

**New Program Proposal  
 Master of Science in Data Science and Analytics  
 Clemson University**

**Executive Summary**

Clemson University requests approval to offer the program leading to the Master of Science in Data Science and Analytics to be implemented in Summer 2019. The proposed program is to be offered through online delivery. The following chart outlines the stages of approval for the proposal. The Advisory Committee on Academic Programs (ACAP) voted to recommend approval of the proposal. The full program proposal and support documents are attached.

<b>Stages of Consideration</b>	<b>Date</b>	<b>Comments</b>
Program Proposal Received	8/1/18	Not Applicable
ACAP Consideration	9/27/18	<p>Clemson University (CU) representatives introduced the proposed Master of Science (MS) degree in Data Science and Analytics, citing the program is a joint initiative between the institution’s mathematics and management departments. The representatives stated that the program complements the economics of the state and that several local industries provided input and feedback on the program. Additionally, online modality makes the program available to current professionals in the workplace.</p> <p>The Clemson representatives also explained the cost-to-revenue ratio of the program is driven by high demand, citing that the high demand for this type of program is reflected in the high salaries for data science and analytics related positions and notable competition with private markets.</p> <p>Commission staff inquired about the anticipated robust enrollment for the program. The representatives stated that there is already interest in the program and the anticipated enrollment is a realistic expectation.</p> <p>After remaining discussion, ACAP voted to recommend approval of the program proposal. Staff transmitted remaining questions for additional clarity.</p>
Comments and suggestions from CHE staff sent to the institution	10/1/18	<p>Staff requested the proposal be revised to:</p> <ul style="list-style-type: none"> <li>• Explain the 60% margin in budget and how the budget for the administrator is calculated;</li> <li>• Clarify the method of calculation for the projected enrollment calculated.</li> </ul>
Revised Program Proposal Received	10/8/18	The revised proposal satisfactorily addressed the requested revisions.

**Recommendation**

The staff recommends the Committee on Academic Affairs and Licensing approve the program leading to the Master of Science in Data Science and Analytics to be implemented in Summer 2019.

**Clemson University Student and Program Data**

<b>Graduate In-/Out-of-State Enrollment, Fall 2017</b>	2,058 (41.28%) / 2,927 (58.72%)
<b>Number of Approved Programs in 10 Yrs. (FY 2007- 2017)</b>	37
<b>Number of Terminated Programs in 10 Yrs. (FY 2007- 2017)</b>	18

**Industry related Occupational Wages and Projections in South Carolina, 2014 – 2024\***

<b>Occupational Field<sup>1</sup></b>	<b>2016 Median Income<sup>2</sup></b>	<b>2014 Estimated Employment<sup>3</sup></b>	<b>2024 Projected Employment</b>	<b>Total 2014-2024 Employment Change</b>	<b>2014-2024 Annual Avg. Percent Change</b>	<b>Total Percent Change</b>
Computer and Mathematical	\$66,270	39,597	45,397	5,800	1.38%	14.65%

<sup>1</sup> “Occupational Field” represents the closest related occupation category that includes the occupations aligned with the program proposal.

<sup>2</sup> SC Department of Employment & Workforce (DEW), Labor Market Information. (2018). Occupational Wage Rates for Multiple Occupations in South Carolina in 2014-2024 [Data file]. Retrieved from <https://jobs.scworks.org/vosnet/lmi/default.aspx?pu=1>

<sup>3</sup> SC Department of Employment & Workforce (DEW), Labor Market Information. (2018). Occupational Projections (Long-term) for Multiple Occupations in South Carolina in 2014-2024 [Data file]. Retrieved from <https://jobs.scworks.org/vosnet/lmi/default.aspx?pu=1>

\* Data downloaded October 8, 2018

**NEW PROGRAM PROPOSAL FORM**

Name of Institution: Clemson University

Name of Program (include degree designation and all concentrations, options, or tracks):  
M.S., 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.)

Consider the program for supplemental Palmetto Fellows and LIFE Scholarship awards?

- Yes  
 No

Proposed Date of Implementation: July/August 2019

CIP Code: 30.3001

Delivery Site(s): Online (85750) only

Delivery Mode:

- Traditional/face-to-face                       Distance Education  
\*select if less than 25% online                       100% online  
 Blended/hybrid (50% or more online)  
 Blended/hybrid (25-49% online)  
 Other distance education (explain if selected)

Program Contact Information (name, title, telephone number, and email address):

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Institutional Approvals and Dates of Approval (include department through Provost/Chief Academic Officer, President, and Board of Trustees approval):

Mathematical Sciences Department Grad Affairs Committee: September 21, 2017  
Management Department Faculty: November 2, 2017  
Mathematical Science Council: September 26, 2017  
College of Business Curriculum Committee: November 10, 2017  
College of Science Curriculum Committee: November 28, 2017  
University Graduate Curriculum Committee: January 12, 2018  
Board of Trustees: February 2, 2017

## Background Information

### State the nature and purpose of the proposed program, including target audience, centrality to institutional mission, and relation to the strategic plan.

This 30-credit hour online program will combine Mathematical Sciences and Management courses to train students to use, manage, and apply data science and analytics in a variety of industries and workplace scenarios. The courses offered are similar to existing courses but will be modified to include examples of relevant data science applications. Fields of application consider the unique economic landscape of the state and region and would include but are not limited to marketing, healthcare administration, manufacturing, and military fields. Likewise, the application-based learning environment will align with Clemson University's strategic plan initiative of promoting real-world problem-solving experiences that foster student learning. Furthermore, this program provides a unique degree in that it promotes expertise in both the Management and Statistics fields while offering the program broadly through online delivery. Online delivery will increase the number and quality of students and graduates with expertise in data science and analytics, and allow Clemson University to better compete in a worldwide market with other institutions offering similar degree programs. The format will also accommodate students having an extant professional career the opportunity to advance their workforce value.

The target audience for this program includes working professionals looking to gain an education in data analytics to further their careers. This degree is a joint venture between the Management and Mathematical Sciences departments; as such, the graduates of this program will be uniquely prepared as data analysts with knowledge in business administration.

This online-only program has an estimated starting date of Summer 2019.

## Assessment of Need

### Provide an assessment of the need for the program for the institution, the state, the region, and beyond, if applicable.

IBM predicts that demand for Data Scientists will increase by 28% by 2020 (<https://www.forbes.com/sites/louiscolombus/2017/05/13/ibm-predicts-demand-for-data-scientists-will-soar-28-by-2020/#47dc948d7e3b>). Clemson currently has no general degree in data science at the Master's level. This program will fill a significant gap in professional Master's degrees available through Clemson.

This program directly supports Clemson University's *ClemsonForward* strategic plan that states the future of Clemson as having a "real impact on the greatest challenges of our time", having "real-world experiences that prepare students for what comes next", and a refocused mission into six innovation clusters—one of which is Big Data Science. Masses of data are produced daily by advancements in technologies; the ability to formulate decisions to complex problems based on data is certainly a challenge of our time. The very foundation of this program is having students use real-world data to formulate analysis for decisions.

While numerous organizations and publications have reported on the future need and demand for data scientists and analysts, the following companies have provided feedback on this program's proposed curriculum and expressed interest in hiring graduates of this new program:

- PikitDok, confirmed by Ted Tanner, CTO and Co-founder
- Hubbell Lighting, confirmed by Tom Cull, Director Enterprise Reporting
- BMW, confirmed by Kevin Carpenieri, Senior Network & Telecommunications Specialist, and by Craig Kargol, Big Data Product Manager and Solution Architect
- IBM, confirmed by Mac Devine, Vice President & CTO of Emerging Technology & Advanced Innovation
- Siemens, confirmed by Terry Royer, Senior Vice President Global Operations & Supply Chain at The Master Lock Company, and by Jim Fischer, Vice President
- Dollar Tree, confirmed by Kevin McKenzie, Chief Information Security Officer (CISO)

- Cummins, confirmed by Shajan Cyril Raj, Supply Chain Manager
- Duke Energy, confirmed by Sasha Weintraub, Senior Vice President, Customer Solutions

**Transfer and Articulation**

**Identify any special articulation agreements for the proposed program. Provide the articulation agreement or Memorandum of Agreement/Understanding.**

None.

**Employment Opportunities**

Occupation	State		National		Data Type and Source
	Expected Number of Jobs	Employment Projection	Expected Number of Jobs	Employment Projection	
Database Developer/Administrator	1,110 (current)	14.1% (by 2026)	119,500 (current)	11.5% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTerm">http://www.projectionscentral.com/Projections/LongTerm</a> AND <a href="https://www.bls.gov/ooh/computer-and-information-technology/database-administrators.htm">https://www.bls.gov/ooh/computer-and-information-technology/database-administrators.htm</a>
Computer and Information Research Scientists	360 (current)	3.4% (by 2026)	27,900 (current)	19.0% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTerm">http://www.projectionscentral.com/Projections/LongTerm</a> AND <a href="https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm">https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm</a>
Market Research Analysts	Not available	Not available	595,400 (current)	23.2% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTerm">http://www.projectionscentral.com/Projections/LongTerm</a> AND <a href="https://www.bls.gov/ooh/business-and-financial/market-research-analysts.htm">https://www.bls.gov/ooh/business-and-financial/market-research-analysts.htm</a>
Statisticians	410 (current)	37.8% (by 2026)	37,200 (current)	33.9% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTerm">http://www.projectionscentral.com/Projections/LongTerm</a> AND <a href="https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm">https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm</a>
Logisticians	3,070 (current)	19% (by 2026)	148,700 (current)	6.9% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTerm">http://www.projectionscentral.com/Projections/LongTerm</a> AND

					<a href="https://www.bls.gov/ooh/business-and-financial/logisticians.htm">https://www.bls.gov/ooh/business-and-financial/logisticians.htm</a>
Management Analysts	8,830 (current)	17.3% (by 2026)	806,400 (current)	14.3% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTermANDhttps://www.bls.gov/ooh/business-and-financial/management-analysts.htm">http://www.projectionscentral.com/Projections/LongTermANDhttps://www.bls.gov/ooh/business-and-financial/management-analysts.htm</a>
Financial Analysts	1,680 (current)	15.0% (by 2026)	296,100 (current)	10.8% (by 2026)	<a href="http://www.projectionscentral.com/Projections/LongTermANDhttps://www.bls.gov/ooh/business-and-financial/financial-analysts.htm">http://www.projectionscentral.com/Projections/LongTermANDhttps://www.bls.gov/ooh/business-and-financial/financial-analysts.htm</a>
<b>TOTAL</b>	15,460 (current)		2,031,200 (current)		

**Supporting Evidence of Anticipated Employment Opportunities**

**Provide supporting evidence of anticipated employment opportunities for graduates.**

While the occupations listed in the table above would certainly benefit from this Master’s program, they are not necessarily specific to a graduate with expertise in Data Science. The field of Data Science and Analytics is relatively new, and it lacks extensive historical data and consistent job titling that fully encapsulate the benefits of a Data Science and Analytics degree. The goal of the program is to produce graduates that can work with both Analysis Specialists and Managers/Administrators to encourage and promote educated, data-driven decisions. Fields of application for this type of graduate would include but not be limited to health care administration, marketing, finance, manufacturing, and military fields.

In creating this program, regional corporations were consulted on the curriculum and overall structure of the program. Positive feedback and interest was received from companies such as: PokitDok, Hubble Lighting, BMW, Siemens, Dollar Tree, Home Depot, Cummins, and Duke Energy. Representatives from these companies provided feedback on the curriculum, topics covered in the courses, the useful skills graduates of this program should possess in order to be marketable to employers. In addition to feedback, several companies expressed interest in providing company data, projects, and/or real-world problems for students to utilize and explore. Company representatives also shared a desire to see their current employees enroll as students in the program.

Therefore, irrespective of the demand for Data Science and Analytics degree-holders, this program is also developing professional networks and communication pipelines that will prove beneficial to program graduates, Clemson University, and regional industries.

**Description of the Program**

<b>Projected Enrollment</b>			
<b>Year</b>	<b>Fall Headcount</b>	<b>Spring Headcount</b>	<b>Summer Headcount</b>
<b>2019</b>			<b>35</b>
<b>2019-2020</b>	<b>35</b>	<b>35</b>	<b>40</b>
<b>2020-2021</b>	<b>75</b>	<b>40</b>	<b>40</b>
<b>2021-2022</b>	<b>80</b>	<b>40</b>	<b>45</b>
<b>2022-2023</b>	<b>85</b>	<b>45</b>	<b>45</b>

**Explain how the enrollment projections were calculated.**

The above numbers are based on a cohort model. Students will begin the program with a 3-credit hour course during the **latter half of the** first summer and then progress through three 9 credit hour fall/spring semesters. We anticipate 35 students the first year and then increasing to a maximum of 45 incoming students in subsequent years. When the program is at its maximum, each course will have 2 sections. After discussions with faculty, it was determined that the ideal number of students for effective teaching per section would be around 20-22 students or less. The numbers in the above table are based on full-time students, although there is a path for part-time students as well. We anticipate a mix of both full-time and part-time students.

There has been expressed interest in this program from several potential students. We believe this program will be extremely appealing to students particularly because of its online aspect. The program coordinator will continue to work closely with the Graduate School, the College of Science, and the College of Business to develop a comprehensive advertising and recruitment plan.

There are few programs that offer a master's degree consisting of the essential components of both data science and business management. The fully online format for this degree makes it available to a broader audience. The enrollment projections are based off of available information for other similar MS degree programs in the Data Science field. To provide a frame of reference for the proposed enrollment projections, below is a table of enrollments for similar programs currently offered around the country. Due to the online delivery method, the expressed interest from potential students, the expressed interest from regional corporations, and the joint disciplinary aspect of this degree we feel the enrollment projections of 35 – 45 students per cohort (85 overall enrolled) are realistic.

University	Degree Name	Delivery Type	Enrollment
Johns Hopkins	MS in Data Science	Combination online and in person	120 Currently enrolled
University of Minnesota	MS Data Science	Combination Online and in person	34 Currently enrolled
University of Central Florida	MS in Statistical Computing – Data Mining Track	In person	60 currently enrolled
Harvard	MS Data Science	In person	40-50 ** per class
NC State	MS Analytics	In person	120 Currently enrolled
Penn State	MPS Data Analytics	In person	200 Currently enrolled
University of Tennessee	Masters in Business Analytics	In person	38 Full Time 6 Part time Currently enrolled
Bentley University	MS Business Analytics	In person	95 Currently enrolled
Texas A&M	MS Analytics	Online	45 / 65 ** Class 2018/Class 2019

\*\* These numbers are per class/cohort not overall currently enrolled students

Note: There are some smaller programs as well but this table is to illustrate the universities that have medium to large programs as is the intent at Clemson University.

References:

<http://magazine.amstat.org/blog/2018/04/01/masters-and-doctoral-programs-in-data-science-and-analytics/>

[http://magazine.amstat.org/blog/2017/12/01/master\\_doctorate\\_program/](http://magazine.amstat.org/blog/2017/12/01/master_doctorate_program/)

<http://magazine.amstat.org/blog/2017/06/01/masters-programs2/>

<http://magazine.amstat.org/blog/2017/04/01/mastersprograms2017/>

**Besides the general institutional admission requirements, are there any separate or additional admission requirements for the proposed program? If yes, explain.**

Yes

No

Students will need a background that includes some mathematical knowledge either through course work (e.g., Statistics, Quantitative Research/Analysis, or other Mathematics courses) or related job experiences. It is



preferred that potential students have some Statistical knowledge and some quantitative reasoning skills. There are no specific degree requirements other than a bachelor's degree.

## Curriculum

### New Courses

**List and provide course descriptions for new courses.**

Five of the courses in the curriculum will be housed and taught by the Management Department at Clemson University. The other 5 will be housed and taught by the Mathematical Sciences Department at Clemson University.

#### Mathematical Sciences Department Courses:

##### DSA 8030 – Introduction to Statistical Computing

Introduction to statistical computing packages. Topics include data importation, reports, basic descriptive statistic computation, basic graphic preparation, and statistical analysis methods and procedures. Applications specific to Data Science and Analytics.

##### DSA 8010 – Statistical Methods I

Application of statistics in research; estimation, test of significance, analysis of variance, multiple comparison techniques, basic designs, mean square expectations, simple and multiple regression. Examples in Data Science topics of interest.

##### DSA 8420 – Advanced Mathematical Programming

Theory, methodology, and applications of integer and nonlinear programming. Topics include model development, computer solutions, branch and bound, unconstrained and constrained optimization algorithms, complexity and convergence analysis. Case studies in Data Science & Analytics are included.

##### DSA 8020 – Statistical Methods II

Extended coverage of methods introduced in DSA 8010: multiple regression; experiment design; nonparametric methods; mixed models; categorical data analysis; multivariate methods and sampling designs; use of statistical software. Case studies in Data Science and Analytics will be explored.

##### DSA 8070 – Multivariate Analysis

Applications in Data Science and Analytics multivariate analysis: computer plots of multivariate observations; multidimensional scaling; multivariate tests of means, contrivances and equality of distribution; univariate and multivariate regressions and their comparisons; MANOVA; principal components analysis; factor analysis.

#### Management Department Courses:

##### DSA 8280 - Introduction to Business Intelligence and Analytics for Managerial Decision Making

Online course designed to introduce common language, terminology and concepts related to business analytics as well as basic statistical concepts and skills. Examples will be given that are specific to the Data Science and Analytics field.

##### DSA 8640 – Analytics and Application

It is essential to understand how to develop analytics application in organizations. That is, we develop an analytics application in complex organizational contexts. This course aims to understand how such a development process is implemented at both the system level and the technical level.

##### DSA 8660 – Data Management & Warehousing

The course aims to focus on business advantages and potential of data assets. Emphasis on case studies and corporate data to explore operational and business intelligence in managerial decision making.

DSA 8670 - Business Analytics Application and Projects

This course aims at deepening students' understanding of business analytics through practical case studies and projects. This course will give students opportunities to conduct analysis using business analytics software applications. Students are expected to apply business analytics skills to solve real-world problems.

DSA 8590 – Managerial Decision Making

Survey of decision modeling techniques useful in managerial decision making, including linear programming, project management, queuing models, transportation problems and Monte Carlo simulation

Total Credit Hours Required: **30**

The following curriculum would be the path for full-time students.

Curriculum by Year					
Course Name	Credit Hours	Course Name	Credit Hours	Course Name	Credit Hours
<b>Year 1</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
				DSA 8280 – Introduction to Business Intelligence and Analytics for Managerial Decision Making Bootcamp	3
Total Semester Hours		Total Semester Hours		Total Semester Hours	3
<b>Year 2</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
DSA 8030 – Introduction to Statistical Computing	3	DSA 8420 – Advanced Mathematical Programming	3		
DSA 8010 – Statistical Methods I	3	DSA 8020 – Statistical Methods II	3		
DSA 8640 – Analytics and Application Development	3	DSA 8660 – Data Management & Warehousing	3		
Total Semester Hours		Total Semester Hours		Total Semester Hours	
<b>Year 3</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
DSA 8070 – Multivariate Analysis	3				
DSA 8670 – Business Analytics Application and Projects	3				
DSA 8590 – Managerial Decision Making	3				
Total Semester Hours		Total Semester Hours		Total Semester Hours	

The following curriculum would be the path for part-time students.

Curriculum by Year					
Course Name	Credit Hours	Course Name	Credit Hours	Course Name	Credit Hours
<b>Year 1</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
				DSA 8280 – Introduction to Business Intelligence and Analytics for Managerial Decision Making Bootcamp	3
Total Semester Hours		Total Semester Hours		Total Semester Hours	3
<b>Year 2</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
DSA 8010 – Statistical Methods I	3	DSA 8420 – Advanced Mathematical Programming	3		
DSA 8640 – Analytics and Application Development	3	DSA 8020 – Statistical Methods II	3		
Total Semester Hours	6	Total Semester Hours	6	Total Semester Hours	
<b>Year 3</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
DSA 8070 – Multivariate Analysis	3	DSA 8660 – Data Management & Warehousing	3		
DSA 8030 – Introduction to Statistical Computing	3				
Total Semester Hours	6	Total Semester Hours	3	Total Semester Hours	
<b>Year 4</b>					
<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
DSA 8670 – Business Analytics Application and Projects	3				
DSA 8590 – Managerial Decision Making	3				
Total Semester Hours	6	Total Semester Hours		Total Semester Hours	

Total Credit Hours Required: **30**

**Similar Programs in South Carolina offered by Public and Independent Institutions**

Identify the similar programs offered and describe the similarities and differences for each program.

Program Name and Designation	Total Credit Hours	Institution	Similarities	Differences
Post-Bacc Certificate in Business Analytics	12	University of South Carolina	Focused in training business individuals to explore data analysis methods	This is a graduate certificate obtained after MBA, as opposed to a Master's program.  This graduate certificate is not an online program.
Post Bacc Certificate – Data Analytics	18	Furman University	Objective to provide professionals with a foundation in the applied practices of computer science, statistics, and intellectual disciplines.	This is a post-baccalaureate certificate not a Master's program.  This certificate is not an online program.
BS – Data Science Emphasis in Analytics	74	College of Charleston	This program focuses on the mathematics and computer science contributions to data science.	This is an undergraduate program. Graduates from this program would make good candidates for our MS degree.
MS Biomedical Data Science and Informatics	32-34	Clemson University	Applies concepts and methods from computer science and quantitative disciplines with principles of information science.	Focus is on the application to problems in biology, medicine, and public health. Not an online program.
PhD Biomedical Data Science and Informatics	65-68	Clemson University & MUSC (Joint Program)	Applies concepts and methods from computer science and quantitative disciplines with principles of information science.	Research-oriented doctoral degree. Not an online program
MS in Data Science and Analytics	36	College of Charleston (Starting Fall 2018)	Program is focuses on big data and development of data scientists.	This is <u>not</u> an online program and does not have emphasis on business analytics

**Faculty**

Rank and Full- or Part-time	Courses Taught for the Program	Academic Degrees and Coursework Relevant to Courses Taught, Including Institution and Major	Other Qualifications and Relevant Professional Experience (e.g., licensures, certifications, years in industry, etc.)
Assistant Professor 1*	Statistical Methods I (3)  Advanced Mathematical Programming (3)  Statistical Methods II (3)  Multivariate Analysis (3)  Introduction to Statistical Computing (3)	Will Begin Fall 2018	New faculty in Mathematical Sciences Department
Assistant Professor 2*	Statistical Methods I (3)  Advanced Mathematical Programming (3)  Statistical Methods II (3)  Multivariate Analysis (3)  Introduction to Statistical Computing (3)	TBD – Will be hired 2019-2020	New faculty in Mathematical Sciences Department
Assistant Professor 3*	Introduction to Business Intelligence and Analytics for Managerial Decision Making Bootcamp (3)  Analytics and Application Development (3)  Data Management & Warehousing (3)  Business Analytics Application and Projects (3)  Managerial Decision Making	TBD – Will be hired 2019-2020	New faculty in Management Department
Assistant Professor 4*	Introduction to Business Intelligence and Analytics for Managerial Decision Making Bootcamp (3)  Analytics and Application Development (3)  Data Management & Warehousing (3)	TBD – Will be hired 2019-2020	New faculty in Management Department

	Business Analytics Application and Projects (3)  Managerial Decision Making		
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Total FTE needed to support the proposed program:

Faculty: 2.5 FTE/yr

Staff: 0.5 FTE/yr

Administration: 0.15 FTE/yr

**Faculty, Staff, and Administrative Personnel**

**Discuss the Faculty, Staff, and Administrative Personnel needs of the program.**

Management: 2 Tenure-track 9-month Employees

Mathematical Sciences: 2 Tenure-track 9-month Employees; 50% of existing administrative staff support; 1 course release + 1 month summer for Program Coordinator

The best practice for graduate courses at this level is to have between 15-20 students per section. Within each department this program allows for 5 courses per year. Each course will have 2 sections each, a total of 10 sections per year. Faculty members typically teach 4 sections per year. Therefore, once the program is in its 2<sup>nd</sup> year with all courses running each department will need 2 new faculty members.

New hires will be required to in order to implement the program. In the first year, 1 assistant professor in Management and 1 assistant professor in Mathematical Sciences. In the second year, 1 additional assistant professor in each department will be needed. Four tenure track faculty members will be hired (two Assistant Professors in Management and two Assistant Professors in Mathematical Sciences), with appropriate compensation and start-up packages to secure top talent.

A faculty member (tenure track or lecturer) will be appointed to serve as Program Coordinator by the Chairs of the Departments of Management and Mathematical Sciences. The Program Coordinator will be given one course release per year PLUS one month of summer salary. This Coordinator will be assisted by an Administrative Coordinator. Approximately 1/8 of an existing faculty member’s time will be redirected to ensure successful program coordination. Fifty percent of an existing administrative staff person’s time will also be allocated for programmatic and operational support.

**Resources**

**Library and Learning Resources**

**Explain how current library/learning collections, databases, resources, and services specific to the discipline, including those provided by PASCAL, can support the proposed program. Identify additional library resources needed.**

The Clemson University Library holdings and electronic access are adequate to support the program. The Clemson University Libraries maintain online research resources specific to both the Mathematical Sciences and Business/Management in the form of field-specific print and e-books, as well as peer-reviewed journals (i.e., MathSciNet, Taylor & Francis, JSTOR, Marketing Research Reports, and Primary Industry Databases). The required resources for the proposed program are available through Interlibrary Loan and PASCAL, which are available to students and faculty without cost as they are covered by the RM Cooper Library existing budget. All major journals in our field are available online or through open access. No additional library resources are anticipated.

Overall, the Clemson University Libraries hold more than 1.8 million items including books, periodicals, electronic resources, digital media collections, government publications and patents, musical recordings, maps and microforms.

### **Student Support Services**

**Explain how current academic support services will support the proposed program. Identify new services needed and provide any estimated costs associated with these services.**

In addition to library and learning resources, a number of academic and student support services are available to all graduate students—including online students—at Clemson University:

- **Clemson Computing and Information Technology (CCIT)** - Provides a leading-edge integrated information environment integral to learning and research. Graduates students may (but are not limited to) take advantage of services such as Clemson email account, emergency text messages, mobile guidebooks, video conferencing, web development, and data storage. Help services are available via phone, email, or online chat.
- **Student Accessibility Services** – Graduate Students may register with Student Accessibility Services to use services such as academic access letters, assistive technology, communication services, test proctoring center and electronic textbooks.
- **Center for Career and Professional Development** – Clemson University is dedicated to engaging students in career development that will empower them to successfully pursue their educational and professional goals. Services provided by the career center include career workshops, resume writing, career development, job search assistance, and networking.
- **Legal Assistance** - All Clemson students are eligible to receive one legal aid voucher per semester. Each voucher entitles the student to one-half hour consultation with a lawyer off campus.
- **Counseling and Psychological Services (CAPS)** - Counseling and Psychological Services (CAPS), the mental health department of Student Health Services, offers a wide array of services along a continuum of intensity for various psychological issues.
- **Graduate Student Life** – Operating under the Division of Student Affairs, this is a central body that collaborates with the Graduate School and Graduate Student Government to enhance the overall graduate student life experience.
- **Clemson University Writing Center** – The goal of the writing center is to help all members of the Clemson community become more confident and effective writers.
- **The Harvey and Lucinda Gantt Multicultural Center** - The Harvey and Lucinda Gantt Multicultural Center is committed to creating diverse learning environments that enhance the intercultural competence of our students. The center supports and advocates for the needs of all students, challenges students to think critically about themselves and their communities, provides engaging experiential learning opportunities and empowers students to be positive change agents.
- **Clemson Online** - Clemson Online staff are here to ensure that all online students have access to the the same resources and support that a first-class Clemson education comprises for students enrolled in programs having in-person modalities. Clemson University is devoted to ensuring an innovative and substantive educational experience for all students.



**Physical Resources/Facilities**

**Identify the physical facilities needed to support the program and the institution's plan for meeting the requirements.**

As this is an online-only degree program, we do not anticipate a need for any new physical resources or instructional equipment. Any physical space needed for new faculty is already available within current facilities at Clemson University.

**Equipment**

Identify new instructional equipment needed for the proposed program.

Laptop computers will be provided to new faculty members within this degree program; the funds for these resources will be provided by the designated department. Any resources for video recording or specialized software are already available via Clemson Online or CCIT services. The program does not anticipate a need for new or additional instructional equipment beyond what is already offered to faculty.

**Impact on Existing Programs**

**Will the proposed program impact existing degree programs or services at the institution (e.g., course offerings or enrollment)? If yes, explain.**

Yes

No

**Financial Support**

**Sources of Financing for the Program by Year**

Category	1st Summer 2019		2nd 2019-20		3rd 2020-21		4th 2021-22		5th 2022-2023		Grand Total	
	New	Total	New	Total	New	Total	New	Total	New	Total	New	Total
Tuition Funding	\$178,500	\$178,500	\$1,313,250	\$1,313,250	\$2,083,077	\$2,083,077	\$2,257,028	\$2,257,028	\$2,496,941	\$2,496,941	\$8,328,796	\$8,328,796
Program-Specific Fees												
Special State Appropriation												
Reallocation of Existing Funds												
Feder, Grant or Other Funding												
<b>TOTAL</b>	<b>\$178,500</b>	<b>\$178,500</b>	<b>\$1,313,250</b>	<b>\$1,313,250</b>	<b>\$2,083,077</b>	<b>\$2,083,077</b>	<b>\$2,257,028</b>	<b>\$2,257,028</b>	<b>\$2,496,941</b>	<b>\$2,496,941</b>	<b>\$8,328,796</b>	<b>\$8,328,796</b>

**Estimated Costs Associated with implementing the Program by Year**

Category	1st		2nd		3rd		4th		5th		Grand Total	
	New	Total	New	Total	New	Total	New	Total	New	Total	New	Total
Program Administration, and Faculty and Staff Salaries	\$445,781	\$530,432	\$873,844	\$961,306	\$901,650	\$992,025	\$930,418	\$1,023,809	\$960,183	\$1,056,700	\$4,111,877	\$4,564,272
Facilities, Equipment, Supplies and Materials	\$239,276	\$239,276	\$335,731	\$335,731	\$296,367	\$296,367	\$253,932	\$253,932	\$183,682	\$183,682	\$1,308,988	\$1,308,988
Library Resources												
Other (Debt Service)	\$8,776	\$8,776	\$62,683	\$62,683	\$103,290	\$103,290	\$116,261	\$116,261	\$147,897	\$147,897	\$438,906	\$438,906
Other (Admin Overhead)	\$42,431	\$42,431	\$312,642	\$312,642	\$494,947	\$494,947	\$535,192	\$535,192	\$590,832	\$590,832	\$1,976,043	\$1,976,043
<b>TOTAL</b>	<b>\$736,264</b>	<b>\$820,915</b>	<b>\$1,584,899</b>	<b>\$1,672,362</b>	<b>\$1,796,254</b>	<b>\$1,886,628</b>	<b>\$1,835,803</b>	<b>\$1,929,194</b>	<b>\$1,882,594</b>	<b>\$1,979,110</b>	<b>\$7,835,814</b>	<b>\$8,288,209</b>
<b>Net Total (Sources of Financing Minus Estimated Costs)</b>	<b>\$(557,764)</b>	<b>\$(642,415)</b>	<b>\$(271,649)</b>	<b>\$(359,112)</b>	<b>\$286,823</b>	<b>\$196,449</b>	<b>\$421,225</b>	<b>\$327,833</b>	<b>\$614,347</b>	<b>\$517,831</b>	<b>\$492,982</b>	<b>\$40,587</b>

**Note:** New costs - costs incurred solely as a result of implementing this program. Total costs - new costs; program's share of costs of existing resources used to support the program; and any other costs redirected to the program.

## Budget Justification

Provide an explanation for all costs and sources of financing identified in the Financial Support table. Include an analysis of cost-effectiveness and return on investment and address any impacts to tuition, other programs, services, facilities, and the institution overall.

### Revenue Highlights:

- **Tuition and Fees:** Academic Tuition and Fees of \$1,700 per online credit hour for in-state and out-of-state students are proposed. Total estimated program cost is ~\$52K. Program degree length ranges from four terms for full-time students to six terms for part-time students. The financial plan assumes that tuition and fees grow at 3% annually.
  - No graduate assistantships or fellowships will be offered for students in this degree program.

### Expense Highlights:

- **Personnel Costs:**
  - Four tenure track faculty members will be hired (two Assistant Professors in Management and two Assistant Professors in Mathematical Sciences), with appropriate compensation and start-up packages to secure top talent.
- **Administration Costs**
  - \$48K of an existing faculty member's time will be redirected to ensure successful program coordination. Fifty percent of an existing administrative staff person's time will also be allocated for programmatic and operational support.
  - Additional course delivery costs, including summer pay, course delivery costs for Computer Science courses, and two graduate grading assistants at competitive stipends are included to support the program.
- **Operational Costs:**
  - Costs to ensure federal compliance as an online program, as well as \$50K annually for software licenses for students are included.
  - Other costs for travel and operational support for the four additional faculty members are included.
  - Marketing will be largely supported through the nationally recognized Clemson Online office, but additional funding is included for regional marketing efforts.
- **Other Costs:**
  - Administrative overhead, intended to represent general and administrative cost and required debt service to the state

**Cost Effectiveness and ROI:** The program is designed and its internal approval predicated on its prospective ability to sustainably support its costs with only a modest positive margin so as to remain affordable and priced within market-driven ranges.

We acknowledge that the program has a significant student-facing price. While this is supported by high demand and starting salaries, this price is ultimately driven by costs that stem in part from incorporating business components and expertise into this program. A close examination of the Financial Support table indicates that the program is not intended as a profit center—indeed, net margins are thin. Since the Total costs in the financial table include sunk costs the university is obligated to pay irrespective of the existence of this program, we believe the most meaningful view of cost effectiveness and return is based on the New costs and revenues that are solely associated with the existence of this program. In the context of this methodology, the positive \$492K margin of total 5-year revenues over costs represents a 6.3% return on the invested costs or a 5.9% return on student revenues. We believe these margins are

prudent and reasonable, and allow modest reinvestment in the program with the minimum burden on students (or their paying employers).

## Evaluation and Assessment

Program Objectives	Student Learning Outcomes Aligned to Program Objectives	Methods of Assessment
Graduates will demonstrate applied knowledge of managerial decisions based on mathematical models, data management, and statistical literacy.	<ul style="list-style-type: none"> <li>• Students utilize tools for statistical analysis of both large and small data sets</li> <li>• Students manage large amounts of data</li> <li>• Students apply advanced mathematical decision-making models to business scenarios</li> <li>• Students design data-guided managerial decisions</li> </ul>	Examinations and projects within curriculum <ul style="list-style-type: none"> <li>• DSA 8280 (Introduction)</li> <li>• DSA 8640 (Reinforcement)</li> <li>• DSA 8420 (Reinforcement)</li> <li>• DSA 8660 (Reinforcement)</li> <li>• DSA 8590 (Demonstrate)</li> </ul>
Graduates will demonstrate an advanced understanding statistical analysis tools, analysis software and data driven decisions tools.	<ul style="list-style-type: none"> <li>• Students produce detailed reports summarizing results of data analysis</li> <li>• Students utilize statistical software packages to conduct analysis of large datasets</li> <li>• Students apply managerial concepts to various workplace scenarios</li> </ul>	Examinations and projects within curriculum <ul style="list-style-type: none"> <li>• DSA 8030 (Introduction)</li> <li>• DSA 8010 (Reinforcement)</li> <li>• DSA 8020 (Reinforcement)</li> <li>• DSA 8070 (Demonstrate)</li> </ul>
Graduates will demonstrate an application of their data science and analytics graduate coursework through the completion of a relevant research project.	<ul style="list-style-type: none"> <li>• Students apply mathematical analysis and theoretical business decisions to real-word scenarios and case studies.</li> </ul>	Development and Execution of Research Project within DSA 8670

**Explain how the proposed program, including all program objectives, will be evaluated, along with plans to track employment. Describe how assessment data will be used.**

Means of assessment in addition to those done of the individual students among their curriculum courses will include but may not be limited to:

- Student tracking of course completion and performance as well as student ability to meet learning outcomes will be followed by the program coordinator via advising sessions and faculty discussions.
- Exit interviews and other forms of self-reporting involving graduates of the program to measure perceived program success and job placement
- Surveys/interviews with employers concerning the effectiveness of the program for producing useful, valuable employees in the field of data science.

The Program Coordinator in the Department of Mathematical Sciences as well as the Department Chairs of Management and Mathematical Sciences are responsible for ensuring the program's long-term viability, financial stability, and programmatic success. As with any new program, the risk for undersubscribed enrollment is possible. However, the program will be reviewed and evaluated to determine if the program is sustainable. Enrollment targets will be evaluated, and other necessary adjustments and mitigation plans developed, if needed. If the program experiences a downward trend in enrollment, the departments may discontinue the program, make additional investments in marketing of the program, or reallocate faculty to other endeavors.

### Accreditation and Licensure/Certification

**Will the institution seek program-specific accreditation (e.g., CAEP, ABET, NASM, etc.)? If yes, describe the institution's plans to seek accreditation, including the expected timeline.**

Yes

No

**Will the proposed program lead to licensure or certification? If yes, identify the licensure or certification.**

Yes

No

**Explain how the program will prepare students for this licensure or certification.**

Students may obtain the knowledge for passing the SAS Base Certification Exam. The course DSA 8030 Introduction to Statistical Computing will cover computational techniques through the SAS and R languages.

**If the program is an Educator Preparation Program, does the proposed certification area require national recognition from a Specialized Professional Association (SPA)? If yes, describe the institution's plans to seek national recognition, including the expected timeline.**

Yes

No