NEW PROGRAM PROPOSAL

Name of Institution

College of Charleston (University of Charleston, South Carolina)

Name of Program (include concentrations, options, and tracks)

Master of Science in Data Science and Analytics

Program Designation

- ☐ Associate's Degree
- ☒ Master's Degree
- ☐ Bachelor's Degree: 4 Year
- ☐ Specialist
- ☐ Bachelor's Degree: 5 Year
- ☐ Doctoral Degree: Research/Scholarship (e.g., Ph.D. and DMA)
- ☐ Doctoral Degree: Professional Practice (e.g., Ed.D., D.N.P., J.D., Pharm.D., and M.D.)

Does the program qualify for supplemental Palmetto Fellows and LIFE Scholarship awards?

- ☐ Yes
- ☒ No

Proposed Date of Implementation
Fall 2018

CIP Code
11.0199

Delivery Site(s)
College of Charleston, Charleston, SC. Harbor Walk Location.

Delivery Mode

- ☒ Traditional/face-to-face*
  *select if less than 50% online
- ☐ Distance Education
  - ☐ 100% online
  - ☐ Blended (more than 50% online)
  - ☐ Other distance education

Program Contact Information (name, title, telephone number, and email address)
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Institutional Approvals and Dates of Approval

Faculty Senate: 11/7/2017
Board of Trustees: 10/19/2017 (pre-approval pending Senate approval)
Graduate Council: 10/13/2017
Graduate Education Committee: 10/6/2017
SSM Chairs/Dean: 2/1/2017
CSCI Department: 10/26/2016

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Background Information

State the nature and purpose of the proposed program, including target audience and centrality to institutional mission. (1500 characters)

The goal of this proposal is to create a degree program to fill the growing demand for graduates with data-driven, quantitative, analytics, and computing skills – i.e., a data scientist. There are several overlapping but distinct ways to identify and define a data scientist. At the heart of data science is the goal of knowledge discovery from data. This requires a core of specialized skills from the domains of computer science and mathematics complemented with significant exposure to a domain of specialization (e.g., business, science, social sciences, and humanities).

This type of interdisciplinary program is central to the liberal arts tradition at the College of Charleston and will further serve the institution's mission of providing exceptional training to support the low country and surrounding areas. This program directly supports the mission of The College of Charleston which reads in part *"… [The College] strives to meet the growing educational demands primarily of the Lowcountry and the state and, secondarily, of the Southeast."* Currently, there are no data science and analytics master's degree programs in the state.

The target audience includes non-traditional as well as traditional students who have earned a degree in any discipline. However, all students are required to demonstrate prerequisite knowledge of computer science and statistics by passing an entrance exam as part of the admissions requirements. Typically, full-time students can choose to follow either a 13 month pathway with a practicum focus or a 25 month pathway with a research focus to degree completion, although in either example pathway, a practicum or research thesis option could be possible. Students may also complete this degree program in a part-time fashion since a strict cohort model is not intended or enforced in example pathways. The degree program requires 36 credit hours to complete.

List the program objectives. (2000 characters)

Graduates of this degree program will master the following core skills: Data Modeling, Data Wrangling, Experimental Design, Statistics, Optimization, Machine Learning, and Data Visualization.

The core skills are complemented by domain-specific elective coursework. Recommended elective packages are provided which specifically prepare students for the following career goals: Machine Learning Data Scientist, Modeling and Software Engineering Data Scientist, Computational Data Scientist, Scientific Computing, and a Business Analytics Data Scientist.

All students in this program will apply their core and domain-specific skills and knowledge to either an industry practicum or research thesis experience.

The specific learning objectives of the program are:

1. Graduates will demonstrate advanced and applied knowledge of computer programming, data organization, data mining, data visualization, and algorithms.
2. Graduates will demonstrate an advanced understanding in the core area of mathematics and statistics, including optimization, machine learning, regression, and linear algebra.
3. Graduates will demonstrate an application of their data science graduate coursework through the completion of a Practicum Experience or Research Thesis.

Assessment of Need

Provide an assessment of the need for the program for the institution, the state, the region, and beyond, if applicable. (1500 characters)

Currently, there are no master's degree programs in the state of South Carolina that are significantly similar to this proposed degree. The master's degree in data science and analytics builds onto the existing bachelor's degree in data science at The College of Charleston which is credited as being the first in the country (http://www.networkworld.com/article/3059276/it-skills-training/8-universities-at-the-forefront-of-big-data.html). This proposal provides a new, attractive master's degree pathway for graduates of the existing undergraduate math, data science, physics and other programs, and for non-traditional students in the region wanting to retrain.

This program directly supports the mission of The College of Charleston which reads in part *"... [The College] strives to meet the growing educational demands primarily of the Lowcountry and the state and, secondarily, of the Southeast."* The Charleston Regional Development Alliance (http://www.crda.org) states *"Charleston is home to 250+ tech companies and counting. New job opportunities and announcements are always popping up."* These companies need a variety of high tech professionals including data scientists with a master's degree. The following high tech companies in the Lowcountry, for example, have expressed interest to us in hiring graduates of this new program:

- SnapCap, confirmed by Steve Swanson, Inside Director of Operations and Strategy
- Pokitdok, confirmed by Ted Tanner, CTO and Co-Founder
- SPARC, confirmed by Bob Williams, Chief Scientist
- Blackbaud, confirmed by Hannah Fellers, University Talent Specialist
- Blue Acorn, confirmed by Kevin Eichelberger, Founder and CEO
- Boomtown ROI, confirmed by Grier Allen, Founder and CEO

- Geocent, confirmed by Aaron Whitney, Principal Software Engineer
- Hawkes Learning Technologies, confirmed by Marcel Prevuznak, Vice President
- Soteria LLC, confirmed by Christopher O'Rourke, CEO

The need for this new program stretches well beyond South Carolina. A June 2011 report by the McKenzie Global Institute titled "Big data: The next frontier for innovation, competition, and productivity," reports that the "*Demand for deep analytical talent in the US could be 50 to 60 percent greater than its projected supply by 2018.*" and "*This may result in a shortage of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analyst*"

In Fall 2013, the United States Bureau of Labor Statistics (BLS) published a fantastic article titled "Working with Big Data" in Career Outlook which states: "*The increased amount of data in the world has created many opportunities for analysis.*" and "*In addition to having a bachelor's degree, **most analysts who work with big data have a master's or higher degree**. Common specialties include mathematics, statistics, or computer science.*" The latter quote in particular supports the need for (and the structure of) this master's degree in data science and analytics proposal.

And most recently, a February 2017 article by Forbes.com titled "*The Toughest Jobs To Fill In 2017*" states "*One job that made the list this year – as it did last year – is data scientist. …. **Universities now are just starting to integrate specific majors for that field.** It's got a high growth outlook but right now it's still a burgeoning field. According to the numbers, the data scientist occupation has a 16% growth outlook over the next eight years, and right now the median annual salary for that position is more than $128,000.*" The article is based on a report from CareerCast.com which looked to its roster of the top 200 jobs within the workforce that it follows as part of its Jobs Rated Report. It then researches each, looking to data from the Bureau of Labor Statistics, industry publications, trade statistics, the Georgetown University Center on Education and college graduate employment figures.

Employment Opportunities

Is specific employment/workforce data available to support the proposed program?

☒Yes

☐No

If yes, complete the table and the component that follows the table on page 4. If no, complete the single narrative response component on page 5 beginning with "Provide supporting evidence."

Employment Opportunities			
Occupation	**Expected Number of New Jobs**	**Annual Growth Projection**	**Data Source**

Database Developer	13,400	11% (by 2024)	https://www.bls.gov/ooh/computer-and-information-technology/database-administrators.htm
Computer and Information Research Scientist	2,700	11% (by 2024)	https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm
Information Security Analyst	14,800	18% (by 2024)	https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm
Market Research Analyst	92,300	19% (by 2024)	https://www.bls.gov/ooh/business-and-financial/market-research-analysts.htm
Statistician	10,100	30% (by 2024)	https://www.bls.gov/ooh/math/statisticians.htm
Database Architect	132,710	16% (by 2018)	https://www.recruiter.com/careers/database-architects/outlook/
Data Warehousing Specialist	40,910	2% (by 2018)	https://www.recruiter.com/careers/data-warehousing-specialists/outlook/
Bioinformatics Scientist	7,170	3% (by 2018)	https://www.recruiter.com/careers/bioinformatics-scientists/outlook/

Provide additional information regarding anticipated employment opportunities for graduates. (1000 characters)

A search of Indeed.com on May 25, 2017 for the phrase "Data Analyst" in South Carolina, four Southeast States, and the Unites States returned the below results. Graduates of the Master's in Data Science and Analytics degree program will compete for jobs starting *above* the $65,000 salary range. In South Carolina, 41 such job openings were identified. Although many job titles were exactly "Data Analyst," several types of relevant positions and titles were identified, including: Remote Data Analyst, Data Analyst / Report Developer, System Analyst, Data Conversion Specialist, Big Data Analyst, Compliance Data Analyst, Corporate Data Analyst, and Business Analyst.

Florida	Georgia	North Carolina	South Carolina	United States
		Salary		
$45,000+ (220)	$45,000+ (131)	$50,000+ (173)	$50,000+ (54)	$50,000+ (5000)
$60,000+ (170)	$60,000+ (105)	**$65,000+ (134)**	$60,000+ (43)	$60,000+ (4230)
$65,000+ (142)	**$65,000+ (90)**	$75,000+ (101)	**$65,000+ (41)**	**$70,000+ (3193)**
$70,000+ (109)	$70,000+ (71)	$80,000+ (87)	$75,000+ (23)	$80,000+ (2002)
$80,000+ (57)	$85,000+ (29)	$95,000+ (39)	$85,000+ (12)	$90,000+ (1170)
		Company		
Veredus (6)	Amdex Corporation (6)	Bank of America (10)	TechFlow (8)	Amazon Cor (49)

TekPartners(6)	Customer V...(5)	IBM (6)	FGP International (5)	UnitedHealth Group (48)
Apex Systems Inc (5)	Home Depot (5)	Open Sys.... (6)	Recruiting Solutions (5)	Apex Systems Inc (45)
The CSI Companies (4)	Principle Solutions (4)	Premier Inc. (5)	AccruePartners (5)	Kaiser Permanente (43)
Citi (4)	InComm (3)	Charlotte (5)	BlueCross BlueS... (4)	Diverse Lynx (28)
Advent Software (3)	Cox Communications (3)	Mitchell Martin (4)	DP Professionals (2)	Modis (25)
Vaco (3)	Equifax (3)	Ally Financial Inc. (4)	Knowledge Services (2)	Internatio..... (24)
4 Corner Resources (3)	HUNTER Te... (3)	Principle Solutions (4)	TM Floyd & Company (2)	JP Morgan Chase (22)
ektello (3)	Harness Solutions (3)	Kavaliro (3)	Technical R.... (2)	Booz Allen Hamilton (22)
Rapid Interviews (2)	ICF (2)	DIVERSANT LLC (3)	Nexsolv Inc (2)	Capital One (21)
Carnival Cruise Line (2)	WD-40 Company (2)	TEKSystems (3)	Booz Allen Hamilton (2)	Veterans So.....(21)
Venus Fashion Inc (2)	Ajilon (2)	Aeroflow Hea.. (3)	Globalpundits (2)	Experis (19)
Mettler Toledo (2)	Cox Automotive (2)	Apex Systems Inc (3)	Motley Rice LLC (2)	Johns Hopkins(18)
Electronic Arts (2)	Applied Resou.... (2)	Kite Staffing (3)	Global Lending.... (1)	Accountemps (18)
Criteo (2)	Get Orderly (2)	Aarkay Tech. (2)	Jtekt Nort.... (1)	Open Systems (17)

Since this degree program educates students to compete in such a broad range of job opportunities with varying job titles, another search of Indeed.com on May 25, 2017 for the occurrence of the words "Data" and "Analyst" in South Carolina, four Southeast States, and the Unites States was conducted which revealed the below results. In South Carolina, 415 job openings ***above*** the $65,000 amount were identified. As before, although many job titles were exactly "Data Analyst," several types of relevant positions and titles were identified. A cursory examination of the 164 hits at the $90,000+ salary level, reveals the following jobs for which graduates of this program would compete: Data Scientist, Hadoop Database Development Team Lead, Business Analyst, IT Business Analyst, Compliance Data Analyst, Hadoop Database Developer, Data Analyst, Big Data Analyst, Big Data Engineer, Database Analyst, Business Operations Analyst, Mortgage Business Analyst, Risk Analyst, Insights Analyst, Planning Analyst, BI Analyst, Big Data Business Analyst, Pricing Research Analyst, Quality Assurance Analyst, Data Visualization Analyst, Application Analyst, Performance Tester, IT Site Reliability Engineer, Big Data Analytics Engineer, Test Engineer, and Information Security Analyst.

Florida	Georgia	North Carolina	South Carolina	United States
		Salary Estimate		
$50,000+ (3225)	$55,000+ (2170)	$50,000+ (2108)	$50,000+ (598)	$50,000+ (73049)
$60,000+ (2754)	**$65,000+ (1852)**	**$65,000+ (1709)**	$60,000+ (521)	$65,000+ (59083)
$70,000+ (2141)	$75,000+ (1359)	$75,000+ (1368)	**$70,000+ (415)**	**$75,000+ (45120)**
$80,000+ (1405)	$80,000+ (1053)	$85,000+ (926)	$80,000+ (290)	$85,000+ (30382)
$90,000+ (822)	$95,000+ (478)	$100,000+ (420)	$90,000+ (164)	$100,000+ (15070)
		Company		

Citi (134)	Capgemini (110)	Bank of America (134)	AccruePartners (28)	JP Morgan Chase (771)
The State of Florida (54)	Home Depot (90)	Wells Fargo (65)	LPL Financial (24)	Amazon Corporate LLC (673)
Adventist Health System (53)	SunTrust (37)	BB&T (48)	State of South Carolina (22)	Vencore (660)
WellCare (53)	Veredus (35)	Apex Systems Inc (41)	Novant Health (17)	Booz Allen Hamilton (595)
Veredus (48)	Synovus (22)	Veredus (31)	Blackbaud (16)	Leidos (501)
Lockheed Martin (34)	WestRock (21)	Mitchell Martin (30)	Nexsolv Inc (12)	General Dynamics (385)
JP Morgan Chase (33)	Comcast (20)	Credit Suisse (29)	American Credit ..(12)	Citi (379)
RAYMOND JAMES (33)	TSYS (20)	ACT-Consulting (29)	BlueCross BlueShield (11)	Bank of America (367)
General Dynamics (32)	First Data (20)	Advance Auto Parts (28)	MUSC (10)	Capgemini (360)
TekPartners(30)	Cox Automotive (20)	Spectrum (28)	DP Professionals (10)	UnitedHealth Group (355)
Lennar (29)	Interactive Data (19)	Optomi (26)	Pricewaterhouse ...(10)	Northrop Grumman (327)
The CSI Companies (29)	Principle Solutions (18)	Open Systems Tech (24)	Recruiting Solutions (10)	Lockheed Martin (308)
University of Miami (27)	Turner (18)	Novant Health (23)	FGP International (9)	CACI (290)
Black Knight Fin...(26)	ADP (18)	Charlotte (23)	Citi (9)	IBM (289)
B3H Corporation (25)	HUNTER Technical (17)	Ally Financial Inc. (22)	TechFlow (8)	Apex Systems Inc (277)

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Provide supporting evidence of anticipated employment opportunities for graduates, including a statement that clearly articulates what the program prepares graduates to do, any documented citations that suggests a correlation between this program and future employment, and other relevant information. Please cite specific resources, as appropriate. (3000 characters)

Note: Only complete this if the Employment Opportunities table and the section that follows the table on page 4 have not previously been completed.

N/A

Will the proposed program impact any existing degree programs and services at the institution (e.g., course offerings or enrollment)?

☒Yes

☐No

If yes, explain. (500 characters)

This proposal will have a positive effect on both the Master in Computer and Information Sciences (a joint program offered with The Citadel) and the Master in Mathematical Sciences degree programs offered at the College of Charleston because it will increase the enrollment in some of the courses taught in each of those master's degree programs, and it may attract students to the College of Charleston who would not otherwise enter either program.

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List of Similar Programs in South Carolina

Currently, no master's in data science and analytics exist in the state of South Carolina which overlaps significantly with our proposed program. Further, the College of Charleston is home to the nationally recognized undergraduate degree in Data Science (also one of its kind in SC). We believe the addition of a master's in data science and analytics would strengthen the undergraduate program, bring a more diverse student population to the field of data science, and provide our data science undergraduates an opportunity for graduate coursework in South Carolina. At present, our graduates seek this education in neighboring states.

Program Name	Institution	Similarities	Differences
MS in Computer Science and Information Science	Joint Program with The Citadel and The College of Charleston	Overlap in the computing coursework; however, this program is more of a traditional computer science program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused computer science.
MS in Mathematical Sciences	The College of Charleston	Overlap in the math/statistics coursework, however, this program is more of a traditional mathematics program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused on math/statistics alone.
MS in Applied Economics and Statistics	Clemson University	Some electives courses can be taken in statistics which might be similar to some of the statistics courses in this new program.	Clemson's program is completely grounded in economics. This new program has no economics.
MS in Computer Science	Clemson University	Overlap in the computing coursework; however, this program is more of a traditional computer science program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused computer science
MS in Mathematical Sciences	Clemson University	Overlap in the math coursework; however, this program is more of a traditional math program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused on math/statistics alone.

MS in Health Informatics	MUSC	A small amount of content overlap in the database and analytics courses might be possible.	MUSC's program is mainly an online program focused on healthcare analytics. The curriculum is not as technical as the proposed program.
Ph.D. in Biomedical Informatics and Data Science	MUSC and Clemson	A small amount of core data science concepts.	The mission of the proposed master's degree is a broad professional-oriented degree serving the industry needs for data scientists. While our program could potentially include courses that discuss data science topics related to biomedical applications, the focus of our classes would be more general in nature. However, graduates of our program could provide some of the most qualified students for recruitment into MUSC's Ph.D. program.
MS in Computer Science	USC Columba	Overlap in the computing coursework; however, this program is more of a traditional computer science program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused computer science.
MS in Software Engineering	USC Columbia	Overlap in the computing coursework; however, a software engineering program focuses on the process of building software while a data science program like the one we are proposing focuses more on the processing and analysis of data.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not focused on software engineering at all.
MPH in Biostatistics	USC Columbia	Possibly a small amount of overlap in the math/statistics coursework.	This is an MPH program at USC's which focused on analytical and investigative biostatistical skills in a public health setting, which is very different from our proposal, broad-based, technical data science program.
MS in Mathematics	USC Columbia	Overlap in the math coursework; however, this program is more of a traditional math program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused on math/statistics alone.

MAS in Applied Statistics	USC Columbia	Overlap in the math/statistics coursework; however, this program is more of a traditional applied statistic program and not a data science program.	The USC program is a distance education program with significant difference in coursework. Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused on math/statistics alone.
MS in Statistics	USC Columbia	Overlap in the math/statistics coursework; however, this program is more of a traditional statistic program and not a data science program.	Our new program offers a combination of computing, math, statistics data science, and domain-specific coursework, and is not mainly focused on math/statistics alone.
MS in Informatics	USC Upstate	A small amount of content overlap in the knowledge inference coursework might be possible.	USC Upstate's informatics program involves the study of information and the application of information technology to the acquisition, processing, management and utilization of information. It does not overlap with our program which is a technical data science and analytics program.
MS in Information Systems Technology	Coastal Carolina University	Coastal's program has a possible concentration in Data Analytics. Students in this option, might have overlap in coursework.	Coastal's program "It will prepare graduates to design, evaluate, and implement secure technology systems and infrastructure." It requires a student to take core coursework in security and all coursework is focused on either cyber security or data analytics content. It does not require any pure statistics, math, computer science, or domain-specific coursework, all of which our new program requires, producing a broad-based technical data scientists capable of working in a variety of domains.

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Description of the Program

Projected Enrollment						
Year	Fall		Spring		Summer	
	Headcount	Credit Hours*	Headcount	Credit Hours*	Headcount	Credit Hours
2018- 19					10	60
2019 - 20	10	90	10	90	25	150
2020- 21	25	225	25	225	30	180
2021- 22	30	270	30	270	35	210
2022-23	35	315	35	315	35	210
2023-24	35	315	35	315	35	210

* Conservative estimation of credit hours which assumes all students are enrolled in 9 hours per semester. Students pursuing the 13 month degree completion pathway would be enrolled in 12 hours.

Besides the general institutional admission requirements, are there any separate or additional admission requirements for the proposed program?

☒Yes

☐No

If yes, explain. (1000 characters)

In addition to the College of Charleston's general graduate school application, official transcripts, and GRE admissions requirements, applicants must also:

- **Pass an Entrance Exam**. Because this new program attracts a wide array of students with diverse backgrounds, academic degrees, work experience, and talent, it is important to establish a common thread of knowledge and vocabulary in fundamental areas before students start classes. This enables instructors to start classes at a higher level, appropriate for a graduate program. Students accepted into this program must demonstrate pre-requisite knowledge in the areas of fundamental programming, computer science, mathematics, and statistics. The following two MIT Open Courseware online courses outline the pre-requisite content needed: Introduction to Computer Science and Programming and Introduction to Probability and Statistics. The online courses are self-paced and free. All students entering this new graduate degree program must pass a proficiency test prior to beginning their first graduate courses. The test is administered by the program director.
- **Provide Statement of Purpose.** A 300-500 word statement of purpose is required. Applicants should discuss their goals after obtaining the master's degree and what the applicant believes he/she will contribute to the program.
- **Provide Letters of Recommendation**. Two letters of recommendation that should provide specifics on the applicant's motivation and ability to complete the program are required.

Are there any special articulation agreements for the proposed program?

☐Yes

☒No

If yes, identify. (1000 characters)

N/A

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Curriculum

Select one of the following charts to complete: Curriculum by Year **or** Curriculum by Category

Curriculum by Year (13 month example pathway)					
Course Name	**Credit Hours**	**Course Name**	**Credit Hours**	**Course Name**	**Credit Hours**
Year 1					
				Summer (Before)	
				DATA 505	3
				DATA 506	3
				Total Semester Hours	6
Fall		**Spring**		**Summer (After)**	
CSIS 604	3	DATA 534	3	ELECTIVE	3
DATA 510	3	CSIS 638	3	DATA 698	3
MATH 540 or DATA 507	3	MATH 550	3		
ELECTIVE	3	DATA 698	3		
Total Semester Hours	12	Total Semester Hours	12	Total Semester Hours	6

Curriculum by Year (25 month example pathway)					
Year 1					
				Summer	
				DATA 505	3
				DATA 506	3
				Total Semester Hours	6
Fall		**Spring**		**Summer**	
CSIS 604	3	DATA 534	3		
DATA 510	3	CSIS 638	3		
MATH 540 or DATA 507	3	MATH 550	3		
Total Semester Hours	9	Total Semester Hours	9	Total Semester Hours	
Year 2					
Fall		**Spring**		**Summer**	
ELECTIVE	3	ELECTIVE	3		
DATA 698 or 699	3	DATA 698 or 699	3		
Total Semester Hours	6	Total Semester Hours	6	Total Semester Hours	

Curriculum by Category*			
Required Courses (30 credit hours)	**Type**	**Elective Course (Choose 6 credit hours)****	**Type**
DATA 505 Computational Data Science and Analytics	Core	BIOL 612 Conservation Genetics	Elective
DATA 506 Mathematical Data Science and Analytics	Core	BIOL 649 Comparative Genomics	Elective
DATA 507 Scientific Computing in Data Science	Core	CSIS 602 Foundations of Software Engineering	Elective
or MATH 540 Statistical Learning	Core	CSIS 618 Programming Languages	Elective
DATA 510 Data Cleaning, Organization, Visualization	Core	CSIS 632 Data Communications and Networking	Elective
DATA 534 Machine Learning, Data Mining, Analytics	Core	CSIS 654 Software Requirements and Specifications	Elective
CSIS 604 Distributed Comp Systems Architecture	Core	CSIS 690 Special Topics in Computing	Elective
CSIS 638 Advanced Topics in Data Systems	Core	DATA 590 Special Topics in Data Science and Analytics	Elective
MATH 550 Linear Models	Core	EVSS 549 Geographic Information Systems	Elective
DATA 698 Practicum or 699 Thesis (6 hours)	Core	EVSS 569 Advanced GIS: Environmental and Hazards Models	Elective
		MATH 541 Statistical Learning II	Elective
		MATH 545 Numerical Analysis I	Elective
		MATH 551 Linear Programming and Optimization	Elective
		MATH 552 Operations Research	Elective
		MATH 555 Bayesian Statistical Methods	Elective
		MBAD 503 Financial Management	Elective
		MBAD 516 Financial Modeling	Elective
		MBAD 521 Consumer Marketing Strategy	Elective
		MBAD 522 Marketing Research & Analytics, Decision Making	Elective
		MBAD 525 Marketing Management	Elective

* Add category titles to the table (e.g., major, core, general education, concentration, electives, etc.)

** Although students are free to take any two elective courses, the following sets of electives provide some guidance for students wishing to pursue the following career specializations: Machine Learning and Optimization (pick two from MATH 541, 551, 555), Modeling and Software Engineering (pick two from CSIS 602, 618, 632), Computational Data Science (pick two from MATH 545, 551, 552), Business Analytics (pick 2 from MBAD 503, 516, 521, 522, 525), Natural and Physical Sciences (pick two from BIOL 612, 649, EVSS 549, 569). CSIS courses are part of the joint Master's Computer and Information Sciences degree program offered with The Citadel.

Total Credit Hours Required 36

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Course Descriptions for New Courses

Course Name	Description
DATA 505 Computational Data Science and Analytics	This course covers key concepts in programming, pipeline development, data structures, algorithms, and complexity that are foundational to the fields of data science and analytics.
DATA 506 Mathematical Data Science and Analytics	This course covers key concepts from linear algebra, optimization, probability and statistics, calculus, and discrete mathematics that are foundational to the fields of data science and analytics.
DATA 507 Scientific Computing in Data Science	This course covers the role of the scientific method in applied data science with a focus on topics such as incomplete data, temporal cadence, systematic biases, rejection of outlier data, constraints on the mathematical modeling systems arising from underlying scientific considerations, experimental design, signal to noise, time-dependent modeling, ensemble modeling, statistical image analysis, and scientific numerical methods.
DATA 510 Data Cleaning, Organization, & Visualization	This course will cover the systems and strategies for cleaning, wrangling, organizing, querying, and visualization of data streams and big data.
DATA 534 Machine Learning, Data Mining, and Analytics	This course will cover the concepts and methods of machine learning, analytics, and data mining. Students will implement and use state-of-the-art machine learning algorithms for knowledge discovery.
DATA 590 Special Topics in Data Science and Analytics	An intense investigation of an area of current interest in data science and analytics. Lectures three hours per week. Repeatable for up to 6 credit hours when course content varies.
DATA 698 Practicum in Data Science and Analytics	Students will demonstrate their knowledge, skills, and dispositions for performing applied data science assignments in a professional setting. Students already employed in a data science field must perform additional data science tasks outside of their preexisting responsibilities. May be repeated for up to 6 credit hours.
DATA 699 Thesis in Data Science and Analytics	Thesis in Data Science and Analytics is a three credit hour course for the completion of a formal master's research thesis under faculty direction. A Research Thesis is a traditional research project characterized by a comprehensive paper on a research topic. This course may be repeated for up to 6 credit hours.

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Faculty

Faculty and Administrative Personnel					
Faculty	**Rank**	**Full- or Part-time**	**Courses Taught or To be Taught, Including Term, Course Number & Title, Credit Hours**	**Academic Degrees and Coursework Relevant to Courses Taught, Including Institution and Major**	**Other Qualifications and Comments (i.e., explain role and/or changes in assignment)**
Paul Anderson	Assistant Professor	Full	CSIS 604 (Fall) DATA 534 (Spring) DATA 505 (Summer)	Ph.D. in Computer Science and Engineering from Wright State University	Director of BS in Data Science
Aspen Olmsted	Assistant Professor	Full	CSIS 638 (Spring)	Ph.D. in Computer Science from University of South Carolina	Director of MS in Computer and Information Sciences
Jim Young	Senior Instructor	Full	MATH 540 (Fall) MATH 541 (Spring)	Ph.D. in Statistics from UC Berkeley	
Martin Jones	Professor	Full	MATH 550 (Spring) DATA 506 (Summer)	Ph.D. in Mathematics from GA Tech	Director of MS in Mathematical Sciences
Jon Hakkila	Professor	Full	DATA 507 (Spring)	Ph.D. in Astronomy from New Mexico State University	Associate Dean of the Graduate School
New hire	Assistant Professor	Full	DATA 510 (Fall) DATA 590 (Spring)		
*Various		Full	Electives		
**Various		Full	DATA 699		

Note: Individuals should be listed with program supervisor positions listed first. Identify any new faculty with an asterisk next to their rank.

* Elective courses will be taught by various professors in the Math, Business, etc departments, all of whom will be properly credentialed in accordance with College policy: http://academicaffairs.cofc.edu/procedures-and-practices/credentials/.
** The following (full time, tenure/tenure-track) College of Charleston faculty members have indicated an interest in mentoring master's theses: Anthony Leclerc, Computer Science, Garrett Mitchener, Mathematics, Bill Manaris, Computer Science, Martin Jones, Mathematics, Paul Anderson, Computer Science, Joe Carson, Physics, William Bares, Computer Science, Dan McGlinn, Biology, Leslie Suatter, Geology, Erik Sotka, Biology, Andrew Shedlock, Marine Genomics, Adem Ali, Geology, Dinesh Sarvate, Mathematics, Tim Callahan, Geology, Chris Fragile, Physics, Jon Hakkila, Physics, Bernhard Lindner, Physics, Mike Larsen, Physics, Jim Bowring, Computer Science, Eric McElroy, Biology, Norman Levine, Geology

Total FTE needed to support the proposed program (i.e., the total FTE devoted just to the new program for all faculty, staff, and program administrators):

Faculty	1/3	Staff	1/10	Administration	1/5

Faculty /Administrative Personnel Changes

Provide a brief explanation of any additional institutional changes in faculty and/or administrative assignment that may result from implementing the proposed program. (1000 characters)

Departmental administrative duties will be supported by existing staff, director and department chair personnel. One third of a new faculty line will be dedicated to teaching courses required by this new program.

Library and Learning Resources

Identify current library/learning collections, resources, and services necessary to support the proposed program and any additional library resources needed. (1000 characters)

The College of Charleston libraries are structured around one main library, the Marlene and Nathan Addlestone Library, with smaller, more specialized libraries that support the diverse teaching and research needs of the institution. The Addlestone Library encompasses 140,000 square feet, accommodates up to one million volumes, seats 1,600 patrons, offers 20 study group rooms, and maintains over 239 computer workstations. The facility was designed to accommodate the technological needs of a contemporary academic library. The computer workstations are equipped with links to several web browsers, a suite of Microsoft Office software, statistical software packages, and other standard computer applications. These computers are networked to seven high capacity laser printers; one color printer is also available. In addition to the desktop computers, students may borrow one of 20 laptops equipped with wireless internet hardware and software for use within the building and grounds, 3 flip cameras and 2 iMac computers with video editing capabilities. There are 60 iPads to enhance student learning in the classroom, including 5 iPads that students can check out at any time. Wireless access is available throughout the library.

The libraries' collection consists of over 1,085,194 cataloged monographs, serials and other hard copy items, including 13,472 audiovisual items in the media collection and 3,202 print subscriptions to journals and other periodicals. Print subscriptions are supplemented by 388,290 electronic books and 110,032 electronic journals which are available online and available 24/7/365. All faculty and students with a valid College of Charleston account may access electronic resources from anywhere in the world.

The library is a member of the Partnership among South Carolina Academic Libraries (PASCAL), a consortium of the state's academic libraries together with their parent institutions and state agency partners. PASCAL fosters cooperation on a broad range of issues including shared licensing of electronic resources (including unlimited access to over 200,000 e-book titles from major publishers and university presses) and universal borrowing.

Other significant materials can be found in the Lowcountry Digital Library. Established by the College in 2009, the Lowcountry Digital Library (LCDL) produces digital collections and projects that support research about the Lowcountry region of South Carolina and historically interconnected sites in the Atlantic World. LCDL is committed to a multifaceted approach that incorporates historical and anthropological scholarship, oral history, integrative archival practices, digital librarianship, and spatial, temporal, and environmental information. Together with its institutional partners, LCDL helps students, scholars, and a wide range of public audiences develop a better understanding of the history and culture of the South Carolina Lowcountry relative to the nation and the world. In order to provide a well-rounded digital collection, the library works with over 17 partner institutions across the coastal region of South Carolina and Barbados to digitize and describe unique local resources while adhering to national best practices and standards, ensuring the overall quality, accessibility and sustainability of these digital resources.

In addition to material and technology resources, the libraries' employ 27 tenure track faculty librarians. Librarian assistance in research, instruction, and digital scholarship is available for faculty and students. In addition, the Ask Us service provides basic research and computing assistance, both online and in person, through a combination of librarians, library staff, information technology professionals, and student employees.

The Addlestone Library completed a major renovation project in Summer 2014, adding 200 seats for students, new outlets for charging laptops, tablets and other mobile devices, and a new high tech lecture room that doubles as added study space for students.

Student Support Services

Identify academic support services needed for the proposed program and any additional estimated costs associated with these services. (500 characters)

In addition to library and learning resources a number of academic and student support resources are available to graduate students at the College of Charleston.

- Information Technology: A variety of computing resources are available to graduate students, including a COUGARS email account, student computing system assistance. A dedicated student Help Desk is available to students via email or telephone.

- Center for Disability Services: The College of Charleston is committed to ensuring that all graduate programs and services are accessible to a diverse

student population. The center provides reasonable and effective accommodations to facilitate student learning, and offers educational opportunities to students, faculty and staff that enhance understanding the broad spectrum of disabilities and promote an environment of institutional respect for disabilities.

- Office of Research and Grants Administration (ORGA): ORGA is the central resource for information and assistance regarding major government agencies, foundations, and corporations which support research and scholarship. A dedicated staff is available to provide faculty, graduate students, and administrators with assistance in identifying extramural funding sources, developing funding and completing proposals, narratives and budgets, assuring compliance with federal and state regulations; negotiating grant awards and contracts; and administering funded projects.

- Center for Student Learning (CSL): CSL provides students with academic assistance to facilitate effective learning strategies. Supplemental instruction, study groups and study skills seminars are scheduled throughout each semester.

- Career Center: The Career Center is a multifaceted resource center with a goal of educating and assisting students in preparing for transition to the dynamic work environment.

- Bookstore: Barnes & Noble College Booksellers manages the College of Charleston Bookstore which houses an extensive selection periodicals, best sellers, and feature titles that reflect the breadth and dept of scholarship at the college.

- Cougar Card Services: All graduate students will receive a Cougar Card. This official College of Charleston identification card connects students to all campus resources.

- Resource Coordinator: The Resource Coordinator acts as impartial party who gives guidance and/or explanations of policies and procedures for employees, faculty and students who encounter problems arising from the operation of the college and who request assistance in identifying the proper person, office, policy, or procedure that can best address their particular situation.

- Dining Services: A variety of dining options located throughout the College of Charleston campus are available to graduate students.

- Attorney Assistance Program: Up to one hour of legal services are available on a pro bono basis to students who face a variety of personal or financial legal difficulties.

- Campus Recreation Services: A number of fitness facilities are available to students to enhance their overall physical wellness.

- Counseling and Substance Abuse Services: The mission of Counseling and Substance Abuse Services is to increase student psychological resilience and personal growth to support persistence and success in school.

- Student Health Services: The Student Health Service provides quality primary health care in an ambulatory setting. The center provides students with access to early diagnosis and treatment of the conditions which they have or develop while in attendance at the College, and promotes awareness of the importance of regular health maintenance.

- Office of Victims Services: Service are available to College of Charleston students whether the crime occurs on or off campus, or whether the student elects to file an official police report or not. Certified victim assistance specialists provide support for both short and long-term issues associated with trauma and victimization issues, and help students address issue related to the crime and its impact on the college experience.

- Office of Institutional Diversity (OID): The Office of Institutional Diversity offers education, training, resources, and support for all students, faculty, and staff. OID fosters and advocates for a globally diverse campus at the College of Charleston.

Physical Resources

Identify any new instructional equipment needed for the proposed program. (500 characters)

None.

Will any extraordinary physical facilities be needed to support the proposed program?

☐Yes

☒No

Identify the physical facilities needed to support the program and the institution's plan for meeting the requirements, including new facilities or modifications to existing facilities. (1000 characters)

The College of Charleston's campuses have adequate space to support the Data Science and Analytics program. Courses within this new program will be taught in existing classroom space. No physical plant modifications are necessary to implement this program.

The College manages and maintains 157 facilities to include numerous buildings for instructional use. These buildings and classrooms are equipped with projectors and computers for adequate instruction. Beyond its historic main campus, the College utilizes three off-campus instructional locations (North Campus, Grice Marine Laboratory, and 701 East Bay Street, Charleston, SC 29403) to fulfill its academic programming, support services, and administrative needs. The College operates and maintains its physical facilities in a manner that supports its strategic plan, academic programs, support services, and other mission-related activities. This is accomplished through routine maintenance, repairs, grounds maintenance, energy management, custodial services, engineering, construction, space management, and capital planning.

NEW PROGRAM PROPOSAL

Financial Support

Estimated New Costs by Year						
Category	**1st**	**2nd**	**3rd**	**4th**	**5th**	**Total**
Program Administration *(director stipend)*						
Faculty and Staff Salaries *(1/3 of a new Faculty Hire: based on 1/3 * 90k + 40% fringe = 42k)*	$42,000	$42,000	$42,000	$42,000	$42,000	$210,000
Grad. Assistants (3 x 16k then 6 x 16k)	$48,000	$96,000	$96,000	$96,000	$96,000	$432,000
Equipment						
Facilities						
Supplies and Materials						
Library Resources						
Other*						
Total	$90,000	$138,000	$138,000	$138,000	$138,000	$642,000
Sources of Financing						
Category	**1st**	**2nd**	**3rd**	**4th**	**5th**	**Total**
Tuition Funding[1]	$134,856	$337,140	$404,568	$471,996	$471,996	$1,820,556
Program-Specific Fees						
State Funding (i.e., Special State Appropriation)*						
Reallocation of Existing Funds*						
Federal Funding*						
Other Funding*						
Total	$134,856	$337,140	$404,568	$471,996	$471,996	$1,820,556
Net Total (i.e., Sources of Financing Minus Estimated New Costs)	$44,856	$199,140	$266,568	$333,996	$333,996	$1,178,556

*Provide an explanation for these costs and sources of financing in the budget justification.

[1] Tuition funding is based on an in-state/out-of-state ratio of 90%/10%, projected enrollments, and a calculation of per credit hour rate for tuition of $484 in-state/$1263 out-of-state.

NEW PROGRAM PROPOSAL

Budget Justification

Provide a brief explanation for the other new costs and any special sources of financing (state funding, reallocation of existing funds, federal funding, or other funding) identified in the Financial Support table. (1000 characters)

Note: Institutions need to complete this budget justification *only* if any other new costs, state funding, reallocation of existing funds, federal funding, or other funding are included in the Financial Support table.

No other new costs, state funding, reallocation of existing funds, federal funding, or other funding is required.

NEW PROGRAM PROPOSAL

Evaluation and Assessment

Programmatic Assessment: Provide an outline of how the proposed program will be evaluated, including any plans to track employment. Identify assessment tools or software used in the evaluation. Explain how assessment data will be used. (3000 characters)

It is the responsibility of the director to directly and indirectly assess the learning objectives of the program. Indirect assessment includes coordinating the data science track of the annual (external) industrial advisory board which is already established, as well as tracking employment status of graduates.

For direct assessment, Student Learning Objective assessment will be tracked and documented each year using the Compliance Assist software package. This system is already being used by the other programs in the department, including the undergraduate data science degree program. At the start of each academic year, the program director plans out the assessment assignments for the year. Each outcome will be directly assessed in at least two courses every year. The resulting data tables and rubrics are collected by the director and discussed with the faculty so that changes to the curriculum/methodology/etc can be initiated. The following curriculum map shows how the learning objectives are tied to the required/core coursework (I - Introduction, R - Reinforcement, D – Demonstrate):

Program Outcome Description	DATA 505	DATA 506	DATA 507	DATA 510	DATA 534	CSCI 604	CSCI 638	MATH 540/550	DATA 698	DATA 699
1. Graduates will demonstrate advanced applied knowledge computer programming, data organization, data mining, data visualization, and algorithms.	I		R	R	R	R	R		D	D
2. Graduates will demonstrate an advanced understanding in the core area of mathematics and statistics, including optimization, machine learning, regression, and linear algebra.		I	R	R	R			R	D	D
3. Graduates will demonstrate an application of their data science graduate coursework through the successful completion of a Practicum Experience or Research Thesis.									D	D

Student Learning Assessment

Expected Student Learning Outcomes	Methods of/Criteria for Assessment
1. Graduates will demonstrate advanced and applied knowledge of computer programming, data organization, data mining, data visualization, and algorithms.	Measure 1. Direct assessment with questions on the Final Exam in DATA 505. This assessment at the beginning of the program aids in determining the efficacy of the entrance exam, the quality of the students being recruited into the program, and the students' performance after the first computing-heavy course in the curriculum. Target: We expect 80% of the students will achieve acceptable performance according to the rubric. Measure 2. Direct assessment at the end of the program with an exit exam administered during the final semester. Target: We expect 80% of the students will achieve acceptable performance according to the rubric. Administered by the program director.
2. Graduates will demonstrate an advanced understanding in the core area of mathematics and statistics, including optimization, machine learning, regression, and linear algebra.	Measure 1. Direct assessment with questions on the Final Exam in DATA 506. This assessment at the beginning of the program aids in determining the efficacy of the entrance exam, the quality of the students being recruited into the program, and the students' performance after the first Math-heavy course in the curriculum, Target: We expect 80% of the students will achieve acceptable performance according to the rubric. Measure 2. Direct assessment at the end of the program with an exit exam administered during the final semester. Target: We expect 80% of the students will achieve acceptable performance according to the rubric. Administered by the program director.
3. Graduates will demonstrate an application of their data science graduate coursework through the successful completion of a Practicum Experience or Research Thesis.	Measure 1: Successful completion of bi-weekly reports during practicum experience or midterm report for Thesis. Target: We expect 90% of the students will successfully produce a mid-term report (determined by a Thesis Committee) or produce acceptable bi-weekly reports for their practicum experience (determined by a rubric). Measure 2: Successful completion of an acceptable final technical report from a practicum experience, or the defense of a Thesis. Target: We expect 90% of the students will successfully defend their Thesis (determined by a Thesis Committee) or produce an acceptable final report for their practicum experience (determined by a rubric).

NEW PROGRAM PROPOSAL

Will the proposed program seek program-specific accreditation?

☐Yes

☒No

If yes, provide the institution's plans to seek accreditation, including the expected timeline for accreditation. (500 characters)

Will the proposed program lead to licensure or certification?

☐Yes

☒No

If yes, explain how the program will prepare students for licensure or certification. (500 characters)

NEW PROGRAM PROPOSAL

Teacher or School Professional Preparation Programs

Is the proposed program a teacher or school professional preparation program?

☐Yes

☒No

If yes, complete the following components.

Area of Certification

Please attach a document addressing the South Carolina Department of Education Requirements and SPA or Other National Specialized and/or Professional Association Standards.