
Dr. Kara Owens, Associate Vice President for Planning and Assessment
Dr. Antoinette Coleman, Associate Vice Chancellor for Academic Affairs, USM

Office Use Only: PP#

MHEC
Creating a state of achievement

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

Institution Submitting Proposal	Salisbury University

Each action below requires a separate proposal and cover sheet.

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

Payment Submitted: (●) Yes ( ) No
Payment Type: (●) R*STARS ( ) Check
Payment Amount: 850.00
Date Submitted: 7/26/19

Department Proposing Program	Math and Computer Science	
Degree Level and Degree Type	Bachelor of Science	
Title of Proposed Program	Bachelor of Science in Data Science	
Total Number of Credits	120	
Suggested Codes	HEGIS: 170100.00	CIP: 270101.0000
Program Modality	(●) On-campus ( ) Distance Education (*fully online*) ( ) Both	
Program Resources	(●) Using Existing Resources ( ) Requiring New Resources	
Projected Implementation Date	(●) Fall ( ) Spring ( ) Summer	Year: 2020
Provide Link to Most Recent Academic Catalog	URL: https://www.salisbury.edu/administration/academic-affairs/catalog/index.aspx	
Preferred Contact for this Proposal	Name: Richard T. Wilkens, Ph.D.	
	Title: Associate Provost	
	Phone: (410) 543-6020	
	Email: rtwilkens@salisbury.edu	
President/Chief Executive	Type Name: Charles A. Wight, Ph.D.	
	Signature: [signature]	Date: 07/29/2019
	Date of Approval/Endorsement by Governing Board:	

Revised 12/2018

A. Centrality to Institutional Mission and Planning Priorities

1. Program Description

The Richard A. Henson School of Science and Technology at Salisbury University is pleased to submit a proposal for a new Bachelor of Science degree in Data Science. The B.S. in Data Science will provide students pursuing careers in a variety of fields with a course of study that balances core fundamentals with the applied practice of data science. The B.S. in Data Science will provide the knowledge and skills necessary to compete in rapidly-expanding industries that operate in a multifaceted and ever-evolving technological environment. The discipline of data science seeks to understand and leverage all five stages of the data science life cycle namely 1) capture (data acquisition or extraction); 2) maintenance (data cleansing and organizing); 3) processing (data mining and modeling); 4) analysis (quantitative and qualitative analysis); and 5) communication (reporting and visualization).[1] The concepts and tools of data science are being applied to nearly every corner of human endeavor including medicine, cosmology, human behavior, business efficiency, entertainment, media, and basic science. With its foundations in mathematics, statistics, and computer science, data science uses formal techniques and methodologies of abstraction to generate models that can be automated to solve real-world problems and drive decision-making. This unique degree program provides the rigorous technical background and experience to accelerate rapidly a graduate into emerging roles within a wide diversity of public and private organizations. We propose six different tracks, which reflects both our strengths as an institution and the broad utility of data science to an array of disciplines. The tracks are Astrostatistics, Bioinformatics, Chemometrics, Computational Data Science, Geoanalytics, and Mathematical Data Science. This degree program, once approved, will be available to students beginning in August 2020 and most students will complete the Bachelor of Science in Data Science degree in four years.

2. How Proposed Program Supports Institution's Strategic Goals

The proposed Data Science BS program supports Salisbury University's mission to "empower our students with the knowledge, skills, and core values that contribute to active citizenship, gainful employment, and life-long learning in a democratic society and interdependent world" and to "actively contribute to the local Eastern Shore community and the educational, economic, cultural, and social needs of our State and nation" (SU's Mission and Values, 2019). The Data Science B.S. program provides students with a multidisciplinary background in mathematics, statistics, computer programming, and data visualization to prepare them for the demands of this field.

While its administrative home will be in the Department of Mathematics and Computer Science, the program utilizes a multi-disciplinary approach with several tracks to allow students to pursue "a broad array of ideas and perspectives" as promoted in the University's mission. This approach will help students achieve excellence, envision their future as data scientists, grow intellectually, and pursue career, leadership, and graduate school opportunities.

[1] https://datascience.berkeley.edu/about/what-is-data-science/

3. Brief Narrative Describing Adequate Financing of Program

Because this proposal incorporates many existing courses into the new major, no new resources are required for the new Data Science BS program. Salisbury University's existing faculty will be largely able to offer the courses as part of their regular teaching load; therefore, it will not require any additional administrative support or increased funding. Future program growth will necessitate additional faculty.

4. Commitment to Adequate Continued Support

In general, Salisbury University is committed to providing additional administrative, financial, and technical support to match increase in student demand. We also pledge to provide the appropriate support to enable all students officially enrolled in the program to complete their degree, even in the unlikely event we phase out the approved degree and stop admitting new students. Nonetheless, the proposed program is expected to attract a new set of students who are interested in pursuing careers in data science. Its unique, interdisciplinary curricular nature will draw students from the region and beyond.

For more financial details, see section L below.

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

1. Demonstrate Demand and Need for the Program

In a study in 2017, Burning Glass Technologies, IBM, and the Business Higher Education Forum found that there were over 2.35 million listings for Data Science and Analytics jobs in the United States and that demand has been growing at over 10% per year.[2]

2. Consistency with Maryland State Plan for Postsecondary Education

The State directs its postsecondary institutions to "respond nimbly to changes in industries, and programs must support student development in critical thinking, problem-solving, and communication skills throughout the curriculum," as indicated in Goal #5 of the Maryland State Plan for Postsecondary Education (2017-2021).[3] The Data Science degree will advance this goal by providing a unique high-quality program that facilitates "lifelong learning, preparing students to enter the workforce and advance in their careers, fostering cultural understanding, emphasizing ethical principles and practices in personal and professional interactions, and conveying the importance of contributing to the common good as a citizen of the local, national, and global communities."[4] The program prepares students to be effective data scientists, an area of expanding demand.

[2] https://www.ibm.com/downloads/cas/3RL3VXGA, pg 6
[3] https://bit.ly/2GgJnw8, pg 51
[4] https://bit.ly/32Dzvpx, pg 19

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

According to the job-search firm Indeed, data-science job openings are expanding faster than the number of technologists looking for them.[5] In the Burning Glass study referenced earlier, the number of data science job listings is projected to grow by nearly 364,000 listings to approximately 2,720,000 by next year.[6] As of the date of this proposal, there are currently 1,064 data scientist jobs in Maryland listed on Glassdoor[7] and 1,126 data scientist jobs in Maryland listed on Indeed.[8] Upon graduation, a student with this major should be able to apply for entry-level data analyst positions. Approximately 40% of the jobs listed seeking "data science" ask for a bachelor's degree as a requirement. The remaining 60% generally require an advanced degree or "a bachelor's degree plus equivalent work experience."

D. Reasonableness of program duplication

Salisbury University is one of only two USM institutions that serve the residents of the Eastern Shore of Maryland and the other, the University of Maryland Eastern Shore, does not offer an undergraduate degree in data science. Currently, no other USM institutions offer an undergraduate degree in data science.

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

HBIs in Maryland do not offer an undergraduate degree in data science.

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

HBIs in Maryland do not offer an undergraduate degree in data science.

G. Adequacy of curriculum design and delivery to related learning outcomes

1. <u>How the Proposed Program was Established; Faculty Oversight</u>

   A full course listing with course titles and descriptions is provided in Appendix A. These courses were chosen to match with stated industry needs: mathematics, statistics, computer programming, and data visualization skills.[9] The unique design of this program applies knowledge developed from a group of fundamental courses to specific fields such as astrostatistics, bioinformatics, chemometrics, geoanalytics, and computational and mathematical data science. By learning and applying the core theories and applications to specific science disciplines, program students will better develop an array of critical thinking, communication, and leadership aptitudes, which are broadly applicable in a rapidly changing technological environment and interdependent society.

---

[5] https://bit.ly/2RQJaHz
[6] https://www.ibm.com/downloads/cas/3RL3VXGA, pg 11
[7] https://www.glassdoor.com/Job/maryland-data-scientist-jobs-SRCH_IL.0,8_IS3201_KO9,23.htm
[8] https://www.indeed.com/q-Data-Scientist-l-Maryland-jobs.html
[9] https://www.ibm.com/downloads/cas/3RL3VXGA, pg 11

The Data Science Major will be housed in the Mathematics and Computer Science Department, and will generally be managed by this Chair, Dr. Donald Spickler. However, Chairs with courses making up the six tracks will be consulted as necessary: Astrostatistics – Dr. Matthew Bailey, Physics; Bioinformatics – Dr. Les Erickson, Biology; Chemometrics, Dr. David Rieck, Chemistry; Computational Data Science and Mathematical Data Science – Dr. Donald Spickler, Mathematics and Computer Science; Geoanalytics – Dr. Dan Harris, Geography and Geosciences.

The Data Science BS program core requires 34 course credits, with additional general education courses, electives, and chosen track courses.

2. Educational Objectives and Learning Outcomes

   The Data Science B.S. program follows a student-centered learning approach that is the hallmark of Salisbury University[10] and focuses on principles, models and techniques that effective data scientists use to perform their jobs effectively and support a broad array of applications.

   For program objectives for the BS in Data Science, graduates of the program will be able to do the following: 1) demonstrate the knowledge and skills central to the academic discipline of data science; 2) describe and transform information to discover relationships and insights into large and complex datasets; 3) use formal techniques and methodologies of abstraction to create models that can be automated to solve real-world problems; 4) apply their learned knowledge to cross-disciplinary problems as part of a project team; and 5) effectively and competitively pursue careers to meet the growing demand for data scientists

3. Assessment and Documentation of Student Learning Outcomes: see Section M below.
4. List of Courses with Credit Hours and Course Descriptions

Overall Accounting of Credits

Courses	# of Credits
Core – Data Science Major	34
Track – Data Science Major	14-15
General Education	44-46
Free Electives	25-28
TOTAL	**120 credits (minimum)**

Data Science Major Courses: Required courses include the following (see Appendix A for course descriptions).

CORE COURSES (9 Courses)

COSC 117 – Programming Fundamentals	4
COSC 120 – Computer Science I	4
DSCI 311 - Introduction to Data Science	4
MATH 201 – Calculus I	4
MATH 202 – Calculus II	4

[10] https://www.salisbury.edu/discover-su/mission-values.aspx

MATH 216 – Statistical Thinking	4
MATH 306 – Linear Algebra	4
DSCI 470 – Research Methods in Data Science	3
DSCI 490 – Capstone Project	3
Total Core Credits	**34 credit hours**

TRACK COURSES (6 Tracks)

Astrostatistics Track (4 courses)

PHYS 221 – Physics I	4
PHYS 223 – Physics II	4
PHYS 307 – Astronomical Surveys and Databases	3
Complete 1 course from the following:	
PHYS 108 – Introduction to Astronomy	4
PHYS 317 – Astrophysics and Stellar Astronomy	3
Total	**14-15 credit hours**

Bioinformatics Track (4 courses)

BIOL 210 – Biology: Concepts and Methods	4
BIOL 302 – Bioinformatics I	4
BIOL 360 – Genetic Analysis	4
BIOL 441 – Bioinformatics II	3
Total	**15 credit hours**

Chemometrics Track (4 courses)

CHEM 121 – General Chemistry I	4
CHEM 122 – General Chemistry II	4
CHEM 321 – Analytical Chemistry	4
CHEM 333 – Instrumental Analysis	3
Total	**15 credit hours**

Computational Data Science Track (5 courses)

MATH 210 – Introduction to Discrete Mathematics	4
COSC 220 – Computer Science II	4
COSC 320 – Advanced Data Structures & Algorithm Analysis	4
COSC 420 – High-Performance Computing	4
Complete 1 course from the following:	
COSC 386 – Database Implementation	3
COSC 490 – Special Topics (Department Approved)	3
Total	**19 credit hours**

Geoanalytics track (4 courses)

GEOG 204 – Statistical Problem Solving in Geography	4
GEOG 219 - Map Interpretation and Analysis	4
Complete 2 courses from the following:	
GEOG 304 – Decision Making with GIS	4
GEOG 315 – Topics in GIS Modeling	3
GEOG 317 - Atmospheric Data Analysis and Programming	3
GEOG 319 – Geographic Information Science	4

GEOG 320 – Cartographic Visualization	3
Total	**14-16 credit hours**

Mathematical Data Science Track (5 courses)

MATH 310 – Calculus III	4
Complete 4 courses from the following:	
MATH 411 – Design and Analysis of Experiments	4
MATH 413 – Mathematical Statistics I	4
MATH 414 – Mathematical Statistics II	4
MATH 471 – Numerical Methods	4
MATH 472 – Numerical Linear Algebra	4
MATH 490 – Special Topics (Department Approved)	4
MATH 493 – Advanced Topics in Statistics	4
MATH 495 – Directed Consulting (Department Approved)	4
Total	**20 credit hours**

GENERAL EDUCATION COURSES: The following courses are required to meet the general education requirements for Salisbury University. In order satisfy the general education requirements, Salisbury University students must take courses from five different groups.

General Education Requirements

Group I: English Composition and Literature (2 Courses)

A. ENGL 103 (C or Better) or HONR 111	4
B. Literature course (from either ENGL or MDFL Depts.)	4

Group II: History (2 courses)

A. HIST 101, 102, or 103	4
B. HIST 101, 102, 103 or a HIST course above 103	4

Group III: Humanities and Social Sciences (3 courses)

A. ART, CMAT, DANC or THEA, MDFL, MUSC, PHIL, HONR 211	4
B. ANTH, CADR, ECON or FINA, ENVR, Human GEOG, POSC, PSYC, SOCI, HONR 112	3/4
C. Select one course from either Group IIIA or IIIB (course must be from a different area than previously selected)	3/4

Group IV: Natural Science, Math or Computer Science (4 courses)

A. Select courses with laboratories from at least two of the following four areas:	4
BIOL, CHEM, GEOL or Physical GEOG, PHYS	4
B. Select one additional course (need not be a lab) from Group IVA or ENVH or ENVR or COSC or MATH or HONR 212	FULFILLED BY MAJOR
C. Select one course from MATH	FULFILLED BY MAJOR

Group V: Health Fitness (1 course)

FTWL 106 – Personalized Health/Fitness	3

Total general education credit hours	**44 - 46 credits hours**

5. Specialized accreditation or graduate certification requirements: N/A

6. Contracting with another institution or non-collegiate organization

   There are no contracts with other institutions or organizations.

7. Assurance that SU provides clear, complete and timely information to students

   Before any program opens for admission, SU updates all curricular, course and degree requirements in our catalog and online (in both narrative and checklist formats). The Academic Advising Center prepares all advisors to assist incoming students with all MHEC-approved programs; furthermore, the Academic Advising Center dedicates one of their advisors as a liaison to the Henson School of Technology, the home of the proposed degree. Our catalog and website make available all pertinent information to prospective and current students regarding academic and student support, SU's learning management system, financial aid resources and costs and payment policies.

8. Assurance that advertising, recruiting and admission material are clear and accurate

   All publications, including marketing, catalog and website admissions pages are vetted by the Marketing and Communications Department at SU, which fact-checks all submissions.

H. Adequacy of Articulation: N/A

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

1. Narrative of Faculty Demonstrating Quality of Program Faculty

   The data science courses will be taught by SU's faculty from the Henson School of Science and Technology. Data science core courses will be taught by faculty from the Department of Mathematics and Computer Science. Collectively, these faculty have decades of experience teaching complex numerical concepts and ways to extract value from data.

Table of Faculty Resources. (note: all faculty are regular state employees, that is not contractual)

	Faculty member	Terminal Degree	Field	Degree-granting Institution	Academic Rank	Full- or Part-Time	Courses taught by each faculty member
Mathematical and Compuational Data Science	Joseph Anderson	Ph.D.	Computer Science and Engineering	The Ohio State University	Assistant Professor of Computer Science	FT	MATH 210, COSC 220, MATH 471, MATH 490, COSC 490, MATH 495
	Jiacheng Cai	Ph.D.	Computer Science	University of Nevada	Assistant Professor of Mathematics and Computer Science	FT	MATH 413, MATH 414, MATH 493, MATH 490, COSC 490, MATH 495
	Lori Carmack	Ph.D.	Mathematics	University of Santa Barbara	Associate Professor of Mathemataics	FT	MATH 310, MATH 411, MATH 471, MATH 490, COSC 490, MATH 495
	Randall Cone	Ph.D.	Computer Science	Virginia Polytechnic Instititute and State University	Associate Professor of Mathematics and Computer Science	FT	COSC 320, COSC 420, COSC 490, MATH 490, COSC 490, MATH 495
	Donald Spickler	Ph.D.	Pure Mathematics	University of Virginia	Professor and Chair of Mathematics and Computer Science	FT	COSC 320, COSC 386, COSC 490, MATH 490, COSC 490, MATH 495
Astrostatistics Faculty	Nicholas Troup	Ph.D.	Astronomy	University of Virginia	Assistant Professor of Physics	FT	PHYS 108, PHYS 307, PHYS 317
	Mathhew Bailey	Ph.D.	Physics	Utah State University	Associate Professor of Physics	FT	PHYS 221, PHYS 223
Chemometric Faculty	David Keifer	Ph.D.	Physical and Analytical Chemistry	Indiana University Bloomington	Assistant Professor of Chemistry	FT	CHEM 121, CHEM 122, CHEM 321
	Robert Luttrell	Ph.D.	Analytical Chemistry	University of Tennessee	Associate Professor and Associate Chair of Chemistry	FT	CHEM 121, CHEM 122, CHEM 333
	David Rieck	Ph.D.	Chemistry	University of Wisconsin Madison	Professor and Chair of Chemistry	FT	CHEM 121, CHEM 122
Geoanalytical Faculty	Daniel Harris	Ph.D.	Geoscience Education	University of Maryland, College Park	Associate Professor of Geography and Geosciences	FT	GEOG 219, GEOG 319
	Arthur Lembo	Ph.D.	Environmental Resource Engineering	State University of New York, College of Environmental Science and Forestry	Professor of Geography and Geosciences	FT	GEOG 204, GEOG 315, GEOG 319
	Stuart Hamilton	Ph.D.	Geography	Univesity of Southern Mississippi	Associate Professor of Geography and Geosciences	FT	GEOG 304, GEOG 317, GEOG 320

2. <u>Demonstrate Pedagogical Training for Faculty</u>

The Office of Instructional Design & Delivery provides professional development in pedagogy and instructional technologies. They provide ongoing online and in-person workshops on the Canvas learning managements system, plagiarism detection service, lecture capture software and more. In their weekly newsletter during Fall and Spring semesters, they provide best practices for traditional, hybrid and online learning environments. Through our Quality Matters subscription faculty are provided professional development in quality course design, instructor presence and other best practices for the online and hybrid environments – specifically our Certificate of Online Learning and Teaching certificate and our Soaring with Online Learning course development programs. Additional opportunities are provided through the Faculty Development Committee and our Faculty Learning Communities such as the Distance Education FLC and the Scholarship of Teaching and Learning FLC. Finally, the institution hosts two annual faculty development events – one in August at the beginning of the semester (our most recent focused on Effective Teaching Strategies) and a Teaching & Learning conference in the Spring where faculty present on evidence-based practices and their experiences at SU.

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

Salisbury University Libraries have existing resources to support completely the new Data Science major.

In relation to journal and newspaper articles, SU has a number of relevant titles through electronic access via our online database subscriptions, including (but not limited to): Academic Search Complete; Business Source Premier; EconLit; JSTOR; ProQuest Newspapers; Science Direct; and Web of Science. In regards to monographic titles, SU has a significant number of titles that would support this major and is frequently adding in more. SU's ability to share resources within the USM system will also greatly support our students in the rare occasion that we might not have the exact title in-house that they would want or need, and these students would generally gain access to that title within the same week they requested it.

In sum, no new library resources are directly required to support the Data Science major. Existing resources that relate to data science will be purchased or acquired in the future as needed once the major is officially implemented. Active and ongoing communication from faculty teaching these courses regarding relevant resources is strongly recommended, with particular emphasis placed on areas of particular curricular focus along with information regarding newly released titles.

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

Delivery of the program will be in existing space and is not contingent on additional resources. With the recent addition of the High Performance Computing Laboratory in Henson Hall, infrastructure is in place, which will provide the necessary computational capacity for faculty and students within the program to perform high-level data manipulation and analysis. Incremental growth of the program will support equipment maintenance and updates. We do not currently have plans to offer this program through distance learning.

L. Adequacy of Financial Resources as outlined in COMAR 13B.02.03.14.

TABLE 1: RESOURCES for the Data Science B.S. at Salisbury University					
Resources Categories	(Year 1 - FY21)	(Year 2 -FY22)	(Year 3 -FY23)	(Year 4 -FY24)	(Year 5 -FY25)
1.Reallocated Funds	$0	$0	$0	$0	$0
2. Tuition/Fee Revenue (c+g below)	$157,788	$195,310	$244,732	$285,375	$349,272
a. #F.T. Students	15	18	22	25	30
b. Annual Tuition/Fee Rate (FY20 Resident rate)*	$10,044	$10,245	$10,450	$10,659	$10,872
c. Annual Full Time Revenue (a x b)	$150,660	$184,410	$229,900	$266,475	$326,160
d. # Part Time Students	2	3	4	5	6
e. Credit Hour Rate*	$297	$303	$309	$315	$321
f. Annual Credit Hours	12	12	12	12	12
g. Total Part Time Revenue (d x e x f)	$7,128	$10,908	$14,832	$18,900	$23,112
3. Grants, Contracts, & Other External Sources	$0	$0	$0	$0	$0
4. Other Sources	$0	$0	$0	$0	$0
TOTAL (Add 1 - 4)	$157,788	$195,310	$244,732	$285,375	$349,272

*Figured at a 2% Annual Increase

TABLE 2: EXPENDITURES – for the Data Science B.S. at Salisbury University					
Expenditure Categories	(Year 1-FY21)	(Year 2-FY22)	(Year 3-FY23)	(Year 4-FY24)	(Year 5-FY25)
1. Total Faculty Expenses (b + c below)	$94,292	$96,178	$122,626	$125,079	$127,580
a. # FTE	1.00	1.00	1.25	1.25	1.25
b. Total Salary (plus 2% increase each year)	$70,896	$72,314	$92,200	$94,044	$95,925
c. Total Benefits (33% of salary)	$23,396	$23,864	$30,426	$31,035	$31,655
2. Total Administrative Staff Expenses (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. Total Support Staff Expenses (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	$0	$0	$0	$0	$0
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)	$94,292	$96,178	$122,626	$125,079	$127,580

M. Adequacy of provisions for evaluation of program as outlined in COMAR 13B.02.03.15.

The Henson School of Science and Technology has a long tradition of assessment and accreditation. Within the Henson School's Departments of Mathematics and Computer Science, Biological Sciences, Geography and Geosciences, Chemistry, and Physics, all faculty members are evaluated every year by their department chairs and all degree programs undergo comprehensive review every seven years. With guidance from the SU's Office of University Analysis, Reporting, and Assessment, course and program-based assessments are being developed at the start. Thus, the curriculum, program faculty and other resources, and student learning outcomes will be routinely evaluated through the annual and periodic review assessment cycles. In addition, once the Data Science B.S. program is launched, the program and courses will be evaluated using student surveys and program committee reviews on a regular basis.

N. Consistency with the State's minority student achievement goals as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education.

Any student meeting the SU admissions requirements can choose to pursue the B.S. in Data Science. The program will work to help all accepted students improve their workplace competitiveness and reach their professional goals, an aim consistent with the State's minority student achievement goals.

More specifically, Strategy 7 of the Maryland State Plan for Postsecondary Education (2017-2021) calls on universities to enhance career advising and planning services and integrate them explicitly into academic advising and planning.[11] The program will reach out to undeclared undergraduate students at Salisbury University to inform them of the wide array of career opportunities available with the Data Science major.

Strategy 8 of the State plan calls on universities to "develop new partnerships between colleges and businesses to support workforce development and improve workforce readiness."[12] As the only undergraduate program of its kind in the USM, the Data Science B.S. program will result in new public-private partnerships for students in this program. The program requires that students complete a senior capstone project, and the project can be completed through collaborations with local, state, federal, and private sectors.

O. Relationship to low productivity programs identified by the Commission: The 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 No distance learning is proposed at this time.

[11] https://bit.ly/2GgJnw8, pg 60
[12] https://bit.ly/2GgJnw8, pg 66

Appendix A

B.S. Data Science - Salisbury University
Course Descriptions

Core Courses

COSC 117: PROGRAMMING FUNDAMENTALS (4 credit hours)
Introductory course in computer programming, which involves solving problems by designing, implementing and testing algorithms. Emphasis is on problem solving through the use of algorithms and learning to develop computer programs that are reliable, well-documented, and correct. Implementation is done in object-oriented based languages concentrating on fundamental instructions and the development and implementation of events, methods, and functions. Three hours lecture, two hours lab per week.

COSC 120: COMPUTER SCIENCE I (4 credit hours)
Step-by-step approach to problem solving, modular structured design, and structured programming in C++. Emphasizes production of readable, well documented, efficient, tested and correct programs. Includes time intensive assignments. Prerequisite: C or better in COSC 117 or permission of department. Three hours lecture, two hours laboratory per week.

DSCI 311: INTRODUCTION TO DATA SCIENCE (4 credit hours)
This course provides a foundation in the area of data science based on data curation and statistical analysis. The primary goal of this course is to learn data analysis concepts and techniques that facilitate making decisions from a rich data set. Students will investigate data concepts, metadata creation and interpretation, machine learning, and basics of information visualization. This course introduces fundamentals about data standards and methods for organizing, curating, preserving data for reuse, drawing conclusions and making decisions from data. Students will understand how to use data analysis tools for data manipulation, analysis, and visualization. This course includes discussions on diverse issues around data including technologies, behaviors, organizations, policies, and society. Prerequisites: COSC 120, MATH 216, and MATH 306. Four hours per week.

MATH 201: CALCULUS I (4 credit hours)
Introduction to analytic geometry, limits, continuity, derivatives of elementary functions, applications of the derivatives. May not receive credit for both MATH 198 and MATH 201. Prerequisite: MATH 140 or equivalent. Four hours per week.

MATH 202: CALCULUS II (4 credit hours)
Introduction to integrals, infinite series, applications and techniques of integration. Prerequisite: C or better in MATH 198 or MATH 201 or equivalent. Four hours per week.

MATH 216: STATISTICAL THINKING (4 credit hours)
Descriptive and inferential analysis of data, emphasizing appropriate assumptions, computer use and interpretation. Parametric and non-parametric methods are compared and contrasted. Includes a weekly laboratory. Prerequisite or Corequisite: C or better or concurrent enrollment in MATH 160, 198, 201 or similar calculus experience. Four hours per week.

MATH 306: LINEAR ALGEBRA (4 credit hours)
Basic concepts of linear algebra: linear equations and matrices, vector spaces and subspaces, similar matrices, basis and dimension, linear transformations, eigenvalues, determinants, orthogonality, coordinate systems, and applications to geometry. Prerequisite: MATH 202. Four hours per week.

DSCI 470: RESEARCH METHODS IN DATA SCIENCE (3 credit hours)
Preparation for professional research and problem solving in data science and DSCI 490 projects. This course includes discussion of methodologies that can be used within data science, to ensure that the data used in problem solving is relevant and properly manipulated to support data science projects. Students will gain an understanding of the philosophy of using experimentation to gain scientific knowledge and the important components of successful experimentation and presentation. Basic information literacy techniques including; searching for primary literature and information using library reference materials and on-line databases; writing reports and research papers; analyzing and presenting graphical data; the ethical use of information; and presenting research using presentation development software will be discussed. Prerequisite: C or better in COSC 311. Three hours per week.

DSCI 490: CAPSTONE PROJECT (3 credit hours)
Capstone project in one of the areas of data science chosen, designed, and carried out by the student with the advice and approval of a faculty member. Actual work may be carried out at off-campus sites. Written report, seminar presentation are required. Pre-requisites: DSCI 470 and permission of instructor who will direct study.

Courses for the Astrostatistics Track

PHYS 108: INTRODUCTION TO ASTRONOMY (4 credit hours)
Survey of modern astronomy for non-science majors. Basic physics concepts utilized to study the night sky, light, optics and telescopes, planets, the moon and sun, stars nebulae, galaxies and the universe. Some night observations required. May not be taken for credit if student already has credit for PHYS 109. Three hours lecture, two hours laboratory per week.

PHYS 221: PHYSICS I (4 credit hours)
Introduction to calculus-based Newtonian mechanics for students majoring in physics, engineering and chemistry. Prerequisite or Corequisite: MATH 201. Six hours lecture/activity per week.

PHYS 223: PHYSICS II (4 credit hours)
Continuation of introductory physics. Topics include: electrostatica, current and resistance, DC and AC circuit analysis, magnetic fields, induction, electromagnetic waves and geometrical and wave optics. Prerequisite: PHYS 221. Prerequisite/Corequisite: MATH 202. Six hours lecture/activity per week.

PHYS 307: ASTRONOMICAL SURVEYS AND DATABASES (3 credit hours)
Introduction to astronomical data science including the application and development of sophisticated statistical methodology to large and/or complex data sets. This course covers common types of data in astronomy such as light curves, spectra, and images as well as statistical methods used for analyzing these data sets, such as functional data analysis, measurement error models, hierarchical models, survival analysis, and machine learning techniques. An emphasis will be placed on the complexity of the inference tasks faced by astronomers and the propagation of uncertainty across several levels of inference. This course includes

discussions on topical issues in the analysis of astronomy data. Prerequisites: COSC 117 or 120, PHYS 108 or 109. Three hours per week.

PHYS 317: ASTROPHYSICS AND STELLAR ASTRONOMY (3 credit hours)
Physical and mathematical principles applied to the study of astronomy, binary stars, stellar structure and evolution, galactic and extragalactic astronomy, quasars and cosmology. No prior knowledge of astronomy required. Prerequisites: PHYS 223, 309. Four hours lecture/activity per week.

Courses for the Bioinformatics Track

BIOL 210: BIOLOGY: CONCEPTS AND METHODS (4 credit hours)
Introduction to the study of biology, focusing on how biologists know things and study the world of life, with emphases on cell biology, genetics, ecology and evolution. First course required for biology majors. Four hours of lecture/laboratory, two hours online per week.

BIOL 302: BIOINFORMATICS I (4 credit hours)
Computer-based course introduces biological databases. Emphasis placed on quantitative approaches to modeling and analyzing biological data. Prerequisite: BIOL 210. Prerequisite/Corequisite: MATH 198 or MATH 201. Three hours lecture, three hours laboratory per week.

BIOL 360: GENETIC ANALYSIS (4 credit hours)
Introduction to genetic analysis including Mendelian principles, population and quantitative genetics, cytogenetics and contributions to molecular biology. Satisfies Biology Department core requirements for genetics. Recommended Prerequisite: MATH 155. Prerequisites: BIOL 210. Three hours lecture, three hours laboratory per week.

BIOL 441: BIOINFORMATICS II (3 credit hours)
Exploration of viral, prokaryotic and eukaryotic genomes. Emphasis on computational techniques for assessing the genome and manipulating genomic data. Prerequisite: C or better in BIOL 302. Prerequisite/Corequisite: BIOL 306 or BIOL 370. Four hours lecture/laboratory per week.

Courses for the Chemometrics Track

CHEM 121: GENERAL CHEMISTRY I (4 credit hours)
Study of fundamental laws of chemistry and atomic structure emphasizing quantitative relationships. Prerequisite: Two years high school algebra and chemistry, or CHEM 100. Three hours lecture, one three-hour laboratory per week.

CHEM 121: GENERAL CHEMISTRY I (4 credit hours)
Study of fundamental laws of chemistry and atomic structure emphasizing quantitative relationships. Prerequisite: Two years high school algebra and chemistry, or CHEM 100. Three hours lecture, one three-hour laboratory per week.

CHEM 321: ANALYTICAL CHEMISTRY (4 credit hours)
Study of the theory and applications of classical and modern analytical techniques. Includes volumetric, potentiometric, spectrophotometric and chromatographic methods. Prerequisite: CHEM 122. Three one-hour lectures, one three-hour laboratory per week.

CHEM 333: INSTRUMENTAL ANALYSIS (3 credit hours)
Study of the theoretical and practical aspects of modern instrumental analysis. Topics include information processing, spectroscopic, chromatographic and electrochemical methods. Prerequisite: CHEM 321. Three hours lecture per week.

Courses for the Computational Data Science Track

MATH 210: INTRODUCTION TO DISCRETE MATHEMATICS (4 credit hours)
Introduction to basic techniques and modes of reasoning for discrete problem solving. Set theory, recurrence relations, counting, graphs and lattices, number theory. Prerequisites: MATH 140 or equivalent. Four hours per week.

COSC 220: COMPUTER SCIENCE II (4 credit hours)
Object-oriented approach to design and implementation of medium to large software projects. Abstract data types including lists, stack and queues. Emphasizes design trade-offs based on analysis of run time and storage requirements. Includes time-intensive assignments. Prerequisite: COSC 120. Pre or Corequisite: MATH 210. Three hours lecture, two hours lab per week.

COSC 320: ADVANCED DATA STRUCTURES AND ALGORYTHM ANALYSIS (4 credit hours)
A continuation of the study of the design, implementation and testing of programs. Further study of object-oriented programming. Introduction to graphical user interfaces. Emphasis is on analysis of algorithms and abstraction. Prerequisites: COSC 220, MATH 210. Three hours lecture, two hours lab per week.

COSC 386: DATABASE DESIGN AND IMPLEMENTATION (3 credit hours)
Concentrates on the physical design and implementation of databases. Query algorithms and efficiency optimization will be explored. Students will design, implement and document large database systems. Prerequisites: COSC 220 and MATH 210. Three hours per week.

COSC 420: HIGH-PERFORMANCE COMPUTING (4 credit hours)
Principles and practice of parallel and distributed computing. Topics include modern computing architectures, concurrency principles and algorithm design, and applications and programming. Prerequisite: C or better in COSC 320. Four hours per week.

COSC 490: SPECIAL TOPICS (3 credit hours)
Seminar course with content that varies semester to semester (e.g., artificial intelligence, compiler construction or other topics suggested by faculty or students). May be taken twice under different titles recorded by the registrar. May be offered for undergraduate or graduate credit. Prerequisite: COSC 220. Three hours per week.

Courses for the Geoanalytics Track

GEOG 204: STATISTICAL PROBLEM SOLVING IN GEOGRAPHY (4 credit hours)
Introduction to the basic principles of quantitative analysis in geography. Emphasis on the geographic applications of various techniques rather than on the underlying statistical theory. Prerequisites: Completion of MATH 155 or 213. Three hours lecture plus two hours lab per week.

GEOG 219: MAP INTERPRETATION AND ANALYSIS (4 credit hours)
Introduction to mapping science principles and practice, focusing on the application of methods to produce hardcopy and digital maps. Topics include earth representation and map projections, field data collection utilizing ground survey, global positioning systems (GPS) and remote sensing, and map compilation and design within a geographic information system (GIS). Three hours lecture, two hours laboratory per week.

GEOG 304: DECISION MAKING WITH GIS (4 credit hours)
Overview of GIS technology and its use in decision making for various disciplines. The disciplines include social, health and environmental sciences, urban planning, and government operations. Includes three hours of lecture per week and a supplemental laboratory session where students perform hands-on laboratory exercises using GIS software. Prerequisite: GEOG 219. Three hours lecture, two hours laboratory per week.

GEOG 315: TOPICS IN GIS MODELING (3 credit hours)
Analysis of the interaction between humans and their environment. Specific topics may include shoreline erosion, water pollution, land-use land-cover change, biodiversity losses, tsunamis, hurricanes and sea-level rise. Learn the analytical methods necessary to obtain, process and analyze a myriad of modern data concerned with the interface between human and natural landscapes. Prerequisite: College-level statistics or GEOG 219 or permission of instructor. Three hours per week.

GEOG 317: ATMOSPHERIC DATA ANALYSIS AND PROGRAMMING (4 credit hours)
This course involves processing of large, high-dimensional atmospheric and environmental using MATLAB and NCL software and programming. Prerequisite: GEOG 201. Three hours per week.

GEOG 319: GEOGRAPHIC INFORMATION SCIENCE (4 credit hours)
Study of automated information handling using geographically referenced data to support spatial analysis. Consideration of and experience in the collection, storage and display of computer manipulated data. Includes hands-on experience with a variety of commercial software GIS packages. Prerequisite: GEOG 219. Three hours lecture, one two-hour laboratory per week.

GEOG 320: CARTOGRAPHIC VISUALIZATION (3 credit hours)
Theory and application of cartographic principles and practices to advanced cartographic design. Lectures emphasize theory and principles. Laboratory provides practical experience in designing maps. Prerequisite: GEOG 219. Two hours lecture, two hours laboratory per week.

Courses for the Mathematical Data Science Track

MATH 310: CALCULUS III (4 credit hours)
Arc length, indeterminate forms, Euclidean spaces, functions of several variables, partial differentiation, multiple integrals. Prerequisite: MATH 202. Four hours per week.

MATH 411: DESIGN AND ANALYSIS OF EXPERIMENTS (4 credit hours)
Introduction to ideas of planning and designing statistical experiments involving data collection. Study of various statistical analyses for these designs. Discussion of optimal allocation of sampling units to treatments in order to provide the highest accuracy and lowest cost. Use standard statistical software packages such as Minitab and SPSS. Prerequisite: C or better in MATH 155 or 213 or 216, or permission of department. Four hours per week.

MATH 413: MATHEMATICAL STATISTICS I (4 credit hours)
Axioms and algebra of probability, discrete and continuous random variables, multivariate distributions, limit theorems. May be offered for undergraduate or graduate credit. Prerequisites: C or better in MATH 213 or 216, and MATH 310. Four hours per week.

MATH 414: MATHEMATICAL STATISTICS II (4 credit hours)
Methods of estimating, properties of estimator, hypothesis testing, linear models, least squares, analysis of variance, enumerative data, nonparametric statistics. May be offered for undergraduate or graduate credit. Prerequisite: C or better in MATH 413. Four hours per week.

MATH 471: NUMERICAL METHODS (4 credit hours)
Interpolation, functional approximation, numerical differentiation and integration, nonlinear equations, numerical solutions of differential equations, analysis of error. Prerequisites: C or better in COSC 117 or 118 or 120 and one of the following: MATH 306 or MATH 310 or MATH/PHYS 309. Four hours per week.

MATH 472: NUMERICAL LINEAR ALGEBRA (4 credit hours)
Numerical methods and analysis applied to linear systems. Computer arithmetic and error analysis, direct methods for solving linear systems, iterative techniques in matrix algebra, approximating eigenvalues. Prerequisites: C or better in COSC 117, 118 or 120; MATH 202; MATH 306. Four hours per week.

MATH 490: SPECIAL TOPICS (4 credit hours)
Enables study in specialized areas such as complex variables, logic, non-Euclidean geometry or other topics suggested by faculty or students. May be taken twice under different title. Prerequisites: (For most topics) C or better for MATH 306, 310. Four hours per week.

MATH 493: ADVANCED TOPICS IN STATISTICS (4 credit hours)
Study in specialized areas of statistics such as time series, stochastic processes, quality control designs and analyses or other topics suggested by faculty or students. May be repeated once under different subtitles. Prerequisites: C or better in MATH 213 or 216, and permission of instructor. Four hours per week.

MATH 495: DIRECTED CONSULTING (4 credit hours)
Provides teams of 3-12 students with experience in using mathematical and computing tools to solve real-world problems posed by a client organization, such as a research institute, business or industry. Combines individual and group work and requires presentation of a written and oral report to the client organization and the department. Cross-listed with COSC 495. MATH/COSC 495 may be taken twice for a maximum of eight credit hours, but used only once toward a major in mathematics or computer science. Prerequisite: Invitation by the department. Four hours per week. (P/F)