



# UNC CHARLOTTE

## Office of Academic Affairs

9201 University City Blvd, Charlotte, NC 28223-0001  
t/ 704.687.5717 f/ 704.687.1457 www.uncc.edu

December 12, 2019

Dr. Kimberly van Noort  
Vice President for Academic Programs and Instructional Strategy  
University of North Carolina  
Post Office Box 2688  
Chapel Hill, North Carolina 27515-2688

Dear Kim,

Enclosed is UNC Charlotte's Request to Establish a B.S. in Data Science. The proposed program responds to the growing need for undergraduate degrees in Data Science and builds upon an existing institutional foundation in the field with very successful Professional Science Masters' programs in Health Informatics and Data Science and Business Analytics.

Thank you for your consideration of this request. I would be pleased to respond to any questions that you may have.

Sincerely,

Joan F. Lorden  
Provost and Vice Chancellor for Academic Affairs

cc: Philip L. Dubois, Chancellor  
Doug Hague, Interim Executive Director, School of Data Science  
Fatma Mili, Dean, College of Computing and Informatics  
Nancy Gutierrez, Dean, College of Liberal Arts & Sciences  
Jennifer Troyer, Interim Dean, Belk College of Business  
Citrine Tudor-Locke, Dean, College of Health and Human Services  
Rollinda Thomas, Associate Vice President for Academic Programs





THE  
UNIVERSITY OF  
NORTH CAROLINA  
SYSTEM

## Request to Establish New Academic Degree Program

The following approvals must be obtained prior to sending the Request to Establish a New Academic Degree Program to the UNC System Office.

Institution \_\_\_\_\_ University of North Carolina at Charlotte \_\_\_\_\_

Degree Program Title (e.g. M.A. in Biology) \_\_\_\_\_ B.S. in Data Science \_\_\_\_\_

**Reviewed and Approved By (Name and title only. No signature required in this section.)**

**Check box to indicate participation in review. (Provost is required.)**

- Provost: Joan F. Lorden, Provost and Vice Chancellor for Academic Affairs**
- Faculty Senate Chair (as appropriate): n/a**
- Graduate Council (as appropriate): n/a**
- Undergraduate or Graduate Dean (as appropriate): John Smail, Associate provost for Undergraduate Education, Dean of University College**
- Academic College Deans: Fatma Mili, Dean, College of Computing and Informatics, Nancy Gutierrez, Dean, College of Liberal Arts & Sciences, Steve Ott, Dean, Belk College of Business, Catrine Tudor-Locke, Dean, College of Health and Human Services**
- Department Chair: n/a**
- Program Director/Coordinator: Douglas Hague, Interim Executive Director, School of Data Science**

### New Academic Program Process

New academic programs are initiated and developed by the faculty members. Approval of the Request to Establish a New Academic Degree Program must be obtained from department chairs and college deans or equivalent administrators before submission to the UNC System Office review.

Directions: Please provide a succinct, yet thorough response to each section. Obtain the Provost's signature and submit the proposal to the UNC System Vice President for Academic Program, Faculty, and Research, for review and approval by the UNC System Office. Once the Request to Establish is approved, UNC System Office staff can submit the proposal for review and approval by the UNC Board of Governors.

## Request to Establish a New Academic Degree Program

<b>Institution</b>	University of North Carolina at Charlotte
<b>Joint Degree Program (Yes or No)? If so, list partner campus.</b>	No
<b>Degree Program Title (e.g. M.A. in Biology)</b>	B.S. in Data Science
<b>CIP Code and CIP Title (May be found at <a href="#">National Center for Education Statistics</a>)</b>	11.0701 (Computer Science)
<b>Require UNC Teacher Licensure Specialty Area Code (Yes or No). If yes, list suggested UNC Specialty Area Code(s).</b>	No
<b>Proposed Delivery Mode (campus, online, or site-based distance education). Add maximum % online, if applicable.</b>	Campus and Online - A maximum of approximately 60% of the degree may be delivered online.
<b>If requesting online delivery, indicate if program (or one or more courses) will be listed in UNC Online.</b>	n/a
<b>If requesting site-based delivery, indicate address(es), city, county, state, and maximum % offered at site.</b>	n/a
<b>Proposed Term to Enroll First Students (e.g. Spring 2019)</b>	Fall 2020

Do the following sections of your previously submitted and approved Letter of Intent to Develop a New Academic Degree Program document require any change or updated information? If yes, note the items and explain.

<b>Category</b>	<b>Yes or No</b>	<b>Explanation (if applicable)</b>
<b>SACSCOC Liaison Statement</b>	Yes	The SACSCOC Liaison Statement has been revised to read: <i>As required by the Policy Statement on the Substantive Change for Accredited Institutions of the Commission on Colleges, the University of North Carolina at Charlotte (UNC Charlotte) is not required to submit a letter of notification or a prospectus prior to implementation of the new degree program. Information about the program and the rationale for determining that it is not a substantive</i>

		<p><i>change will be kept on file with the Office of Assessment and Accreditation (and evidence that the program has been approved by the University of North Carolina Board of Governors prior to implementation will be kept on file with the the Provost's Office).</i></p> <p>Explanation: While UNC Charlotte does not offer a Data Science bachelor's degree, the University does offer other approved, "big data" analytics programs such as the Graduate Certificate and Master of Science in Data Science and Business Analytics (interdisciplinary program at the intersection of business, computer and information sciences, statistics, and operations research) and the Graduate Certificate and Professional Science Masters' programs in Health Informatics and Analytics (advance the professional practice of health informatics through a thorough grounding in data science, system architecture, and health analytics). The Master of Science in Data Science and Business Analytics and Health Informatics and Analytics address entry level of skills (Python, Statistics, etc), as well as advanced skills (machine learning, text mining, visualization, database development, and cloud computing) all of which will be taught in the BS program. Therefore, the establishment of this program is not a substantive change.</p>
<b>Review Status (campus bodies that reviewed and commented on Letter of Intent)</b>	No	
<b>Program Summary</b>	No	
<b>Student Demand</b>	No	
<b>Societal Demand</b>	No	

**I. Program Planning and Unnecessary Duplication:**

- a. List all other public and private four-year institutions of higher education in North Carolina currently operating programs similar to the proposed new degree program, including their mode of delivery. Show a four-year history of enrollments and degrees awarded in similar programs offered at other UNC institutions (using the format below for each institution with a similar program). Programs at UNC institutions may be found on the UNC System [website](#).

N/A

- b. Describe what was learned in consultation with other programs regarding their experience with student demand and job placement. Indicate how their experiences influenced your enrollment projections.

The UNC Charlotte B.S. in Data Science will be the first undergraduate degree in Data Science in North Carolina. Thus, there is no experience in projecting student demand and job placement within North Carolina. We have consulted with the faculty of the University of Michigan and the University of California Berkley that launched an undergraduate degree programs in Data Science. They had both robust interest and job placement for their program. Their main caution was to manage incoming student demand as it may quickly overwhelm capacity to manage. In addition, our Data Science and Business Analytics Industry Advisory committee and other industry partners in the Charlotte region have been very supportive and impatient for B.S. students to be available for hire. We are also working with Business-Higher Education Forum on the expansion of digital and data skills into a broader population of undergraduate students to provide foundational skills for the new economy.<sup>1</sup> Finally, in the latest Korn Ferry employment report, their leader of Digital Advisory stated, “Organizations aren’t stopping hiring data scientists because of a potential downturn. Those kinds of jobs are thought of as a different bucket.”<sup>2</sup>

We consult with the Data Science Certificate and Master’s programs within North Carolina through the National Consortium for Data Science based in Chapel Hill. Currently Fayetteville State, NC State, and UNC Charlotte offer post-baccalaureate certificates. UNC Wilmington, East Carolina, Appalachian State, NC State, and UNC Charlotte offer Master’s degrees in the field. We expect to continue our collaboration across the state and US.

- c. Identify opportunities for collaboration with institutions offering related degrees and discuss what steps have been or will be taken to actively pursue those opportunities where appropriate and advantageous.

While there are no B.S. in Data Science degrees offered in NC, we participate in the National Consortium on Data Science<sup>3</sup> that is managed by RENCi at UNC Chapel Hill. Most data science and analytics university programs in North Carolina are members or participate in this Consortium (NCSU, UNCC, UNCG, UNCCH). There are also large corporate and governmental agencies that are members including UNC-GA. In the meetings, as well as their publications,<sup>4</sup> NCDS has continuously recommended increasing the number of students at all levels. While most Data Science and Analytics programs have started with M.S. or PSM programs, we have heard from our industry partners (see the letters of support in our Letter of Intent to Develop) that a much larger number of skilled data science professionals are needed, particularly at the undergraduate level.

For the last several years, the School of Data Science has collaborated with UNC Greensboro in their recent launch of their Informatics & Analytics M.S. From discussion on program structure to

---

<sup>1</sup> <http://www.bhef.com/news-events/releases/bhef-releases-new-report-illustrating-foundational-skills-needed-digital>

<sup>2</sup> <https://www.kornferry.com/institute/employment-report-september-2019>

<sup>3</sup> <https://datascienceconsortium.org/>

<sup>4</sup> <https://datascienceconsortium.org/wp-content/uploads/2017/03/NC-Big-Data-Report.pdf>

the necessary technology infrastructure, we provide advice and lessons learned.

We expect to continue and expand these collaborations.

- d. Present documentation that the establishment of this program would not create unnecessary program duplication. In cases where other UNC institutions provided similar online, site-based distance education, or off-campus programs, directly address how the proposed program meets unmet need.

Because there are no other B.S. programs in Data Science in the University of North Carolina system, there is no expected duplication. While there are programs in Management Information Systems, Statistics & Analytics, and Business Analytics, the target skills in these areas are different enough not to be considered as similar. The combination of deep computer science, statistics, and domain knowledge outside of specific business systems will draw both students and employers to seek out this unique combination of skills.

- e. Admission. List the following:

- i. Admissions requirements for proposed programs (indicate minimum requirements and general requirements).

All students must meet UNC Charlotte requirements for admission for undergraduate students. In addition, students must have a 2.0 cumulative GPA unless it is the student's first semester at UNC Charlotte and a cumulative GPA has not been established. General advising for prospective majors and newly declared will introduce students to the curriculum and degree requirements so as not to delay graduation resulting in high cost to the student. UNC Charlotte advises that all students should declare and be accepted into a major or a pre-professional program by the time they have earned 60 semester hours of credit; transfer students entering with more than 60 credit hours should make that declaration upon enrollment or during their first semester of attendance

- ii. Documents to be submitted for admission (listing)

Applications for admission are reviewed when all required credentials are received. The review focuses on the academic history of the applicant and considers all relevant factors. The intent of the University is to offer admission to applicants whose credentials indicate a strong likelihood for success in their selected curricula. It is not always possible to accommodate all the applicants who meet the minimum criteria, and some majors require above-average academic profiles for admission. The Admissions Advisory Committee may make exceptions to the minimum criteria for applicants who are judged to have potential or talent not revealed by test scores and academic performance.

*Freshmen Criteria:*

The Office of Undergraduate Admissions considers applicants whose minimum qualifications include high school graduation or a General Education Diploma (GED). For international applicants, guidelines provided by the American Association of Collegiate Registrars and Admissions Officers (AACRAO) and NAFSA: Association of International

Educators and World Evaluation Services are used to determine if an applicant has met requirements for high school graduation in their country.

Applicants for freshman admission must submit the following to complete their application:

1. The online application for admission
2. \$75 application fee or approved fee waiver
3. Official high school transcript reflecting completed coursework in grades 9-11. Final transcripts reflecting senior grades and graduation date must be provided prior to enrollment.
4. Official SAT or ACT scores.
5. Internationally educated students must have their foreign credentials translated and evaluated by an approved, accredited credential evaluation service.

Applicants for freshman admission are evaluated for admission with primary consideration given to the following:

*High School Performance*

- Academic Courses in Grades 9-11. Applicants must have the minimum course requirements as stated by the UNC system. These courses include 4 units of English, 4 units of Math (including an advanced math), 3 units of Science, 2 units of History/Social Studies, and 2 units of the same foreign language.
- Grade Point Average. The middle 50% of the freshman class has a GPA between 3.7 to 4.3; average GPA is 4.1.
- Senior Year Course Selection. In addition to English and math, we encourage students to take science and foreign languages in their senior year. We expect to see a solid academic schedule.

*SAT or ACT scores*

The middle 50% of the freshman class have SAT scores ranging from 1540-1770 and/or ACT scores ranging from 22-27.

*Transfer Criteria:*

A minimum of twenty-four semester hours of college transferable coursework is required for transfer admission. Transfer admission is based on grade point average achieved and specific courses completed. Transfer admission policies are clearly presented on the Undergraduate Admissions website and in the transfer recruitment brochure. In addition, transfer requirements are presented at community college visits, transfer advising sessions at Open House, and in daily information sessions in the Admissions office. In addition to the application and \$60 fee, official transcripts from every college attended, and an official high school transcript, the following requirements apply:

1. Transfer students under the age of 21 are required to have completed the Minimum Course Requirements in high school: four units of English; 4 units of Math; 3 units of Science; 2 units of Social Science/History; and 2 units of Foreign Language
2. Applicants must present an overall 2.0 grade point average according to calculations performed by the Undergraduate Admissions office.
3. Students who do not meet freshman admission requirements must present a minimum of 24 semester hours (or 36 quarter hours) of transfer credits.
4. Internationally-educated students must have their foreign credentials translated and

evaluated by an accredited credential evaluation service. Transfer applicants must have a “course by course report” completed by the service, and they must present the equivalent of a high school diploma in addition to college-transferable coursework.

5. Applicants must in good standing at and eligible to return to the last institution attended.

Transfers from within UNC Charlotte:

1. Cumulative GPA of 2.0.

f. Degree requirements. List the following:

- i. Total hours required. State requirements for Major, Minor, General Education, etc.

The proposed BS in Data Science will require students to complete general education requirements and complete 55 credit hours of study within the major. There will be no pre-requisites beyond those courses required for general education. The program will not seek specialized accreditation; accordingly, barriers to degree progression that might otherwise be associated with such programs will be avoided.

Proposed Curriculum:

General Education requirements (37-41 credit hours)

Major courses (55 credit hours, 15 of which meet Gen Ed Requirements)

Free Electives (39-43 credit hours)

TOTAL DEGREE REQUIREMENTS: 120 credit hours

- ii. Other requirements (e.g. residence, comprehensive exams, thesis, dissertation, clinical or field experience, “second major,” etc.).

As part of DTSC 4301 and DTSC 4302, a capstone project will be required

g. Enrollment. Estimate the total number of students that would be enrolled in the program during the first year of operation and in each delivery mode (campus, online, site, etc.)

	Campus	Online	Site	Full-Time	Part-Time
<b>Year 1</b>	50	N/A	N/A	50	0
<b>Year 4</b>	380	N/A	N/A	380	0

Assumptions: New freshman entrance rates ramps from 50 to just over 100 over the four years. Starting in Year 3 we will admit transfer students starting with ~35 and having a long-term expectation of ~70/year. With these assumptions and an 85% retention rate of students each year, the long-term size is ~500 students with 130 graduations each year.

h. For graduate programs only, please also answer the following:



<b>Grades required</b>	
<b>Amount of transfer credit accepted</b>	
<b>Language and/or research requirements</b>	
<b>Any time limits for completion</b>	

- i. For all programs, provide a degree plan showing the sequence of courses to be taken each year. List courses by title and number and indicate those that are required. Include an explanation of numbering system. Indicate new courses proposed. A possible format is offered below as an example. If your institution uses a different format that provides the required information, it may be submitted instead.

<b>Year 1</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Required (Y/N)</b>	<b>New (Y/N)</b>	<b>Brief Description (If New Course)</b>
	DTSC 1301	Data and Society A	Y	Y	An introduction to data acquisition, models, and analytic methods for interpreting data and developing hypotheses in the context of a specific social science discipline.
	DTSC 1302	Data and Society B	Y	Y	Prerequisite 1301
	STAT 1220 or STAT 1221 or STAT 1222	Elements of Statistics I (BUSN), Elements of Statistics I, or Introduction to Statistics	Y	N	
	MATH 1120 or MATH 1241	Calculus, or Calculus I	Y	N	
	ITSC 1213	Introduction to Computer Science II	Y	N	DTSC 1302 prerequisite

<b>Year 2</b>	<b>Course No.</b>	<b>Course Title</b>	<b>Required (Y/N)</b>	<b>New (Y/N)</b>	<b>Brief Description (If New Course)</b>
	DTSC 2301	Modeling and Society A	Y	Y	In this studio students will learn how to use statistical methods/tools and query languages on relational

					databases to explore a data science approach to socially relevant challenges associated with a social science discipline. DTSC 1302 and ITSC 1213 prerequisites
	DTSC 2302	Modeling and Society B	Y	Y	Prerequisite of 2301
	MATH 2164	Matrices and Linear Algebra	Y	N	
	STAT 2223	Elements of Statistics II	Y	N	
	ITSC 2175 or MATH 1165	Logic and Algorithms, or Introduction to Discrete Structures	Y	N	
	ITSC 2214	Data Structures and Algorithms	Y	N	

Year 3	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 3601	Predictive Analytics and Their Implications A	Y	Y	In this studio students will learn the ethical use of machine learning to develop models and predictive features from unstructured data to explore a data science approach to socially relevant challenges. DTSC 2302 prerequisite
	DTSC 3602	Predictive Analytics and Their Implications B	Y	Y	Prerequisite of 3601
	STAT 3160	Applied Multivariate Analysis	Y	N	
	ITCS 3160	Database Design and Implementation	Y	N	

Year 4	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 4301	Data Science for Social Good A	Y	Y	This capstone class will combine technical, analytic, interpretive, and social dimensions to design and execute a full data science project. Students will focus on

					real-world applications and situations.
	DTSC 4302	Data Science for Social Good B	Y	Y	Prerequisite 4301
	ITCS 3162	Introduction to Data Mining	Y	N	

## II. Faculty

- a. (For undergraduate and master’s programs) List the names, ranks and home department of faculty members who will be directly involved in the proposed program. The official roster forms approved by SACSCOC may be submitted. For master’s programs, state or attach the criteria that faculty must meet in order to be eligible to teach graduate level courses at your institution.

See Appendix A

- b. (For doctoral programs) List the names, ranks, and home department of each faculty member who will be directly involved in the proposed program. The official roster forms approved by SACSCOC may be submitted. Provide complete information on each faculty member’s education, teaching and research experience, research funding, publications, and experience directing student research including the number of theses and dissertations directed.

N/A

- c. Estimate the need for new faculty for the proposed program over the first four years. If the teaching responsibilities for the proposed program will be absorbed in part or in whole by the present faculty, explain how this will be done without weakening existing programs.

The proposed program will rely on current faculty and will not weaken existing programs as the faculty interest across the College of Liberal Arts & Sciences and the College of Computing and Informatics have been migrating their research areas and teaching interest into this field of study for over 10 years. We have two robust Professional Masters Programs in Data Science and Business Analytics and Health Informatics and Analytics that have been fully supported with more than 15 faculty positions added in the last 8 years. Current interest in joint and affiliated appointments within the School of Data Science exceeds the requirements for the proposed curriculum and expected enrollment. Department Chairs and the Deans of the affiliated colleges have provided letters of support for this program (Appendix B). Two additional faculty positions may be redistributed through joint appointments between the School of Data Science and a College by the Provost as student enrollment grows (see Budget in Appendix C).

- d. Explain how the program will affect faculty activity, including course load, public service activity, and scholarly research.

The faculty for this program is primarily in place and will continue to teach in the program as a part of their existing load. Their scholarly activity will be enhanced through connectivity to faculty with expertise in other colleges. This will encourage the interdisciplinary research that is the cornerstone of data science. Public service will be enhanced by the connections that the program will develop with a broader range of outside entities as part of the work to establish internship opportunities for students.

**III. Delivery Considerations.** Provide assurances of the following (not to exceed 250 words per lettered item):

- a. *Access* (online, site-based distance education, and off-campus programs). Students have access to academic support services comparable to services provided to on-campus students and appropriate to support the program, including admissions, financial aid, academic advising, delivery of course materials, and placement and counseling.

Since a large portion of the program will be offered face-to-face on the main campus of UNC Charlotte, students will have access to resources that are traditionally made available to all undergraduate students. This support includes an academic advisor to assist with degree plan guidance; monitoring of academic standing; career planning; consultation on institutional policies, procedures, and requirements. Students will have regular access to faculty for face-to-face and/or virtual office hours and may access additional campus resources (e.g., Disability Services, Multicultural Academic Services, Financial Aid, Library, Career Center, the University Center for Academic Excellence and Writing Resources Center as needed. These resources offer a broad range of services that include, but are not limited to: Disability Services ensures access to academic programs and campus facilities by providing verification of medical documentation, academic accommodations, counseling, testing, note-taking, and scholarships. Office of Academic Diversity and Inclusion is committed to assisting traditionally underrepresented populations in the awareness and availability of academic support services. University Center for Academic Excellence offers activities such as tutoring, supplemental instruction, academic success workshops, peer mentoring, academic success seminars, a learning lab, and individual consultations, all to support the effort to retain and undergraduate students. Writing Resources Center offers one-to-one writing instruction in writing across the disciplines from first-year to graduate, presentations, and workshops. Consultations, on-line services, and a library of writing-related instructional materials are also available.

- b. *Curriculum delivery* (online and site-based distance education only). The distance education technology to be used is appropriate to the nature and objectives of the program. The content, methods and technology for each online course provide for adequate interaction between instructor and students and among students.

All faculty will be encouraged to work in conjunction with the Center for Teaching and Learning (CTL) to ensure that each online course within the proposed program meets the standards of Quality Matters (QM), a nationally recognized program known for its peer-based approach to quality assurance and continuous improvement in online education and student learning.

Additionally, with the assistance of Audiovisual Integration and Support for Learning Environments (AISLE) each course will promote learner engagement and active learning through varied methods of instruction, including: web-based readings, interactive video lectures, discussion forums (group discussions), and experiential learning projects. AISLE will help to design, maintain and support an effective and accessible digital learning environment by facilitating the creation of high-quality, digital learning objects for supplemental learning experiences.

- c. *Faculty development* (online and site-based distance education only). Faculty engaged in program delivery receive training appropriate to the distance education technologies and techniques used.

Faculty will be encouraged to seek training in online teaching pedagogy. Training on Quality Matters course design will be facilitated by the Center for Teaching and Learning and the Distance Education Office in both online and in person settings. Each of the aforementioned offices will also provide ongoing training in online pedagogy and effective use of tools that support online and blended teaching and learning. Finally, faculty who are new to online and blended teaching will receive additional guidance on online teaching pedagogy including strategies for student engagement and active learning.

- d. *Security* (online and site-based distance education only). The institution authenticates and verifies the identity of students and their work to assure academic honesty/integrity. The institution assures the security of personal/private information of students enrolled in online courses.

The institution assures the security of personal/private information of students enrolled in online courses. The program will rely heavily upon the privacy and security protocols established by the institution. The Office of Information Technology (ITS) will be consulted in every effort to adequately understand what types of software and technology is supported by the institution and has been approved for use. Sensitive student data will be protected by an encrypted code that is only accessible with a University assigned username and a unique, self-selected high security password. The learning management system utilizes the ITS single sign on (SSO) tool, Shibboleth, to provide the ability for students and staff to log into multiple online systems via one web authentication page without repeating the login process. Unique usernames and passwords are used by students to access the SSL-secured university servers and websites; student passwords expire every 180 days. The program will adhere to the Family Educational Rights Privacy Act (FERPA) guidelines for all students regardless of the online platform being utilized for the program in order to protect the privacy of student educational records. All faculty teaching 100% online courses have access to the UNC Online Proctoring Network for the administration of proctored exams.

#### **IV. Library**

- a. Provide a statement as to the adequacy of present library holdings for the proposed program to support the instructional and research needs of this program.

The Bachelor's in Data Science program will have sufficient access to library resources to support the program. As the liaison to the program, Reese Manceaux (data librarian) will build support within the library with added materials, resources, data, and instruction for the program.

Atkins Library has an expansive set of databases that include the subject of data science. Some relevant databases include: ACM Digital Library, Compendex, IEEE Xplore, Inspec, Science Citation, Index, Science Direct, Synthesis Digital Library of Engineering and Computer Science (Morgan and Claypool), and Web of Science. Access to data/text mining is sometimes granted by the publishers of these databases as well. I would suggest buying monographs as funds permit to keep the collection current. Overall, Atkins Library has adequate resources to support the proposed curriculum

- b. If applicable, state how the library will be improved to meet new program requirements for the next four years. The explanation should discuss the need for books, periodicals, reference material, primary source material, etc. What additional library support must be added to areas supporting the proposed program?

Over the next four years, we will request an increased budget to support program needs. Our interdisciplinary liaisons will help to facilitate those needs. Continued access to current dataset subscriptions like ICPSR and others could be supplemented by purchase of other datasets to support the curriculum when needed. Funding from the School of Data Science would be needed in order to add datasets or journals to our collections.

- c. Discuss the use of other institutional libraries.

The J. Murrey Atkins Library at UNC Charlotte provides access to materials at other libraries in North Carolina and the United States through Interlibrary Loan.

- d. For doctoral programs, provide a systematic needs assessment of the current holdings to meet the needs of the program.

N/A

## **V. Facilities and Equipment**

- a. Describe facilities available for the proposed program.

Facilities are available for the Data Science program staff within the Bioinformatics Building at UNC Charlotte. All faculty have private offices, conference rooms, and workspace through the College of Computing and Informatics, the College of Liberal Arts & Sciences, the College of Health and Human Services, and the Belk College of Business.

- b. Describe the effect of this new program on existing facilities and indicate whether they will be adequate, both at the commencement of the program and during the next decade.

Depending upon program growth, additional faculty offices may be required.

- c. Describe information technology and services available for the proposed program.

The UNC Charlotte Information Technology Services support the software, hardware, and technology needs of for the faculty. In addition, the School of Data Science operates the System for Observation of Populous and/or Heterogenous Information (SOPHI) which has integrated 34 leading open source big data software systems and 15 data streaming and syndication services. Over 180 terabytes of data (structured and unstructured) have been collected thus far. SOPHI primary purpose is to store and securely manage research data for the faculty and graduate students. In addition, a data storage and processing infrastructure for classroom use is in operation. This cluster named DSBA-Hadoop consists of 6 worker nodes with nearly 140 terabytes of storage and 4 manager nodes.

- d. Describe the effect of this new program on existing information technology and services and indicate whether they will be adequate, both at the commencement of the program and during the next decade.

Existing technology and services will be adequate to support at the commencement of the program and expansion will be commensurate with the growth of the program. It is expected that students will be exposed to public cloud services and their capabilities. Both on-premise (SOPHI, DSBA-Hadoop) and cloud infrastructure will be managed by the School of Data Science in partnership with Information Technology Services.

## **VI. Administration**

- a. Describe how the proposed program will be administered, giving the responsibilities of each department, division, school, or college. Explain any inter-departmental or inter-unit administrative plans. Include an organizational chart showing the "location" of the proposed new program.

The program will be administered through the School of Data Science (SDS). SDS is governed by a Board of Directors that consists of the Provost and the Deans of the College of Liberal Arts & Sciences, the College of Health and Human Services, the Belk College of Business, the College of Computing and Informatics. The Board of Directors appoints an Executive Director, who with guidance and oversight of the Board, establishes broad policies, oversees the budget, and provides the strategic direction.

See Appendix D for organizational chart.

- b. For joint programs only, include documentation that, at minimum, the fundamental elements of the following institutional processes have been agreed to by the partners:
- i. Admission process
  - ii. Registration and enrollment process for students
  - iii. Committee process for graduate students
  - iv. Plan for charging and distributing tuition and fees
  - v. Management of transcripts and permanent records
  - vi. Participation in graduation

- vii. Design of diploma

## **VII. Additional Program Support**

- a. Will additional administrative staff, new master's program graduate student assistantships, etc. be required? If so, please briefly explain in the space below each item, state the estimated new dollars required at steady state after four years, and state the source of the new funding and resources required.

No additional administrative staff will be necessary as the School of Data Science has a full contingent of staff including an Executive Director, a Director, a Business Manager, a Director of Student Services, and other support staff. This staff is funded through a combination of state appropriations, tuition increment for the graduate programs, and other sources of funds.

## **VIII. Accreditation and Licensure**

- a. Where appropriate, describe how all licensure or professional accreditation standards will be met, including required practica, internships, and supervised clinical experiences.

This program does not lead to licensure and is not professionally accredited

- b. Indicate the names of all accrediting agencies normally concerned with programs similar to the one proposed. Describe plans to request professional accreditation.
- c. If the new degree program meets the SACSCOC definition for a substantive change, what campus actions need to be completed by what date in order to ensure that the substantive change is reported to SACSCOC on time?

N/A

- d. If recipients of the proposed degree will require licensure to practice, explain how program curricula and title are aligned with requirements to "sit" for the licensure exam.

## **IX. Supporting Fields**

- a. Discuss the number and quality of lower-level and cognate programs for supporting the proposed degree program.

As an interdisciplinary program, we will be supported in coursework by the Computer Science, Software and Information Systems, and Mathematics and Statistics Departments. In addition, joint faculty with Business Information Systems and Operations Management (BISOM), Management, Public Policy, Criminal Justice, Sociology, and Organizational Science will support the program. In addition, a partnership with the Institute for Social Capital will support the program through information and guidance on the social impact of information. Each of these organizations are in support of this major in Data Science and the expansion of these fields will be



commensurate with their desired growth and not contingent on our demand. See Letters of Support in Appendix B.

- b. Are other subject-matter fields at the proposing institution necessary or valuable in support of the proposed program? Is there needed improvement or expansion of these fields? To what extent will such improvement or expansion be necessary for the proposed program?

The Belk College of Business, the College of Computing and Informatics, the College of Liberal Arts & Sciences, and the College of Health and Human Services will be providing valuable support through joint and affiliate faculty appointments. In addition, the UNC Charlotte Urban Institute and its Institute for Social Capital (ISC) is expected to provide support through joint projects and data. The ISC is working through its governance process to determine the most appropriate methods for developing data sets that may be used by students in a classroom. Approvals from the data providers will be required. If the ISC is not able to develop the appropriate approvals, the program will utilize other public data sets within the classroom that are more readily available.

- X. Additional Information.** Include any additional information deemed pertinent to the review of this new degree program proposal.

- XI. Budget**

- a. Complete and insert the Excel budget template provided showing incremental continuing and one-time costs required each year of the first four years of the program. Supplement the template with a budget narrative for each year.

See Appendix C

- b. Based on the campus' estimate of available existing resources or expected non-state financial resources that will support the proposed program (e.g., federal support, private sources, tuition revenue, etc), will the campus:

- i. Seek enrollment increase funds or other additional state appropriations (both one-time and recurring) to implement and sustain the proposed program? If so, please elaborate.

New resources are not needed at present and the program will not affect our projections for undergraduate growth. We anticipate that growth in the program will exceed the overall growth in the undergraduate student body as the demand by employers outstrips current graduates across the country. Needs will be addressed redistribution of resources from other Colleges and programs.

- ii. Require differential tuition supplements or program-specific fees? If so, please elaborate.
      - 1. State the amount of tuition differential or program-specific fees that will be requested.

N/A

2. Describe specifically how the campus will spend the revenues generated.

N/A

3. Does the campus request the tuition differential or program-specific fees be approved by the Board of Governors prior to the next Tuition and Fee cycle?

N/A

- c. If enrollment increase funding, differential tuition, or other state appropriations noted in the budget templates are not forthcoming, can the program still be implemented and sustained and, if so, how will that be accomplished? Letters of commitment from the Chancellor and/or Chief Academic Officer should be provided.

Yes, through redistribution College and program funds and differential tuition from M.S. programs as necessary.

## **XII. Evaluation Plans**

- a. What student learning outcomes will be met by the proposed program and how will student proficiency be measured? These items may be updated as necessary to meet student and program needs.

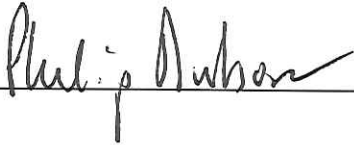

See Appendix E.

- b. The plan and schedule to evaluate the proposed new degree program prior to the completion of its fourth year of operation (to include types of measurement, frequency, and scope of program review).

The new degree program will be evaluated annually, with each Studio courses' SLOs being evaluated annually for each of the first 4 years the courses are taught. SLOs will be modified and altered as new learnings or issues are identified. By the end of the fourth year of operations, DTSC 1302 will have been evaluated 4 times, DTSC 2302 3 times, DTSC 3602 twice and DTSC 4302 once.

## **XIII. Attachments.** Attach the final approved Letter of Intent as the first attachment following this document.

This proposal to establish a new program has been reviewed and approved by the appropriate campus committees and authorities.

Position Title	Signature	Date
Chancellor		12/12/19
Chancellor (Joint Partner Campus)		
Provost		12/12/2019

**Faculty Roster Form**

**Qualifications of Full-Time and Part-Time Faculty**

**Name of Institution:** University of North Carolina at Charlotte

**Name of Primary Department, Academic Program, or Discipline:** School of Data Science – B.S. in Data Science

**Academic Term(s) Included:** Fall 2020-Spring 2024

**Date Form Completed:** September 14, 2019

1	2	3	4
<b>NAME (F, P)</b> Full-time or Part-time	<b>COURSES TAUGHT</b> Including Term, Course Number & Title, Credit Hours (D, UN, UT, G) Developmental, Undergraduate Nontransferable, Undergraduate Transferable, Graduate	<b>ACADEMIC DEGREES &amp; COURSEWORK</b> Relevant to Courses Taught, Including Institution & Major List specific graduate coursework, if needed	<b>OTHER QUALIFICATIONS &amp; COMMENTS</b> Related to Courses Taught
Berardinelli, Angela, Senior Lecturer (F)	Fall 2020, Fall 2021, Fall 2022, Fall 2023 DTSC 1301 Data Science Studio 1A (3, UT) DTSC 1302 Data Science Studio 1B (3, UT)  Spring 2022, Spring 2023, Spring 2024 DTSC 2301 Data Science Studio 2A (3, UT) DTSC 2302 Data Science Studio 2B (3, UT)	Ph.D., University of North Texas, Mathematics, 2015  M.S., University of North Texas, Mathematics, 2012  B.S., Ursinus College, Computer Science, 2010	Assistant Professor at Mercyhurst University that taught Undergraduate computing courses: Database Management, Introduction to Data Science, Introduction to Computer Science and Operating Systems; along with teaching a graduate course in Database Technologies.

<p>Smith, Stephanie Moller, Professor (F)</p>	<p>Fall 2020, Fall 2021, Fall 2022, Fall 2023 DTSC 1301 Data Science Studio 1A (3, UT) DTSC 1302 Data Science Studio 1B (3, UT)</p> <p>Spring 2024 DTSC 4301 Data Science Studio 4A (3, UT) DTSC 4302 Data Science Studio 4B (3, UT)</p>	<p>Ph.D., University of North Carolina at Chapel Hill, Sociology, 2003</p> <p>M.A., University of Georgia, Sociology, 1998</p> <p>M.A., University of Delaware, Urban Affairs and Public Policy, 1996</p> <p>B.S., Guilford College, Sociology, 1994</p>	<p>Trainings taken for SAS Analytics Software:</p> <p>2013 SEM with SAS 2010 Imputation Techniques; SAS Institute 2010 Power Analysis: SAS Institute 2009 SAS Macro Language Essentials; SAS Institute 2007 Multivariate Statistical Methods: Practical Research Applications; SAS Institute 2007 Categorical Data Analysis Using Logistic Regression in SAS; SAS Institute 2005 Fitting Generalized Linear Mixed and Nonlinear Mixed Models Using SAS; SAS Institute</p>
<p>Dou, Wenwen, Assistant Professor (F)</p>	<p>Spring 2024 DTSC 4301 Data Science Studio 4A (3, UT) DTSC 4302 Data Science Studio 4B (3, UT)</p>	<p>Ph.D., University of North Carolina at Charlotte, Computing &amp; Information Systems, 2012</p> <p>B.Sc., Beijing University of Posts and Telecommunications, Engineering, 2006</p>	

<p>Delmelle, Eric, Associate Professor (F)</p>	<p>Fall 2022, Fall 2023 DTSC 1301 Data Science Studio 1A (3, UT) DTSC 1302 Data Science Studio 1B (3, UT)</p>	<p>Ph.D., University of Buffalo – State University of New York, Geography, 2005</p> <p>M.S. University of Buffalo – State University of New York, Industrial Engineering, 2004</p> <p>M.A. University of Buffalo – State University of New York, Geography, 2001</p> <p>B.S., Vrije Universteit Brussels, Belgium, GIS/Transportation, 1999</p>	<p>Graduate Certificate, University of Buffalo – State University of New York in Transportation and Business Geographics, 2005</p> <p>Edited books:</p> <p>2019, B2. Lu. Y and E.M. Delmelle (Eds). Geospatial Technologies for Urban Health - Springer.</p> <p>2016, B1. Kanaroglou P.; Delmelle E.M. and A. Paez (Eds). Spatial Analysis in Health Geography - Ashgate.</p> <p>Invited Talks:</p> <p>2018, State of Art in Geospatial Technologies for Health. Geospatial data in health and welfare research Symposium, University of Helsinki (Finland).</p> <p>2016, Mapping Collective Human Activity in an Urban Environment Based on. Mobile Phone Data. BRU-Net Workshop on Big Data and Urban Geography, Center for Operations Research and Econometrics, Universite Catholique de Louvain, Belgium. Evaluating Travel Impedance Agreement among Online Road Network Data. Providers. GIS Colloquium, Geography Department, University of Heidelberg, Germany.</p>
--	---	---	--

<p>Reisdorf, Bianca, Assistant Professor (F)</p>	<p>Spring 2022, Spring 2023, Spring 2024 DTSC 2301 Data Science Studio 2A (3, UT) DTSC 2302 Data Science Studio 2B (3, UT)</p>	<p>Ph.D., University of Oxford, Information, Communication, and Social Sciences, 2013</p> <p>M.A., University of Bielefeld, Germany, Sociology, 2008</p> <p>B.A., Philipps University, Germany, Sociology, English Linguistics, Minor: Psychology 2005</p>	<p>Peer Reviewed Papers:</p> <p>In Press, Rhinesmith, C., Reisdorf, B.C., &amp; Bishop, M. The Ability to Pay for Broadband. Communication Research and Practice.</p> <p>2018, Groselj, D., Reisdorf, B.C., Petrovcic, A. Obtaining indirect internet access: An examination how reasons for internet non-use relate to proxy internet use. Telecommunications Policy. Online First.</p> <p>2018, Reisdorf, B.C., &amp; Rikard, R.V. Digital Rehabilitation: A Model of Reentry into the Digital Age. American Behavioral Scientist, 62(9), 1273–1290.</p> <p>2017, Dutton, W.H. &amp; Reisdorf, B.C. Cultural Divides and Digital Inequalities: Attitudes Shaping Internet and Social Media Divides. Information, Communication &amp; Society. Online First.</p> <p>Reports:</p> <p>2018, Dutton, W.H., Fernandez, L., Reisdorf, B.C., with Hampton, K. Broadband to the Neighborhoods. Quello Center Final Report for the project “Broadband to the Neighborhood”, supported by Rocket Fiber. East Lansing, MI: Michigan State University.</p>
--	--	--	--

<p>Dai, Yaoyao, Assistant Professor (starting Fall 2020) (F)</p>	<p>Spring 2022, Spring 2023, Spring 2024  DTSC 2301 Data Science Studio 2A (3, UT)  DTSC 2302 Data Science Studio 2B (3, UT)</p>	<p>Ph.D., Pennsylvania State University, Political Science, 2019   M.A., Pennsylvania State University, Political Science, 2016   M.A., Duke University, Political Science, 2014   B.A., Renmin University, International Relations, 2012</p>	
<p>Johnson, Elizabeth, Senior Lecturer (F)</p>	<p>Fall 2023, Fall 2024  DTSC 3601 Data Science Studio 3A (3, UT)  DTSC 3602 Data Science Studio 3B (3, UT)</p>	<p>Ed.D., George Washington University, Education Administration and Policy Studies, 2016   M.A., University of North Carolina at Charlotte, Ethics and Applied Philosophy, 2007   B.A., University of South Carolina, Journalism, 1977</p>	<p>Graduate Certificate, University of North Carolina at Charlotte in Applied Ethics, 2007</p> <p>Publications and Peer Review:</p> <p>2018, "Coding Human Memories," expert contributor, Communications of the Association for Computing Machinery, Joe Dysart</p> <p>2018, "Using Integrative Propositional Analysis to Understand and Integrate Four Theories of Social Power Systems, Steve Wallis and Liz Johnson Co-authors, Journal on Policy and Complex Systems</p> <p>2017, "How United Airlines' Analytics and Algorithms Can Help to Save American Democracy," Co-authors Maury Seldin and Liz Johnson, World Journal of Social Science, Vol.4, No. 2</p>



<p>Arrigo, Bruce, Professor (F)</p>	<p>Fall 2023, Fall 2024 DTSC 3601 Data Science Studio 3A (3, UT) DTSC 3602 Data Science Studio 3B (3, UT)</p>	<p>Ph.D., Pennsylvania State University, Justice Studies, 1993  M.A., Duquesne University, Sociology, 1987  M.A., Duquesne University, Psychology, 1985  B.A., St. Joseph's University, Politics, 1982</p>	
<p>Hull, Gordon, Associate Professor (F)</p>	<p>Fall 2023, Fall 2024 DTSC 3601 Data Science Studio 3A (3, UT) DTSC 3602 Data Science Studio 3B (3, UT)</p>	<p>Ph.D., Vanderbilt University, Philosophy, 2000  M.A., Vanderbilt University, Philosophy, 1999  B.A., Wake Forest University, Philosophy, 1994</p>	<p>Articles:  2016, "<u>Cultural Branding, Geographic Source Indicators, and Commodification</u>," <i>Theory, Culture &amp; Society</i> 33:2, 125-45, doi: <a href="https://doi.org/10.1177/0263276415583140">10.1177/0263276415583140</a>  2015, "<u>Successful Failure: What Foucault Can Teach Us about Privacy Self-Management in a World of Facebook and Big Data</u>," <i>Ethics and Information Technology</i>, doi: <a href="https://doi.org/10.1007/s10676-015-9363-z">10.1007/s10676-015-9363-z</a>  Book:  <i>Forthcoming, "The Biopolitics of Intellectual Property: Regulating Innovation and Personhood in the Information Age"</i> (Cambridge University Press)</p>
<p>Burnap, Charles A., Associate Professor (F)</p>	<p>Fall 2020-Spring 2024 MATH 1120 Calculus (3, UT)</p>	<p>Ph.D., Harvard University, Physics, 1976  B.S., Rensselaer Polytechnic Institute, Physics, 1970</p>	

<p>Taylor, John R. Lecturer (F)</p>	<p>Fall 2020-Spring 2024 MATH 1241 Calculus O (3, UT)</p>	<p>Ph.D., University of North Carolina at Charlotte, Applied Mathematics, 2006</p> <p>M.S., North Carolina State University, Applied Mathematics, 1990</p> <p>B.S., North Carolina State University, Mathematics, 1988</p> <p>B.S., North Carolina State University, History, 1988</p>	
<p>Lehmann, Lorrie J., Senior Lecturer (F)</p>	<p>Fall 2020-Spring 2024 ITSC 1213 Introduction to Computer Science II (4, UT)</p> <p>Fall 2020-Spring 2024 ITSC 2214 Data Structures and Algorithms (3, UT)</p>	<p>M.S., University of North Carolina at Charlotte, Computer Science, 2005</p> <p>B.A., University of North Carolina at Charlotte, Computer Science, 1990</p> <p>B.A., University of Minnesota-Duluth, Mathematics, 1977</p>	
<p>Bishwal, Jaya P., Associate Professor (F)</p>	<p>Fall 2020-Spring 2024 STAT 1220 Elements of Stat I (BUSN) (3, UT)</p>	<p>Ph.D., Sambalpur University, India, Statistics, 2002</p> <p>M.Phil., Sambalpur University, India, Statistics, 1991</p> <p>M.S., Sambalpur University, India, Statistics, 1989</p> <p>B.S., Sambalpur University, India, Physics, 1987</p>	

<p>Diao, Yuanan, Professor (F)</p>	<p>Fall 2020, Fall 2021, Fall 2022, Fall 2023 STAT 1221 Elements of Stat I (BIOL) (3, UT)</p>	<p>Ph.D., Florida State University, Mathematics, 1990</p> <p>M.S., Beijing University of Science and Technology, China, Applied Mathematics, 1984</p> <p>B.S., Wuhan University of Technology, China, Mathematics, 1981</p>	
<p>Zhou, Weihua, Associate Professor (F)</p>	<p>Fall 2020-Spring 2024 STAT 1222 Intro to Statistics (3, UT)</p> <p>Fall 2020-Spring 2024 STAT 2223 Elements of Statistics II (3, UT)</p>	<p>Ph.D., University of Texas at Dallas, Statistics, 2005</p> <p>M.S., University of Texas at Dallas, Statistics, 2004</p> <p>M.S., University of Science and Technology of China, Management Science, 2001</p> <p>B.S., University of Science and Technology of China, Finance and Chemistry, 1998</p>	
<p>Zhang, Zhiyi, Professor (F)</p>	<p>Fall 2020-Spring 2024 STAT 1222 Intro to Statistics (3, UT)</p>	<p>Ph.D., Rutgers, State University of New Jersey, Statistics, 1990</p> <p>M.S., Rutgers, State University of New Jersey, Statistics, 1987</p> <p>B.A., Hunter College, Mathematics, 1985</p>	

Cao, Lijuan, Teaching Associate Professor (F)	Fall 2020-Spring 2024 ITSC 1213 Introduction to Computer Science II (4, UT) ITSC 2175 Logic and Algorithms (3, UT)	Ph.D., University of North Carolina at Charlotte, Information Technology, 2008  B.S., University of Science and Technology of China, Computer Science, 2003	
McLeod, Sterling, Lecturer (F)	Fall 2020-Spring 2024 ITSC 1213 Introduction to Computer Science II (4, UT)	Ph.D., University of North Carolina at Charlotte, Computing and Information Systems, 2019  M.S., University of North Carolina at Charlotte, Computer Science, 2014  B.S., University of North Carolina at Charlotte, Computer Science, 2012	
Roy, Arindam, Assistant Professor (F)	Fall 2020-Spring 2024 MATH 2164 Matrices and Linear Algebra (3, UT)	Ph.D., University of Illinois at Urbana-Champaign, Mathematics, 2015  M.S., University of Texas-Pan American, Mathematical Science, 2009  M.Sc., University of Calcutta, India, Mathematics, 2005  B.Sc., University of Calcutta, India, Mathematics, 2003	

<p>Aksut, Ann A., Lecturer (P)</p>	<p>Fall 2020-Spring 2024 ITSC 2175 Logic and Algorithms (3, UT)</p>	<p>Ph.D., Nova Southeastern University, Information Systems, 2013  M.S., Montclair State University, Computer Science, 1997  B.S., Middle East Technical University, Turkey, Business and Planning, 1985</p>	
<p>Jiang, Jiancheng, Professor (F)</p>	<p>Fall 2020-Spring 2024 STAT 2223 Elements of Statistics II (3, UT)  Fall 2020-Spring 2024 STAT 3160 Applied Multivariate Analysis</p>	<p>Ph.D., Nankai University, China, Statistics, 1994  M.A., Nankai University, China, Mathematical Statistics, 1991  B.S., Nankai University, China, Mathematics, 1988</p>	
<p>Birdsong, Sarah J., Lecturer (F)</p>	<p>Fall 2020-Spring 2024 MATH 1165 Intro to Discrete Structures (3, UT)</p>	<p>Ph.D., University of North Carolina at Charlotte, Applied Mathematics, 2013  M.S., University of North Carolina at Charlotte, Mathematics, 2007  B.S., Mars Hill College, Mathematics and Computer Science, Minor: Theatre Arts, 2005</p>	
<p>Jugan, Daniel J., Lecturer (F)</p>	<p>Fall 2020-Spring 2024 ITSC 2214 Data Structures and Algorithms (3, UT)</p>	<p>M.S., University of North Carolina at Charlotte, Computer Science, 2011  B.S., Appalachian State University, Business Education, 2007</p>	

Cheng, Qiong, Lecturer (F)	Fall 2020-Spring 2024 ITSC 2214 Data Structures and Algorithms (3, UT)	Ph.D., Georgia State University, Computer Science, 2010 M.S., Georgia State University, Computer Science, 2008 B.S., Wuhan University, China, Computer Science, 1995	
Scott, Sara H., Lecturer (F)	Fall 2020-Spring 2024 ITCS 3160 Database Design & Implem (3, UT)	M.B.I.S., Georgia State University, Business Information Systems, 1972 B.A., Agnes Scott College, Mathematics, 1968	
Krishnan, Siddharth, Assistant Professor (F)	Fall 2020-Spring 2024 ITCS 3162 Introduction to Data Mining (3, UT)	Ph.D., Virginia Polytechnic Institute and State University, Computer Science and Applications, 2018 M.S., Florida State University, Computer Science, 2011 B.S., Sri Sathya Sai University, India, Mathematics, 2008	
Thompson, Pamela L., Lecturer (P)	Fall 2020-Spring 2024 ITCS 3160 Database Design & Implem (3, UT) ITCS 3162 Introduction to Data Mining (3, UT)	Ph.D., University of North Carolina at Charlotte, Computer and Information Systems, 2011 M.B.A., James Madison University, Business Administration, 1989 B.B.A., James Madison University, Business Administration, 1982	

**F, P: Full-time or Part-time; D, UN, UT, G: Developmental, Undergraduate Nontransferable, Undergraduate Transferable, Graduate**

## Appendix B: Letters of Departmental Support

Political Science – Dr. Cheryl Brown, Department Chair

Software Information Systems – Dr. Mary Lou Maher, Department Chair

Computer Science – Dr. Bojan Cukic, Department Chair

Mathematics and Statistics – Dr. Yuanan Diao, Department Chair

Sociology – Dr. Stephanie Moller, Department Chair



UNC CHARLOTTE  
College of Liberal Arts & Sciences

Department of Political Science and Public Administration

9201 University City Boulevard, Charlotte, NC 28223-0001  
t/ 704-687-5913 f/ 704-687-1400

March 15, 2019

Re: Letter of Support for the new BS degree in Data Science

To Whom It May Concern:

On behalf of the Department of Political Science and Public Administration, I would like to express my support for the proposed new BS degree in Data Science. I understand that the proposed degree program will include new studio courses that will be co-taught by the faculty from our department. Additional students will increase the pace of growth in course registration, but we will be able to accommodate them. While student enrollment in the BS Data Science will create additional demands for the faculty and staff, we enthusiastically support its creation and will accept new responsibilities.

In you have any questions, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Cheryl L. Brown", with a long horizontal flourish extending to the right.

Cheryl L. Brown  
Chair and Associate Professor





**UNC CHARLOTTE**  
COLLEGE OF COMPUTING AND INFORMATICS  
Department Software Information Systems  
9201 University City Boulevard, Charlotte, NC 28223-0001

April 11, 2019

Re: Letter of Support for the new BS degree in Data Science

To whom it may concern:

On behalf of the Department of Software and Information Systems, I would like to express my support for the proposed new BS degree in Data Science. I understand that the proposed degree program includes existing courses taught in the BS/BA Computer Science as part of the required curriculum. Additional students will increase the pace of growth in course registration, but we will be able to accommodate them. The new studio courses will be co-taught by the faculty from the SIS department. While student enrollment in the BS Data Science will create additional demands for the faculty and staff, we enthusiastically support its creation and will accept new responsibilities.

In case you have any questions, please feel free to contact me.

Sincerely,



Professor Mary Lou Maher  
Chair, Software Information Systems  
Woodward 310A, UNC Charlotte  
Phone: 704 687-1940  
[M.maher@uncc.edu](mailto:M.maher@uncc.edu) | <http://sis.uncc.edu/maher-marylou>



**UNC CHARLOTTE**

**College of Computing and Informatics**

**Department of Computer Science**

9201 University City Blvd, Charlotte, NC 28223-0001

t/704.687.8560 [www.cs.uncc.edu](http://www.cs.uncc.edu)

March 12, 2019

Re: Letter of Support for the new BS degree in Data Science

To whom it may concern:

On behalf of the Department of Computer Science, I would like to express my support for the proposed new BS degree in Data Science. I understand that the proposed degree program includes existing courses taught in the BS/BA Computer Science as part of the required curriculum. Additional students will increase the pace of growth in course registration, but we will be able to accommodate them. Also, the new studio courses will be co-taught by the faculty from our department. While student enrollment in the BS Data Science will create additional demands for the faculty and staff, we enthusiastically support its creation and will accept new responsibilities.

In case you have any questions, please feel free to contact me.

Sincerely,

A handwritten signature in black ink that reads "B. Cukic".

Bojan Cukic, Ph.D.  
Professor and Chair

**The UNIVERSITY of NORTH CAROLINA at CHARLOTTE**

An Equal Opportunity/Affirmative Action Employer



UNC CHARLOTTE

College of Liberal Arts and Sciences

Department of Mathematics and Statistics

9201 University City Blvd, Charlotte, NC 28223-0001  
t/704.687.0620 [www.math.uncc.edu](http://www.math.uncc.edu)

## Memorandum

**To:** Whom this may concern

**From:** Dr. Yuanan Diao, Chair, Department of Mathematics and Statistics

**Subject:** The BS degree in Data Science Proposal

**Date:** March 12, 2019

This memorandum confirms that the Department of Mathematics and Statistics fully supports the proposed BS degree in Data Science. We understand that students in this major will be required to take several mathematics and statistics courses. Since students in this new major are likely drawn from other STEM areas or majors that would also require certain number of courses, we do not expect to see a large increase in the overall enrollment of these courses due to the creation of this new major. Therefore, we expect that we will be able to offer these classes without requiring new resources. Please let me know if you need further assistance.

A handwritten signature in black ink, appearing to read "Yuanan Diao".



Bojan Cukic &lt;bcukic@uncc.edu&gt;

---

## Curriculog support letter

---

**Stephanie Moller** <Stephanie.Moller@uncc.edu>

Wed, Mar 13, 2019 at 11:16 AM

To: Bojan Cukic &lt;bcukic@uncc.edu&gt;

Cc: "Diao, Yuanan" &lt;ydiao@uncc.edu&gt;, Mary Lou Maher &lt;M.Maher@uncc.edu&gt;, "Brown, Cheryl" &lt;cbrown@uncc.edu&gt;

Dr. Bojan: On behalf of the Department of Sociology, I would like to express my support for the proposed new BS degree in Data Science. I understand that the proposed degree program includes existing courses taught in the Department of Sociology as part of the required curriculum. Additional students will increase the pace of growth in course registration, but we will be able to accommodate them. Also, the new studio courses will be co-taught by the faculty from our department. While student enrollment in the BS Data Science will create additional demands for the faculty and staff, we enthusiastically support its creation and will accept new responsibilities.

Stephanie Moller  
Chair, Department of Sociology

On Tue, Mar 12, 2019 at 5:27 PM Bojan Cukic <bcukic@uncc.edu> wrote:

[Quoted text hidden]

[Quoted text hidden]

Appendix C: Budget for B.S. in Data Science

SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR PROPOSED PROGRAM						
INSTITUTION	UNC Charlotte		DATE	3-Sep-19		
Program (CIP, Name, Level)	Data Science					
Degree(s) to be Granted	B.S.		Program Year	Year 1 (2020-2021)		
Differential tuition requested per student per academic yr						
Projected annual FTE students		50				
Projected annual differential tuition		\$0				
Percent differential tuition for financial aid						
Differential tuition remainder		\$0				
	ADDITIONAL FUNDS REQUIRED - BY SOURCE					
	Reallocation of Present Institutional Resources	Projected Differential Tuition	Enrollment Increase Funds	Other New Allocations (Identify)	Total	
EPA/SPA Regular Salaries						
(Identify positions)	\$ -	\$ -	\$ -	\$ -	\$ -	
EPA Academic Salaries						
(Identify positions)	\$ -	\$ -	\$ -	\$ -	\$ -	
Social Security	\$ -	\$ -	\$ -	\$ -	\$ -	
State Retirement	\$ -	\$ -	\$ -	\$ -	\$ -	
Medical Insurance	\$ -	\$ -	\$ -	\$ -	\$ -	
Graduate Stipends						
2	\$ 5,000.00	\$ -	\$ -	\$ 5,000.00	\$ 10,000.00	
Supplies and Materials						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Current Services						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Travel	\$ -	\$ -	\$ -	\$ -	\$ -	
Communications	\$ -	\$ -	\$ -	\$ -	\$ -	
Printing and Binding		\$ -	\$ -	\$ -	\$ -	
Advertising	\$ 2,500.00	\$ -	\$ -	\$ -	\$ 2,500.00	
Fixed Charges						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Capital Outlay (Equipment)						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Libraries	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>TOTAL ADDITIONAL COSTS</b>	<b>\$ 7,500.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 5,000.00</b>	<b>\$ 12,500.00</b>	
Narrative:	First year will have one section of Studio 1 courses taught with current faculty. There is room in other first year core course to manage student load with current faculty. Major fee of \$120/semester results in \$12k in fees.					

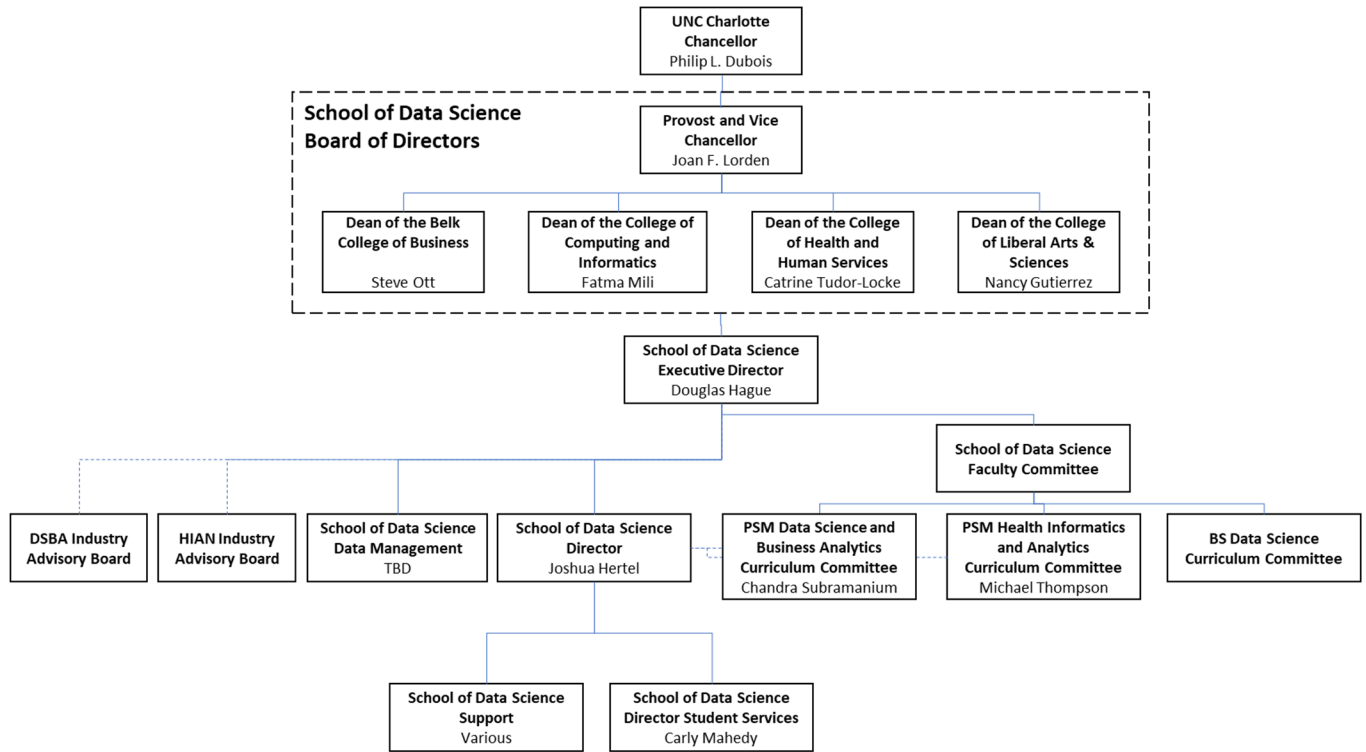
SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR PROPOSED PROGRAM					
INSTITUTION	UNC Charlotte		DATE	3-Sep-19	
Program (CIP, Name, Level)	Data Science				
Degree(s) to be Granted	B.S.		Program Year	Year 2 (2021-2022)	
Differential tuition requested per student per academic yr					
Projected annual FTE students		120			
Projected annual differential tuition		\$0			
Percent differential tuition for financial aid					
Differential tuition remainder		\$0			
ADDITIONAL FUNDS REQUIRED - BY SOURCE					
	Reallocation of Present Institutional Resources	Projected Differential Tuition	Enrollment Increase Funds	Other New Allocations (Identify)	Total
EPA/SPA Regular Salaries					
	1 \$ -	\$ -	\$ -	\$ 50,000.00	\$ 50,000.00
EPA Academic Salaries					
	0 \$ -	\$ -	\$ -	\$ -	\$ -
Social Security	\$ -	\$ -	\$ -	\$ 3,825.00	\$ 3,825.00
State Retirement	\$ -	\$ -	\$ -	\$ 9,430.00	\$ 9,430.00
Medical Insurance	\$ -	\$ -	\$ -	\$ 6,104.00	\$ 6,104.00
Graduate Stipends					
	4 \$ 10,000.00	\$ -	\$ -	\$ 10,000.00	\$ 20,000.00
Supplies and Materials					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Current Services					
Cloud Services	\$ -	\$ -	\$ -	\$ -	\$ -
Travel	\$ -	\$ -	\$ -	\$ -	\$ -
Communications	\$ -	\$ -	\$ -	\$ -	\$ -
Printing and Binding		\$ -	\$ -	\$ -	\$ -
Advertising	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00
Fixed Charges					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Capital Outlay (Equipment)					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Libraries	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00
<b>TOTAL ADDITIONAL COSTS</b>	<b>\$ 20,000.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 79,359.00</b>	<b>\$ 99,359.00</b>
Narrative:	Second year will have one section of Studio 1 and Studio 2 courses taught with current faculty. There is room in other core course to manage student load with current faculty. One advisor will be added to support the current students and develop paths for transfer students. Cloud services such as AWS, Microsoft Azure, Google Cloud will be acquired for student learning. Library purchases will be focused on electronic journals and ebooks. Major fee of \$120/semester results in \$28,800 in fees.				

SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR PROPOSED PROGRAM						
INSTITUTION	UNC Charlotte		DATE	3-Sep-19		
Program (CIP, Name, Level)	Data Science					
Degree(s) to be Granted	B.S.		Program Year	Year 3 (2022-2023)		
Differential tuition requested per student per academic yr						
Projected annual FTE students		240				
Projected annual differential tuition		\$0				
Percent differential tuition for financial aid						
Differential tuition remainder		\$0				
ADDITIONAL FUNDS REQUIRED - BY SOURCE						
	Reallocation of Present Institutional Resources	Projected Differential Tuition	Enrollment Increase Funds	Other New Allocations (Identify)	Total	
EPA/SPA Regular Salaries						
	1 \$ -	\$ -	\$ -	\$ 50,000.00	\$ 50,000.00	
EPA Academic Salaries						
	1 \$ 100,000.00	\$ -	\$ -	\$ -	\$ 100,000.00	
Social Security	\$ 7,650.00	\$ -	\$ -	\$ 3,825.00	\$ 11,475.00	
State Retirement	\$ 13,250.00	\$ -	\$ -	\$ 9,430.00	\$ 22,680.00	
Medical Insurance	\$ 6,104.00	\$ -	\$ -	\$ 6,104.00	\$ 12,208.00	
Graduate Stipends						
	6 \$ 15,000.00	\$ -	\$ -	\$ 15,000.00	\$ 30,000.00	
Supplies and Materials						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Current Services						
Cloud Services	\$ -	\$ -	\$ -	\$ -	\$ -	
Travel	\$ -	\$ -	\$ -	\$ -	\$ -	
Communications	\$ -	\$ -	\$ -	\$ -	\$ -	
Printing and Binding	\$ -	\$ -	\$ -	\$ -	\$ -	
Advertising	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00	
Fixed Charges						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Capital Outlay (Equipment)						
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -	
Libraries	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00	
<b>TOTAL ADDITIONAL COSTS</b>	<b>\$ 152,004.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 84,359.00</b>	<b>\$ 236,363.00</b>	
Narrative:	3, one additional faculty line will be reallocated to the School of Data Science through a joint appointment. An advisor will be added to assist students with course direction and curriculum questions. Cloud services such as AWS, Microsoft Azure, Google Cloud will be acquired for student learning. Library purchases will be focused on electronic journals and ebooks. Major fee of \$120/semester results in \$57,600 in fees.					

SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR PROPOSED PROGRAM					
INSTITUTION	UNC Charlotte		DATE	3-Sep-19	
Program (CIP, Name, Level)	Data Science				
Degree(s) to be Granted	B.S.		Program Year	Year 4 (2023-2024)	
Differential tuition requested per student per academic yr					
Projected annual FTE students		380			
Projected annual differential tuition		\$0			
Percent differential tuition for financial aid					
Differential tuition remainder		\$0			
	ADDITIONAL FUNDS REQUIRED - BY SOURCE				
	Reallocation of Present Institutional Resources	Projected Differential Tuition	Enrollment Increase Funds	Other New Allocations (Identify)	Total
EPA/SPA Regular Salaries					
	2 \$ 50,000.00	\$ -	\$ -	\$ 50,000.00	\$ 100,000.00
EPA Academic Salaries					
	2 \$ 200,000.00	\$ -	\$ -	\$ -	\$ 200,000.00
Social Security	\$ 19,125.00	\$ -	\$ -	\$ 3,825.00	\$ 22,950.00
State Retirement	\$ 35,930.00	\$ -	\$ -	\$ 9,430.00	\$ 45,360.00
Medical Insurance	\$ 18,312.00	\$ -	\$ -	\$ 6,104.00	\$ 24,416.00
Graduate Stipends					
	8 \$ 20,000.00	\$ -	\$ -	\$ 20,000.00	\$ 40,000.00
Supplies and Materials					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Current Services					
Cloud Services for Students	\$ -	\$ -	\$ -	\$ -	\$ -
Travel	\$ -	\$ -	\$ -	\$ -	\$ -
Communications	\$ -	\$ -	\$ -	\$ -	\$ -
Printing and Binding	\$ -	\$ -	\$ -	\$ -	\$ -
Advertising	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00
Fixed Charges					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Capital Outlay (Equipment)					
(Identify)	\$ -	\$ -	\$ -	\$ -	\$ -
Libraries	\$ 5,000.00	\$ -	\$ -	\$ -	\$ 5,000.00
<b>TOTAL ADDITIONAL COSTS</b>	<b>\$ 353,367.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 89,359.00</b>	<b>\$ 442,726.00</b>
Narrative:	<p>section of Studio 4 an additional faculty line may be redistributed in Year 4 (total of 2). This will be a joint appointment and will also add capacity to teach core courses in a College (Math or CS). An additional Advisor to manage student inquiries would also be necessary. Cloud services such as AWS, Microsoft Azure, Google Cloud will be acquired for student learning. Library purchases will be focused on electronic journals and ebooks. Major fee of \$120/semester results in \$91,200 in fees.</p>				



Appendix D: Organizational Chart for the School of Data Science



## **B.S. in Data Science**

### *Student Learning Outcomes*

#### **SLO #1**

**Students will utilize tabular data structures, algorithms to implement a solution to solve problems efficiently.**

##### **1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of SLO #1 is completion of the final project with a score of 1 or above which corresponds to acceptable and above on the attached rubric (SLO Appendix A).

##### **1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, data analysis, as well as various programming techniques.

Summative Assessments- For the direct measure, the final project assesses the student's knowledge of the course objectives relevant to analyzing and interpreting data using appropriate data structures, algorithms, and programming. DTSC 1302 is an introductory course with data structures and algorithms in the final project to be appropriate for that level of course (tabular data, descriptive statistical analysis, and simple modeling such as linear regression). The rubric will be utilized and based upon the expected level of data structures, mathematics, and programming.

Faculty Data Collection & Review: The DTSC 1302 faculty will utilize a standardized rubric to grade the final project and report the results to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as acceptable and above as defined in the standardized rubric (SLO Appendix A).

##### **1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the final project for DTSC 1302 with an acceptable level [1] or above as defined in the standardized rubric.

**Supporting Documentation: Course Syllabus, and Standardized Rubric**

## **SLO #2**

**Students will utilize advanced data structures, algorithms to implement a solution to solve problems efficiently.**

### **1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of SLO #1 is completion of the final project with a score of 1 or above which corresponds to acceptable and above on the attached rubric (SLO Appendix A).

### **1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, data analysis, as well as various programming techniques.

Summative Assessments- For the direct measure, the final project assesses the student's knowledge of the course objectives relevant to analyzing and interpreting data using appropriate data structures, algorithms, and programming. DTSC 2302 has more advanced data structures (e.g. linked tables) and a higher level of statistical models (multivariate regression, classification, etc). The rubric will be utilized and based upon the expected level of data structures, mathematics, and programming.

Faculty Data Collection & Review: The DTSC 2302 faculty will utilize a standardized rubric to grade the final project and report the results to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as acceptable and above as defined in the standardized rubric (SLO Appendix A).

### **1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the final project for 2303 with an acceptable level [1] or above as defined in the standardized rubric.

**Supporting Documentation: Course Syllabus, and Standardized Rubric**

**SLO#3** (*required written communication SLO to address undergraduate education goals*)

**Students will communicate effectively incorporating professional behavior, utilizing inclusive language, employing an evidence-based approach that can be understood by both data science professionals and laypersons in related fields utilizing written communication.**

**1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of written communication skills are the results of the final project paper for DTSC 3602 with a score of [1] or above which corresponds to meets expectations and above on the attached standardized written communication rubric (SLO Appendix B).

**1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, role-play, and self-assessment.

Summative Assessments- For the direct measure, the final project written report assesses the student's knowledge of the course objectives relevant to written and oral communication of the results of data analyses.

Faculty Data Collection & Review: The DTSC 3602 faculty will utilize a standardized rubric to score the final project written report and report the results on written skills to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as [1] or meets expectations and above as defined in each standardized rubric.

**1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the final project written report for DTSC 3602 with a grade of [1] or meets expectations and above as defined in the standardized rubric.

**Supporting Documentation: Course Syllabus and Standardized Rubric**

**SLO#4** (*required oral communication SLO to address undergraduate education goals*)

**Students will communicate effectively incorporating professional behavior, utilizing inclusive language, employing an evidence-based approach that can be understood by both data science professionals and laypersons in related fields utilizing oral communication.**

**1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of oral communication skills are the results of the final project presentation for DTSC 3602 with a score of [1] or above which corresponds to meets expectations and above on the attached standardized oral communication rubric (SLO Appendix C)

**1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, role-play, and self-assessment.

Summative Assessments- For the direct measure, the final project oral presentation assesses the student’s knowledge of the course objectives relevant to written and oral communication of the results of data analyses.

Faculty Data Collection & Review: The DTSC 3602 faculty will utilize a standardized rubric to score the final project oral presentation and report the results on oral communication skills to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as a score of [1] or meets expectations and above as defined in each standardized rubric.

**1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the final project oral presentation for DTSC 3602 with a grade of [1] or meets expectations and above as defined in the standardized rubric.

**Supporting Documentation: Course Syllabus and Standardized Rubric**

## **SLO#5**

### **Students will evaluate the ethical considerations of applying data science to a real-world problem.**

#### **1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of SLO#5 are the results of the written report of the capstone project for DTSC 4302 with a score of [1] or above which corresponds to meets expectations and above on the attached standardized ethical reasoning rubric (SLO Appendix D).

#### **1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, various application/analysis level techniques, and lab practice sessions.

Summative Assessments- For the direct measure, the written report of the capstone project assesses the student's knowledge of the course objectives relevant to the ethical considerations of a data science project aimed at solving real-world problems.

Faculty Data Collection & Review: The DTSC 4302 faculty will utilize a standardized rubric to grade the capstone written submission and report the results on the ethics skills to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as a score of [1] or meets expectations and above as defined in each standardized rubric.

#### **1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the written report of the capstone project for DTSC 4302 with a score of [1] or meets expectations and above as defined in the standardized rubric.

#### **Supporting Documentation: Course Syllabus and Standardized Rubric**

**SLO#6** (*required critical thinking SLO to address undergraduate education goals*)

**Students will design and execute a data science project that combines technical, analytical, interpretive and social dimensions to solve a real-world problem.**

**1.1 Plan for Current Year - Effectiveness Measure:**

The direct measure used to gauge acquisition of SLO#6 are the results of the written report of the capstone project for DTSC 4302 with a score of [1] or above which corresponds to meets expectations and above on the attached standardized critical thinking rubric (SLO Appendix E).

**1.2 Plan for Current Academic Year – Methodology:**

Instructional Methodology- Synchronous lecture sessions with discussions, case studies, various application/analysis level techniques, and lab practice sessions.

Summative Assessments- For the direct measure, the written report of the capstone project assesses the students' ability to utilize critical thinking to design and execute a real-world problem with social implications with data science methods and processes.

Faculty Data Collection & Review: The DTSC 4302 faculty will utilize a standardized rubric to grade the capstone written submission and report the results on critical thinking to the executive director. Review of the data will occur at the next program faculty meeting following the end of the semester. Changes will be recommended to the executive director and the program board based on the data collected and feedback from faculty.

Level of Proficiency: Proficiency will be defined as a score of [1] or meets expectations and above as defined in each standardized rubric.

**1.3 Plan for Current Academic Year - Expected Performance Outcome:**

Performance Outcome: The performance outcome for the direct measure is defined as 75% or more of the students will complete the written report of the capstone project for DTSC 4302 with a score of [1] or meets expectations and above as defined in the standardized rubric.

**Supporting Documentation: Course Syllabus and Standardized Rubric**

SLO Appendix A

SLO #1 and #2: Students will utilize data and algorithms to solve problems efficiently.

**DTSC 1302 and DTSC 2302  
Rubric for BS in Data Science**

	<b>Excels (2)</b>	<b>Acceptable (1)</b>	<b>Unacceptable (0)</b>
<b>Analyze/Identify problem</b>	Correctly determines the desired output, determines necessary input, creates a flow diagram, and defines the objective of each module.	Able to determine the desired output, determines necessary input, creates a flow diagram defines the objective of each module with few (1-3) errors.	Does not address all components of problem analysis process or makes more than three errors in the execution of the process.
<b>Design the solution</b>	Diagrams a structure chart, selects data type/structure that best aligns with the problem, and utilizes an efficient algorithm.	Diagrams a structure chart, selects data type/structure that is applicable but not the best fit, and utilizes an algorithm that may solve the problem in less efficient manner.	Does not address all components of the solution design process or uses incorrect data structures/algorithms.
<b>Implements the solution</b>	Chooses program language that is most appropriate, codes the algorithm and provides thorough documentation with abundant internal comments.	Chooses an applicable language, codes the algorithm and good documentation with some internal comments.	Does not address all components of the process, does so incorrectly and/or provides limited documentation and limited comments.



SLO Appendix B:

SLO #3: Students will demonstrate acceptable written communications skills.

**DTSC 3602**

**Written Communication Rubric for BS in Data Science**

	<b>Excels (2)</b>	<b>Acceptable (1)</b>	<b>Unacceptable (0)</b>
<b>Organization</b>	Information in logical, interesting sequence which reader can follow.	Student has minimal organization but topic sentences are not present in all paragraphs.	Sequence of information is difficult to follow.
<b>Content Knowledge</b>	Student demonstrates full knowledge (more than required).	Student seems to understand content but fails to elaborate.	Student does not have grasp of information.
<b>Grammar and Spelling</b>	Work has no misspellings or grammatical errors.	Work has three to four misspellings or grammatical errors.	Work has seven or more spelling errors and/or grammatical errors.
<b>Conclusion</b>	Work's conclusion totally supports thesis	Work has support of thesis but not already stated.	Work does not support thesis
<b>References</b>	Work displays the correct number of references, written correctly.	Reference section not completely correct.	Work displays no references.

SLO Appendix C:

SLO #4: Students will demonstrate acceptable oral communications skills.

**DTSC 3602**

**Oral Communication Rubric for BS in Data Science**

	<b>Excels (2)</b>	<b>Acceptable (1)</b>	<b>Unacceptable (0)</b>
<b>Organization</b>	Presentation is clear, logical and organized. Listener can follow line of reasoning.	Presentation is clear, logical and organized. Listener can follow line of reasoning.	Listener can follow presentation only with effort. Some arguments are not clear. Organization seems haphazard.
<b>Style</b>	Level of presentation is appropriate for the audience. Presentation is a planned conversation, paced for audience understanding. It is not a reading of a paper. Speaker is clearly comfortable in front of the group and can be heard by all.	Level of presentation is generally appropriate. Pacing is sometimes too fast or too slow. The presenter seems slightly uncomfortable at times, and the audience occasionally has trouble hearing him/her.	Aspects of presentation are too elementary or too sophisticated for audience. Presenter seems uncomfortable and can be heard only if listener is very attentive. Much of the information is read.
<b>Communication Aids including Data Visualizations</b>	Communication aids enhance the presentation. They are prepared in a professional manner. <ul style="list-style-type: none"> <li>• Font on visuals is large enough to be seen by all</li> <li>• Information and data are organized to maximize audience understanding.</li> <li>• Details are minimized so that main points stand out.</li> </ul>	Communication aids contribute to the quality of the presentation. <ul style="list-style-type: none"> <li>• Font size is appropriate for reading.</li> <li>• Appropriate information is included.</li> <li>• Some material is not supported by visual aids.</li> </ul>	Communication aids are poorly prepared or used inappropriately. <ul style="list-style-type: none"> <li>• Font is too small to be easily seen.</li> <li>• Too much information is included.</li> <li>• Unimportant material is highlighted.</li> <li>• Listeners may be confused.</li> </ul>

SLO Appendix D:

SLO #5: Students will demonstrate acceptable ethical reasoning skills.

**DTSC 4302**

**Ethical Reasoning Rubric for BS in Data Science**

	<b>Excels (2)</b>	<b>Acceptable (1)</b>	<b>Unacceptable (0)</b>
<b>Identifies potential ethical issues</b>	Identifies potential sources of bias in data, applicable legal and regulatory frameworks, privacy concerns, as well as other ethical considerations.	Identifies some potential sources of bias in data, applicable legal and regulatory frameworks, privacy concerns.	Does not identify ethical concerns or focuses on a single form of potential ethical issues.
<b>Assessment and Critique</b>	Assesses risks that arise due to the potential issues including concerns that may conflict with each other. Identifies all stakeholders, critiques the situation, and provides suggestions on how to balance potentially conflicting viewpoints.	Assesses some risks that arise due to the potential ethical issues. Identifies some stakeholders, critiques the situation, and provides a point of view.	Assesses no or only a few risks. Only provides a point of view from a single or aligned stakeholders. Minimally addresses conflicting stakeholders and viewpoints.
<b>Appropriate solutions and recommendations</b>	Comprehensively develops models and solutions that address the ethical issues and considerations of most if not all stakeholders. Demonstrates sensitivity to areas where tradeoffs were required.	Adequately develops models and solutions that address most ethical issues and considerations for the primary stakeholders.	Does not address or minimally addresses ethical issues in solution. May focus on single stakeholder without addressing the complexity of other impacted groups or society.

SLO Appendix E:

SLO #6: Students will demonstrate acceptable critical thinking skills.

**DTSC 4302**

**Critical Thinking Rubric for BS in Data Science**

	<b>Excels (2)</b>	<b>Acceptable (1)</b>	<b>Unacceptable (0)</b>
<b>Poses research questions</b>	Student poses a research question that is clearly stated, relevant to the literature, important, and testable.	Student poses a research question that is clearly stated, but one of the following is missing: relevance to the literature, importance, or testability.	Research Question is not clearly stated and/or two of the following are missing: relevance to the literature, importance, and testability.
<b>Synthesizes existing research</b>	Clearly summarizes and critiques research. Applies the literature to the research question. The literature review does not deviate from the research question. Critically compares and evaluates competing perspectives.	Clearly summarizes and critiques research. Applies the literature to the research question. The literature review does not deviate from the research question.	Relevant research is missing from the literature review or the literature review deviates from the research question.
<b>Makes meaningful interpretation of results</b>	Discussion of results and conclusions are connected to the research question, hypotheses, and existing research. Identifies other possible interpretations and defends chosen interpretation.	Discussion of results and conclusions are connected to the research question, hypotheses, and existing research.	Limited ability to explain results (not connected to research question, hypotheses, and existing research)



THE  
UNIVERSITY OF  
NORTH CAROLINA  
SYSTEM

## Letter of Intent to Develop New Academic Degree Program

The following approvals must be obtained prior to sending the Letter of Intent to Develop a New Academic Degree Program to the UNC System Office.

**Institution** \_\_\_\_\_ University of North Carolina Charlotte \_\_\_\_\_

**Degree Program Title (e.g. M.A. in Biology)** \_\_\_\_\_ B.S. in Data Science \_\_\_\_\_

**Reviewed and Approved By (Name and title only. No signature required in this section.)**

**Check box to indicate participation in review. (Provost is required.)**

**Provost: Joan F. Lorden**

**Faculty Senate Chair (as appropriate):** n/a

**Graduate Council (as appropriate):** n/a

**Undergraduate or Graduate Dean (as appropriate): John Smail**, Associate Provost for Undergraduate Education & Dean of University College

**Academic College Dean: Fatma Mili**, Dean, College of Computing and Informatics, **Nancy Gutierrez**, Dean, College of Liberal Arts and Sciences

**Department Chair: Bojan Cukic**, Chair, Department of Computer Science, **Mary Lou Maher**, Chair, Department of Software and Information Systems

**Program Director/Coordinator: Bojan Cukic**, Interim Director, Data Science Initiative

### **New Academic Proposal Process**

New academic programs are initiated and developed by the faculty members. Approval of the Letter of Intent to Develop a New Academic Degree Program must be obtained from department chairs and college deans or equivalent administrators before submission to the UNC System Office review.

Directions: Please provide a succinct, yet thorough response to each section. Obtain the Provost's signature and submit the proposal via the PREP system to the UNC System Vice President for Academic Programs, Faculty, and Research, for review and approval by the UNC System Office. Once the Letter of Intent to Develop is approved, the institution can begin work on the formal Request to Establish a New Degree Program.

## Letter of Intent to Develop a New Academic Degree Program

Institution	University of North Carolina Charlotte
Joint Degree Program (Yes or No)? If so, list partner campus.	No
Degree Program Title (e.g. M.A. in Biology)	B.S. in Data Science
CIP Code and CIP Title (May be found at <a href="#">National Center for Education Statistics</a> )	30.0801
Require UNC Teacher Licensure Specialty Area Code (Yes or No). If yes, list suggested UNC Specialty Area Code(s).	No
Proposed Delivery Mode (campus, online, or site-based distance education). Add maximum % online, if applicable.	Campus
Proposed Term to Enroll First Students (e.g. Spring 2019)	Fall 2019
List other programs in the UNC System (may be found at <a href="#">UNC System website</a> )	None

**SACSCOC Liaison Statement:** *(Provide a brief statement from the University SACSCOC liaison regarding whether the new program is or is not a substantive change.)*

The BS in Data Science program is a significant departure in content from what is currently offered at the institution. Therefore, a substantive change prospectus must be submitted and approved by SACSCOC prior to implementation.

**Program Summary:** *(Briefly describe the proposed program and summarize the overall rationale.)*  
Maximum of 1,000 words.

In May 2018 the National Academies of Sciences, Engineering, and Medicine (NAS) issued a report from the Committee on Envisioning the Data Science Discipline entitled “Data Science for Undergraduates: Opportunities

and Options.”<sup>1</sup> This report unequivocally recommends that universities develop undergraduate degrees in Data Science (Recommendation 2.1).

Data Science is a rapidly developing field. A number of universities have developed Master’s and doctoral degrees in Data Science within the last decade in order to respond to growing demand for ‘big data’ analytics. However, as the NAS report documents, the increase in automation, data engineering and analytics means that demand for undergraduate data science programs is growing. Graduates with bachelors’ degrees in Data Science will be equipped to “operate the systems on which analyses are run, prepare data for analysis, and visualize information.” More broadly, a Data Science undergraduate degree provides students with “data acumen,” a wide range of competencies including:

- Mathematical/Computational/Statistical Foundations,
- Data management, visualization, modeling and assessment,
- Workflow and reproducibility,
- Communication and teamwork,
- Domain specific considerations, and
- Ethical problem solving.

These competencies will prepare graduates for careers in a broad range of fields where the ability to understand and use data is critical.

The University of North Carolina Charlotte (UNC Charlotte) is proposing a new Bachelor of Science in Data Science degree that fully responds to the opportunities articulated in the NAS report. The University has already developed significant capacity in the field with an ongoing data science initiation and goal of the creation of a cross-college School of Data Science as well as the implementation of very successful Professional Science Masters’ programs in Health Informatics and Data Science and Business Analytics. However, well before the release of the NAS report, UNC Charlotte’s Data Science faculty, working with industry partners, realized that there was a need for an undergraduate degree in the field and began planning the state’s **first undergraduate degree** in the field.

The curriculum for UNC Charlotte’s proposed BS in Data Science is fully aligned with the recommendations in the NAS report. In particular, the report recommends that an undergraduate data science degree should be different from traditional computer science or statistics majors; it recommends that the degree be open to a broad range of students and equip them for success in a broad range of careers (Recommendations 2.2, 4.1). Responding to that charge, the curriculum for UNC Charlotte’s BS in Data Science will be built around a sequence of four 6-hour studios, one in each of the four years. These studio experiences will allow students to progressively develop mathematical skills, computational and statistical thinking, data modeling, and knowledge engineering in at least one application domain. The studio format for these core courses ensures that the development of technical competencies will be situated in the context of domain knowledge because each studio will focus on a real-world problem. In addition to technical competencies, students will develop teamwork, communication, and problem solving skills as well as building a deep understanding of the ethics and privacy issues (Recommendation 2.4). Complementing these data science studio experiences, the curriculum

---

<sup>1</sup> NAS Report: [http://sites.nationalacademies.org/cstb/currentprojects/cstb\\_175246](http://sites.nationalacademies.org/cstb/currentprojects/cstb_175246)

will include a set of core course requirements in both computing and statistics. In addition, students will have the opportunity to further enhance their degree by pursuing richer domain knowledge and/or deeper technical skills. The 120-credit hour curriculum will include opportunities for experiential learning and will be offered in a classroom setting, where active learning methodologies will be used wherever appropriate.

UNC Charlotte's proposed BS in Data Science directly supports the mission of the University of North Carolina system, "to discover, create, transmit, and apply knowledge to address the needs of individuals and society." A critical component of data science education is to guide students to develop data acumen. This requires exposure to key concepts in data science, real-world data and problems that can reinforce the limitations of tools, and ethical considerations that permeate many applications. Key foundational concepts related to data acumen are at the core of competitive capabilities of every business, government, or non-profit organization today. The ability of UNC institutions to incorporate data science best practices is the key component in their long-term viability, resilience, and sustainability.

The proposed new degree program also addresses key elements in the mission of UNC Charlotte. As North Carolina's urban research university, UNC Charlotte leverages its location in the state's largest city to offer internationally competitive programs of research and creative activity, exemplary undergraduate, graduate, and professional programs, and a focused set of community engagement initiatives. UNC Charlotte's data science initiative brings together faculty from the Colleges of Computing and Informatics, Liberal Arts & Sciences, Business, and Health and Human Services. By exposing students to real-world data and problems, the undergraduate Data Science program will emphasize educational considerations that clearly align with UNC Charlotte's mission, including social mobility, public policy, and urban analytics. We have clear evidence from employers in the region of their interest in graduates who have the competencies we will be developing in this degree.

As noted, UNC Charlotte's proposed BS in Data Science is the first undergraduate degree in Data Science in North Carolina. Currently Fayetteville State, NC State, and UNC Charlotte offer post-baccalaureate certificates in Data Science. UNC Wilmington, East Carolina, Appalachian State, NC State and UNC Charlotte offer Master's degrees in the field. At UNC Charlotte, Professional Science Master's programs in Health Informatics and Data Science and Business Analytics narrowly focus on the two specialized application areas. Our graduate programs focus on offering working professionals practical knowledge and tools necessary to advance in current jobs or switch careers and thrive in specific sectors of data driven economy. The proposed undergraduate degree will prepare graduates for work in virtually every job sector and in a number of roles.<sup>2</sup> If other institutions within the UNC System seek to develop undergraduate degree programs in Data Science, UNC Charlotte will be open to share its experiences and insights.

**Student Demand:** *(Provide evidence of student demand. Discuss the extent to which students will be drawn from a pool of students not previously served by the institution. Maximum length 1,000 words.)*

Given that the discipline of Data Science is so new and that undergraduate degrees are, as yet, relatively rare, there is limited direct evidence on student demand. The NAS report published in May 2018 identified eight

---

<sup>2</sup> [http://sites.nationalacademies.org/cstb/currentprojects/cstb\\_175246](http://sites.nationalacademies.org/cstb/currentprojects/cstb_175246); pp. S-2



undergraduate degree programs in Data Science in the country including the University of Michigan, Virginia Tech, UC San Diego, UC Irvine, University of Rochester, MIT and New York University. This list is not exhaustive, but the caliber of the institutions offering degrees in the field is obvious and most of these programs are only a year or two old and enrollment figures are not publicly available.<sup>3</sup> At the University of California at Berkeley, the new major in Data Science has been approved and will enroll students in Fall 2018. However, data science courses have been extremely popular with students from other majors on campus. In a recent conversation (July 2018), the Chair of the Department of Electrical Engineering and Computer Science at UC Berkeley Prof. James Demmel revealed that 1,470 undergraduate students have already registered for the introductory undergraduate “Data 8” course offered in Fall 2018.

Indirect evidence of student demand at UNC Charlotte and in North Carolina is also abundant. For example, student demand for enrollment in UNC Charlotte Master’s level programs should be a relevant metric. UNC Charlotte launched its Data Science and Business Analytics (DSBA) Professional Science Master’s degree in 2014. Despite being one of the first such degrees in the country, and with minimal marketing, the program receives over 700 applications a year, and it is enrolled to capacity with 175 students. Given the admissions requirements for a Master’s degree this level of student interest suggests that demand for an undergraduate degree will be significant too.

A second source of evidence for student demand is enrollment trends in related undergraduate fields such as applied mathematics and computer science. Between 2013 and 2017 undergraduate enrollment in applied mathematics (specifically the major in Mathematics for Business) has almost tripled from 42 to 117, and over the same period the number of majors in all fields of Computer Science at UNC Charlotte has almost doubled from 1071 to 1875. While the proposed BS in Data Science may recruit some of the students currently choosing these majors, its overall impact will be to complement rather than compete with these existing degree programs. The strong demand for these degrees suggests that the student demand for the proposed BS in Data Science will be robust, and this is particularly true given the excellent job placement prospects for graduates with these skills and the job satisfaction and salaries in the field.<sup>4</sup>

In this regard, it is important to stress that the curriculum of the proposed degree is specifically designed to have much broader appeal than more traditional computer science or applied mathematics degrees in two respects. First, the tightly structured sequence of pre-requisite courses in the current majors represents a barrier for transfer students or students who are changing their major. This is particularly true for computer science and as a result a relatively large number of students start in the major having already earned 45-60 hours but requiring six more semesters to graduate. (An unknown number of students simply do not declare the major because they cannot finish the required courses in a timely manner.) Based on both national evidence such as that presented in the NAS report on “Data Science for Undergraduates” and the expertise of the local and regional employers who are members of UNC Charlotte’s Data Science Initiative advisory board, we will design the BS in Data Science to be much more flexible.<sup>5</sup> It will obviously have some prerequisite sequences, but the degree will be open to a much broader group of students including new transfers from community colleges that do not offer

---

<sup>3</sup> [http://sites.nationalacademies.org/cstb/currentprojects/cstb\\_175246](http://sites.nationalacademies.org/cstb/currentprojects/cstb_175246); pp. 3-5 to 3-6

<sup>4</sup> [https://www.glassdoor.com/List/Best-Jobs-in-America-LST\\_KQ0,20.htm](https://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm)

<sup>5</sup> [http://sites.nationalacademies.org/cstb/currentprojects/cstb\\_175246](http://sites.nationalacademies.org/cstb/currentprojects/cstb_175246); pp. 4-2 to 4-4

the full complement of computing or applied mathematics courses. Second, the real world, problem-solving focus will make the BS in Data Science attractive to students who do not see themselves as computing or mathematics majors. Students' perception that they are not a good 'fit' for a computer science or mathematics major is one of reasons why those fields, and STEM disciplines more generally, have problems attracting women and underrepresented minorities. Research in STEM education and Computer Science education specifically, suggests that a problem based curriculum similar to the one proposed for the BS in Data Science can make a crucial difference in attracting underrepresented students to the field.<sup>6</sup> In both respects, then, UNC Charlotte's proposed degree will allow us to educate students not currently served by the institution in this field.

**Societal Demand:** *(Provide evidence of societal demand and employability of graduates from each of the following source types. Maximum length 1,000 words)*

There is abundant evidence of societal demand for the graduates of the proposed BS in Data Science. In a study released in 2017, the job market analytics firm Burning Glass partnered with IBM and the Business Higher Education Forum to study the emerging impact of Data Science in the job market.<sup>7</sup> The results suggest a rapid transformation across almost all industry clusters (and government and non-profit as well) as firms and organizations respond to the realities of 'big data.' In 2016 alone, the number of jobs specifically advertised for data science grew by 54%, and there was a corresponding growth in the number of postings for positions requiring the kinds of skills that a data science undergraduate would possess including quantitative data analysis and data visualization. The report predicts that 364,000 new data science positions will be created by 2020. The report describes the job market in data science as extending over a spectrum of analytical rigor from individuals with doctoral degrees who create the sophisticated models to "data savvy" workers who will need a foundational understanding of data and analytics to work on teams with more technically focused members. In the latter category alone, the report anticipates more than 100,000 new job postings by 2020. Significantly, while the report shows that some areas of the data science job market require talent with advanced degrees, most do not. Overall, only 6% of the postings analyzed required a graduate degree. Finally, this report makes clear that because of the paucity of graduates with specific qualifications in the field, positions take longer than average to fill and employers are casting widely for individuals with the requisite skill set.

To complement the national picture provided by the Burning Glass / IBM / BHEF report, UNC Charlotte commissioned a report from EAB on the job market for undergraduate data science graduates in North Carolina and the findings are similar.<sup>8</sup> Between the second half of 2013 and the first half of 2017, the number of positions posted in North Carolina that specifically required a bachelors' in Data Science grew by 76%, and in the Charlotte region the growth was 109%. More broadly, positions that mention competencies developed in a BS in Data Science grew from 2,337 to 4,777 in the last year. Similar information is conveyed in the IT Job Trends reports gathered by NC Tech Association.<sup>9</sup> As is true nationally, firms and organizations are seeking to hire

---

<sup>6</sup> [http://sites.nationalacademies.org/cstb/currentprojects/cstb\\_175246](http://sites.nationalacademies.org/cstb/currentprojects/cstb_175246); pp. 4-2 to 4-4

<sup>7</sup> "The Quant Crunch: How Demand for Data Science Skills is Disrupting the Job Market," Burning Glass Technologies, 2017, available for download at <https://www.burning-glass.com/research-project/quant-crunch-data-science-job-market/>

<sup>8</sup> "Employer Demand for Bachelor's - Level Data Science Professionals, custom report for UNC Charlotte prepared by EAB; full report included in the appendix.

<sup>9</sup> [https://www.nctech.org/\\_files/\\_pdf/Tech%20Talent/NC%20Tech%20Trends-May%202018.pdf](https://www.nctech.org/_files/_pdf/Tech%20Talent/NC%20Tech%20Trends-May%202018.pdf)

across the spectrum of data science. Importantly, there is strong employment potential for individuals with the type of broad, applied expertise that UNC Charlotte's BS in Data Science will be designed to develop. The report notes the small numbers of undergraduate data science degrees being offered nationally and only identified one possible North Carolina program -- a "possible Undergraduate minor in Data Science/Data Studies" at the University of North Carolina Chapel Hill.<sup>10</sup>

Finally, as part of the degree planning process, UNC Charlotte consulted with employers in the region to assess their needs for graduates with data science skills and their assessment of the employability of students completing the proposed BS in Data Science. Executives from 10 companies quickly replied and expressed undivided support for the creation of the program (see attached). The companies they represent include the range from small analytic consultancy start-ups (Hague Advisory) to well established data analytics providers (Quaero, ADP Ventures, Grant Thornton, Gray Matter Analytics), large corporations (Bank of America, Wells Fargo, TIAA, Duke Energy) and product developers (MapR Data Technologies). All the letters quote national and regional statistics about current and anticipated labor shortage in data analytics and strongly endorse the proposed undergraduate Data Science degree program at UNC Charlotte. Mr. Tim Reagan of Gray Matter Analytics offered a testimony that his previous employer "had to leverage Executive Search firms to acquire entry to mid-level talent", a very expensive approach to solve staffing shortage in the data science domain. He explicitly encourages the creation of the BS in Data Science as "the great response to a growing market need". Joel Amick of TIAA also strongly supports the new degree program because "... finding the right people who are capable of working in cross-functional teams, incorporating domains like statistics, engineering, and business analysis, requires a different type of preparation." Tom Fisher of MapR Technologies emphasizes that "today's market allows knowledge workers to live and work anywhere", allowing his company headquartered in Silicon Valley to hire UNC Charlotte's graduates who may want to stay in this area. Chris Heck of Duke Energy notes that the keys to digital transformation of his company include the knowledge and skills of future Data Science program graduates. Misha Dosh of ADP Ventures – Big Data emphasizes that "...it is imperative that we feed the pipeline of qualified candidates interested in the data sciences" calling the proposed program "a proactive investment in the field of professional data sciences; a field that will continue to grow well into the future."

In summary, industry support letters representing a large cross-section of companies in the region, demonstrate the interest for data science talent in general and strongly support the initiative to create BS Data Science degree at UNC Charlotte. Their letters do not appear to leave any doubt about the employment prospects of our future students.

---

<sup>10</sup> <https://research.ncsu.edu/dsi/education/education-unc-ch/>

**Contact:** (List the names, titles, e-mail addresses and telephone numbers of the person(s) responsible for planning the proposed program.)

Position Title	Name	E-mail Address	Telephone
Dean of the College of Computing and Informatics	Dr. Fatma Mili	fatma.mili@uncc.edu	704-687-8450
Dean of the College of Liberal Arts and Sciences	Dr. Nancy A. Gutierrez	ngutierr@uncc.edu	704-687-0081
Chair of the Department of Computer Science, and Interim Director of the Data Science Initiative	Dr. Bojan Cukic	bcukic@uncc.edu	704-687-6155
Chair of the Department of Software and Information Systems	Dr. Mary Lou Maher	M.Maher@uncc.edu	704-687-1940

This Letter of Intent to Plan a New Program has been reviewed and approved by the appropriate campus authorities.

Position Title	Signature	Date
Provost		8/24/2018



June 14, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Mr. Hertel:

I am writing to express my strong support for UNC Charlotte's proposed new degree program in Data Science (Bachelor of Science). I am Head of the Advanced Techniques for Modeling Group in Corporate Model Risk (CMoR) and a senior member of the Quantitative Modeling community in Wells Fargo. Data Science has become increasingly important in banking and financial institutions, and much of our current work deals with modeling, computing, and visualization. More recently, we are moving to machine learning and AI with application covering credit, operational, and market risk, anomaly detection, natural language processing for chatbots, document automation, and various kinds of text analytics.

Before joining Wells Fargo, I was in academia for a long time. I was the Donald A. Darling professor of statistics at the University of Michigan, Ann Arbor and I also served as Chair of the Statistics Department for 12 years. During my time there, I was instrumental in launching multiple initiatives on Data Science. I led the efforts to start an undergraduate degree program in Data Science in 2015. This was a joint program between the College of Literature, Science & Arts and the College of Engineering. Our market analysis indicated a huge need for Data Scientists at all levels and the country was facing a shortfall of several hundred thousand jobs over the next 10 or so years. More recently, UM has started a Master's program in DS. Many other major universities across the country have also been launching similar programs to educate students in this emerging area of study, one that is turning out to be critical importance. In addition, many academic institutions have also started initiatives to promote cross-campus research collaborations and stimulate partnerships with industry. At UM Ann Arbor, I was instrumental in creating the Michigan Institute for Data Science (MIDAS) which had an initial funding of \$100M by the University. MIDAS has become very successful and has been serving as an incubator for transformative applied research in key areas, including Intelligent Transportation, Personalized Medicine, Social Sciences and Learning Analytics. It brings together students and faculty across campus to share their interests in, and learn about, data-intensive research.

In summary, I am very excited to see the proposed degree program in Data Science and UNCC. Graduates with these skills are in short supply, both in industry and the research community, so we are pleased to endorse this program enthusiastically.

Sincerely

Vijay Nair, PhD  
Managing Director and Head of Advanced Technologies for Modeling  
Corporate Model Risk (CMoR)



June 6, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends,

I am writing to express my strong support, on behalf of Hague Advisor Services for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

I have led and hired hundreds of analytics professionals over the last 20 years in financial services, telecom and aerospace companies and am now advising large companies across many more industries about how to build analytical capabilities including data science teams. In all of this, talent is a common factor of concern and stress for the executives leading the programs. As I've hired for the teams and advised others, any company needs to have a range of skills capability. In a universities terms, this is thought of as bachelors, masters and PhD program. UNC Charlotte has a masters program in data science and business analytics, but no undergraduate program. This is a large gap. For many years, I've hired, mathematicians, computer scientist, engineers, and economist at the BS level and then had to take their raw talent and train them in data science and analytics. It was always the students who had one of the degrees with computer science as a minor or second major that were the closest to what we were looking for. The demand for these skills set continue to expand and will for years to come.

I see the proposed creation of the new undergraduate degree in Data Science as great response to market demand. For this reason, I believe every institution of higher learning should be investing in data science educational opportunities for its students - and none more so than UNC Charlotte.

Sincerely,

Douglas C. Hague PhD  
Chief Analytics Officer-Hague Advisory Services  
Chair-Industrial Advisory Board, UNCC Data Science and Business Analytics Program

June 9, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends,

I am writing to express my strong support, on behalf GrayMatter Analytics for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

I have led and developed multiple organizations in the Healthcare analytics space, specifically in the last 10 years. During this time, as the analytics discipline has matured, there continues to remain deficit of qualified resources in the market place to meet the current demand for talent. While at Carolinas Healthcare, our analytics department had to leverage Executive Search firms to acquire entry to mid-level talent. This was an expensive approach to solve the war on talent, specifically in the Charlotte market.

This demand for talent will continue to grow across all business verticals, including healthcare. Understanding this opportunity, in my perspective, positions UNCC to provide a curriculum for current and future students to meet this growing demand for talent. The creation of the new undergraduate degree in Data Science is a tremendous opportunity for UNCC, the City of Charlotte, and the Charlotte Business community.

Sincerely

Tim Reagan  
Vice President, Gray Matter Analytics

June 15, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends,

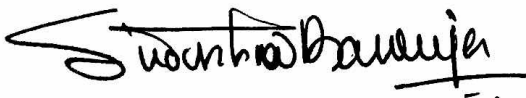
I am writing to express my strong support for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

I have spent a large part of my career working on advanced analytics related roles. During this time, I have experienced rapid transformations in the way data is increasingly being viewed as an asset and is leveraged in driving strategic decisions. Areas of rapid growth include not only modeling data through Artificial Intelligence, Machine Learning, Deep Learning etc. but also capturing and wrangling structured, unstructured and semi structured data and storyboarding the outcome. Advanced analytics therefore encompasses a wider range of skills starting from sourcing the data all the way through cataloging, curating, communicating and executing the data driven outcomes. This type of skillset usually resides in the intersection of data, technology and business and is a critical need today. A degree in Data Science provides a nice integration point between data, technology and business application.

The demand for these skills continue to expand and will for years to come. Therefore, a requirement for an interdisciplinary area of study is a proactive response to the growing demand. UNC Charlotte already has a Master's Program in Data Science and Business Analytics but not an undergraduate degree. This is a large gap. The proposed Bachelor of Science degree will ensure that we have a qualified candidate pool equipped with the right skills, knowledge and expertise to be successful in the Master's Program and fill the talent gap.

I see the proposed creation of the Bachelor of Science in Data Science degree as great response to a growing market demand. It will catalyze building data science leaders of the future.

Sincerely,



Sudeshna Banerjee  
Senior Vice President, Data Science Executive  
Bank of America





**Joel Amick**  
Director, Cyber Analytics and Data  
Science  
Cyber Security  
T 704-988-3267  
jamick@ttaa.org

June 8<sup>th</sup> 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends and Colleagues,

I am writing to express my strong support, on behalf of TIAA for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

In running a Data Science centric team I have seen firsthand how transformative a discipline like Data Science is to our future growth. As such, the need for qualified individuals to build out this workforce is critical and at an all-time high. As this space evolved so rapidly, we are hard pressed to keep up. In our company we are witnessing the rapid transformation of our work and our organizations with the rise of data science and a demand across every business domain. Areas of growth and innovation include, but are not limited to: machine learning, artificial intelligence, Image recognition and new methods for securing, managing, and mining massive flows of unstructured data. Each of these technologies is forcing us to completely re-think how we add value for our customers, how we staff our teams and how we plan and invest for the future.

New data-based technologies are also causing us to re-think the skills, experience, competencies, and the talents that will be required for successful professionals. Finding the right people who are capable of working in cross-functional teams, incorporating domains like statistics, engineering, and business analysis, requires a different type of preparation. Our company has a current need for professionals who possess a deep understanding of data science, and how to apply data tools and technologies to the most complex problems.

We see the proposed creation of the new undergraduate degree in Data Science as an agile response to market demand. The demand for new talent is not going to change - it will only intensify. For this reason, I believe every institution of higher learning should be investing in data science educational opportunities for its students - and none more so than UNC Charlotte as a critical generator of talent for a thriving and growing modern city like Charlotte. I have worked with UNCC on their Graduate program but the need for an undergrad in this discipline is paramount.

Sincerely

Joel Amick  
Director, Cyber Analytics and Data Science  
Advisory Board Member, UNCC Data Science Initiative



June 8, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends of UNC Charlotte,

I recently learned that the University has proposed a degreed program for a Bachelor of Science in Data Science. I wanted to take a moment as a thought leader in this industry and as an Executive in one of the largest providers of technology in the market.

As an industry thought leader residing in Silicon Valley and published author, most recently in Forbes, the prospect of UNC Charlotte offering a specific undergraduate program in Data Science is of tremendous interest and has my, personal, and my companies full support.

The single largest challenge in the market, today, has less to do with the technologies and more to do with the capabilities of the resources in the market today. Today's market allows knowledge workers to live and work anywhere which could be a secondary benefit of UNC Charlotte graduates who may want to stay in the area. The beauty of a program like this is that it will offer graduates an opportunity to move into any number of different vertical businesses because they have a solid foundation through an undergraduate degree in Data Science. A graduate of the proposed program could work in any vertical – from healthcare to financial services to retail to government. Our customers are demanding general purpose resources as the specific knowledge required to support their businesses can be more easily provided by their own industry subject matter experts (SMEs). What the program offers is an incredible opportunity for students to enter the job field with skills that will be applicable today and long into the future.

Artificial Intelligence, Machine Learning, Deep Learning technologies are all built and assume extensive knowledge in Data Science. In order to be effective in utilizing these emerging technologies employees must understand data – where it comes from, how it's represented, if it's structure, unstructured or semi-structured, if it's persisted in files, tables or streams. These are all fundamental to the success in leveraging and gaining business advantage from these emerging and rapidly growing technologies – all anchored around data science.

I personally see this new undergraduate degree in Data Science at UNC Charlotte as a demonstration of forward thinking and tremendous labor market understanding. I fully support UNC Charlotte focusing their previous investments in this specific educational area.

Thank you,

A handwritten signature in black ink, appearing to read 'Tom Fisher', written over a white background.

Tom Fisher  
Chief Technology Officer (CTO) and Executive Vice President, MapR Data Technologies  
Member, Board of Directors at Rambus

June 1, 2018

---

**J. Michael McGuire**  
Chief Executive Officer

**Grant Thornton LLP**  
Grant Thornton Tower  
171 N. Clark St., Suite 2400  
Chicago, IL 60601-3370

**T** +1 312 602 8006  
**M** +1 704 900 4095

**Charlotte office**  
201 S. College St., Suite 2500  
Charlotte, NC 28244

**T** +1 704 632 6788  
**F** +1 704 337 2972  
**S** [linkd.in/grantthorntonus](https://www.linkedin.com/company/grantthornton)  
[twitter.com/grantthorntonus](https://twitter.com/grantthorntonus)

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends,

I am writing to express my strong support, on behalf of all my colleagues at Grant Thornton and across the accounting and consulting profession, for UNCC's proposed addition of two new degree programs in data science.

In our firm and our profession, we are experiencing what every organization and industry is experiencing: the rapid transformation of our work and our organizations from the accelerating rise of new data-based technologies. These include, but are not limited to: artificial intelligence, robotics process automation, data analytics and blockchain. Each of these technologies is forcing us to completely re-think how we do our work for our clients, how we staff our teams and how we plan and invest for the future.

New data-based technologies are also causing us to re-think the skills, experience, knowledge and talents that will be required for successful professionals in accounting and consulting in the future. Clearly, the requirements for this work in the 21st century will not be the same as they were in the 20th century. Professionals who possess a deep understanding of data science, and how to apply data tools and technologies to the most complex and stubborn challenges our clients face in running their organizations, will be central to the growth and progress of our profession going forward.

To put the matter simply: Data science and data-based technologies are re-creating our world, across every industry and every field of human endeavor. That trend is not going to change – it will only intensify. For this reason, I believe every institution of higher learning should be investing in data science educational opportunities for its students – and none more so than UNCC, the flagship public university for a thriving and growing modern city like Charlotte.

Thank you for pursuing this important initiative, and please do hesitate to reach out to me if I can be of further assistance.

Sincerely,



J. Michael McGuire  
CEO



Chris Heck  
VP and CIO  
550 S Tryon Street  
DEC20A  
Charlotte, NC 28202

June 7, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Joshua,

On behalf of Duke Energy I would like to express my support for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

Duke Energy is on an accelerating path for digital transformation. We are looking across all our customer impacting and operational areas for 10x improvement opportunities. Keys to our digital transformation include data governance, data access, advanced analytics, artificial intelligence, and machine learning. These skills and technologies are foundational for our innovation and transformation.

We see the availability of resources with skills in these areas as a major concern. Finding new talent and upskilling our current workforce are prerequisites our transformation .

I know that many other businesses are on the same path. We are all looking to be more digital – and digital is fueled by the data sciences.

I expect the proposed degree program in Data Science will be in high demand throughout the region and I thank you for your foresight in addressing that demand.

Sincerely,

A handwritten signature in black ink, appearing to read "Chris Heck", written in a cursive style.

Chris Heck

June 14<sup>th</sup>, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Friends,

I am writing to express my strong support for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

I have had the privilege of working in data science throughout my career that, thus far, spans 27 years and many of the world's most recognized brands. During that time, I have witnessed firsthand the evolving role that data has played in the decision-making practices of organizations of all sizes. Likewise, the roles and responsibilities of professionals with the skills, capabilities and education to enable businesses to achieve the maximum amount of benefit from their data and data science initiatives has evolved in tandem.

It is imperative that we feed the pipeline of qualified candidates interested in careers in the data sciences. UNC Charlotte's has a masters program in data science and business analytics, but no undergraduate program. We must begin to nurture data science professionals during their bachelors studies to ensure that they are equipped with the tools and education and success to position them for success in a masters program and beyond.

An undergraduate degree in Data Science is a proactive investment in the future of the field of professional data sciences; a field that will continue to grow well into the future. The program will benefit its participants, the university and organizations who rely on these professionals and their skills to drive their businesses. I believe that an initiative like this will develop the types of professionals that this growing industry needs with the competencies that it demands.

Sincerely,



Misha Ghosh  
Division Vice President and General Manager  
ADP Ventures – Big Data



June 11, 2018

Mr. Joshua Hertel  
Director, Data Science Initiative  
UNC Charlotte  
9201 University City Boulevard  
Charlotte, NC 28223

Dear Joshua,

I am writing to express my strong support, on behalf of Quaero, for UNC Charlotte's proposed degree program, the Bachelor of Science in Data Science.

Quaero is a customer data and analytics platform (CDP), based in Charlotte. We work with large companies in multiple vertical industries, including media, business to business services, retail and financial services. Quaero's CDP helps these companies harness their customer data to create insights that generate value for them and their customers.

The primary users of our platform within our clients are data engineers, data scientists and analysts. We have seen an explosion in the need for such talent at all levels, both within our company and at our clients. The demand for these skills set continue to expand and will do so for years to come.

We see the proposed creation of the new undergraduate degree in Data Science as an appropriate and timely response to market demand. For this reason, I believe every institution of higher learning should be investing in data science educational opportunities for its students. This is particularly true of UNC Charlotte, given Charlotte's growth and the critical need for this type of talent to sustain that growth.

Sincerely,

*Naras Eechambadi*

Naras Eechambadi, Ph.D.  
Chief Executive Officer



DATA SNAPSHOT

# Employer Demand for Bachelor's-Level **Data Science** Professionals

Analysis of Employer Demand and Comparable  
Programming



# COE Forum

**Jacquelyn Katuin**  
*Market Research Associate*

**Tess Wallenstein**  
*Market Research Manager*

## LEGAL CAVEAT

EAB is a division of The Advisory Board Company ("EAB"). EAB has made efforts to verify the accuracy of the information it provides to members. This report relies on data obtained from many sources, however, and EAB cannot guarantee the accuracy of the information provided or any analysis based thereon. In addition, neither EAB nor any of its affiliates (each, an "EAB Organization") is in the business of giving legal, medical, accounting, or other professional advice, and its reports should not be construed as professional advice. In particular, members should not rely on any legal commentary in this report as a basis for action, or assume that any tactics described herein would be permitted by applicable law or appropriate for a given member's situation. Members are advised to consult with appropriate professionals concerning legal, medical, tax, or accounting issues, before implementing any of these tactics. No EAB Organization or any of its respective officers, directors, employees, or agents shall be liable for any claims, liabilities, or expenses relating to (a) any errors or omissions in this report, whether caused by any EAB organization, or any of their respective employees or agents, or sources or other third parties, (b) any recommendation or graded ranking by any EAB Organization, or (c) failure of member and its employees and agents to abide by the terms set forth herein.

EAB, Education Advisory Board, The Advisory Board Company, Royall, and Royall & Company are registered trademarks of The Advisory Board Company in the United States and other countries. Members are not permitted to use these trademarks, or any other trademark, product name, service name, trade name, and logo of any EAB Organization without prior written consent of EAB. Other trademarks, product names, service names, trade names, and logos used within these pages are the property of their respective holders. Use of other company trademarks, product names, service names, trade names, and logos or images of the same does not necessarily constitute (a) an endorsement by such company of an EAB Organization and its products and services, or (b) an endorsement of the company or its products or services by an EAB Organization. No EAB Organization is affiliated with any such company.

### **IMPORTANT: Please read the following.**

EAB has prepared this report for the exclusive use of its members. Each member acknowledges and agrees that this report and the information contained herein (collectively, the "Report") are confidential and proprietary to EAB. By accepting delivery of this Report, each member agrees to abide by the terms as stated herein, including the following:

1. All right, title, and interest in and to this Report is owned by an EAB Organization. Except as stated herein, no right, license, permission, or interest of any kind in this Report is intended to be given, transferred to, or acquired by a member. Each member is authorized to use this Report only to the extent expressly authorized herein.
2. Each member shall not sell, license, republish, or post online or otherwise this Report, in part or in whole. Each member shall not disseminate or permit the use of, and shall take reasonable precautions to prevent such dissemination or use of, this Report by (a) any of its employees and agents (except as stated below), or (b) any third party.
3. Each member may make this Report available solely to those of its employees and agents who (a) are registered for the workshop or membership program of which this Report is a part, (b) require access to this Report in order to learn from the information described herein, and (c) agree not to disclose this Report to other employees or agents or any third party. Each member shall use, and shall ensure that its employees and agents use, this Report for its internal use only. Each member may make a limited number of copies, solely as adequate for use by its employees and agents in accordance with the terms herein.
4. Each member shall not remove from this Report any confidential markings, copyright notices, and/or other similar indicia herein.
5. Each member is responsible for any breach of its obligations as stated herein by any of its employees or agents.
6. If a member is unwilling to abide by any of the foregoing obligations, then such member shall promptly return this Report and all copies thereof to EAB.



# Table of Contents

---

<b>1) Research Methodology</b> .....	<b>4</b>
Project Challenge .....	4
Methodology and Definitions .....	4
Burning Glass Labor/Insight™ .....	4
Project Sources .....	5
Profiled Institutions.....	5
<b>2) Executive Overview</b> .....	<b>6</b>
<b>3) Employer Demand Trends</b> .....	<b>7</b>
Demand over Time .....	7
In-Demand Skills.....	8
Commonly Posted Titles .....	9
Employers with High Demand .....	10
Competitive Landscape .....	11
Program Structure.....	12

# 1) Research Methodology

---

**Project Challenge** Leadership at the University of North Carolina-Charlotte approached the Forum as they considered launching a bachelor’s-level data science program. Through a combination of quantitative data analytics and secondary research, the Forum sought to assess employer demand for bachelor’s-level data science professionals and the competitive landscape for a bachelor’s-level data science program.

EAB’s market research function provides insights which guide strategic programmatic decisions at member institutions. The Forum combines qualitative and quantitative data to help administrators identify opportunities for new program development, assess job market trends, and align curriculum with employer and student demand.

EAB reports rely primarily on labor market data from the Burning Glass Labor/Insight™ tool (description below). Reports occasionally use data from the United States Census Bureau and United States Bureau of Labor Statistics data to explore occupation and job trends. Market research reports may also incorporate Integrated Postsecondary Education Data System (IPEDS) data to assess student enrollment, demographics, and completion rates across competitor programs.

**Methodology and Definitions** **Methodology:** Unless stated otherwise, this report includes data from online job postings from September 2016 to August 2017. The Forum identified trends in employer demand over time, common job titles, in-demand skills, and employers with high demand for bachelor’s-level data science professionals.

**Definitions:** “State data” and “state” refer to North Carolina. “Local data” and “local” refer to the Charlotte-Concord-Gastonia, NC-SC Metropolitan Statistical Area (MSA).

Annual growth in job postings is measured in the change between July 2013 and June 2017 by six-month halves (i.e., H2 2013 is July 2013 to December 2013).

**Burning Glass Labor/Insight™** **EAB’s Partner for Real-Time Labor Market Data**  
This report includes data made available through EAB’s partnership with Burning Glass Technologies, a Boston-based leader in human capital data analytics. Burning Glass Technologies specializes in the use of web spidering technology to mine more than 80 million online job postings and analyze real-time employer demand. Under this partnership, EAB may use Burning Glass’s proprietary Labor/Insight™ tool to answer member questions about employer demand for educational requirements, job titles, and competencies over time, as well as by geography. The tool considers job postings “unspecified” for a skill, industry, employer, geography, certification, or educational requirement when the job posting did not advertise for one of these particular job characteristics. Unspecified postings represent null values and should be excluded from the total number (n value) of job postings analyzed in the query. A more complete description of the tool is available at <http://www.burning-glass.com/products/laborinsight-market-analysis/>.

For more information about the Labor/Insight™ tool, please contact Betsy Denious, Director of Business Development Learning & Policy at [bdenious@burning-glass.com](mailto:bdenious@burning-glass.com) or 301-525-6596.

## Project Sources

The Forum consulted the following sources for this report:

- EAB’s internal and online research libraries ([eab.com](http://eab.com))
- National Center for Education Statistics (NCES) (<http://nces.ed.gov/>)
- Profiled program webpages:
  - Bellevue College, Bachelor of Applied Science in Data Analytics, accessed October 2017, <https://www.bellevuecollege.edu/programs/degrees/bachelor/da/>
  - Columbia University, Bachelor of Arts in Data Science, accessed October 2017, <https://mice.cs.columbia.edu/c/d.php?d=228>
  - Southern New Hampshire University, Bachelor of Science in Data Analytics, accessed October 2017, <https://www.snhu.edu/online-degrees/bachelors/bs-in-data-analytics>
  - University of Michigan, Undergraduate Program in Data Science, accessed October 2017, <https://www.eecs.umich.edu/eecs/undergraduate/data-science/>
  - Utah Valley University, Applied Data Analytics Minor, accessed October 2017, <https://www.uvu.edu/catalog/current/departments/information-systems-and-technology/applied-data-analytics-minor/>
  - Western Michigan University, Bachelor of Science in Data Science, accessed October 2017, <https://wmich.edu/cs/academics/undergraduate/bs-data-science>

## Profiled Institutions

The Forum prioritized profiles of institutions selected by administrators at the **University of North Carolina-Charlotte** (e.g., **Columbia University**). The Forum profiled programs via secondary research at the following institutions:

### A Guide to Institutions Profiled in this Brief<sup>1</sup>

Institution	Location	Approximate Institutional Enrollment (Undergraduate/Total)	Carnegie Classification
<b>Bellevue College</b>	Pacific West	13,500 / 13,500	Baccalaureate/Associate's Colleges: Associate's Dominant
<b>Columbia University</b>	Northeast	8,000 / 29,500	Doctoral Universities: Highest Research Activity
<b>Southern New Hampshire University</b>	Northeast	54,000 / 73,000	Master's Colleges & Universities: Larger Programs
<b>University of Michigan</b>	Midwest	29,000 / 44,500	Doctoral Universities: Highest Research Activity
<b>Utah Valley University</b>	Mountain West	34,500 / 35,000	Master's Colleges & Universities: Small Programs
<b>Western Michigan University</b>	Midwest	18,500 / 23,000	Doctoral Universities: Higher Research Activity

1) National Center for Education Statistics.

## 2) Executive Overview

---

**Growing state and local demand for bachelor's-level data science professionals indicates an opportunity for the *University of North Carolina-Charlotte* to launch a program.** Demand for bachelor's-level data science professionals in North Carolina rose 76 percent between H2 2013 and H1 2017 (i.e., 1,400 to 2,461 postings). In the same time frame, local employer demand for bachelor's-level data science professionals grew 109 percent (i.e., 590 to 1,236 postings). State and local employers seek bachelor's-level data science professionals in 4,777 and 2,337 job postings in the last year, respectively.

**Limited competition further indicates an opportunity to develop a bachelor's-level data science program.** Few institutions nationwide offer full bachelor's-level data science programs. National completions for programs related to data science and analytics grew seven percent between 2006 and 2015 (i.e., 48,240 to 51,559 completions), indicating growing student interest in data analytics. Administrators should note institutions of interest (e.g., **University of California-Berkeley, University of North Carolina-Chapel Hill**) plan to launch bachelor's-level data science programming in the coming years.

**Integrate statistics, computer science, and business administration coursework in the bachelor's-level data science program to meet employer demand.** Employers at the state and local levels often seek bachelor's-level data science professionals with business administration skills including 'project management' and 'budgeting.' As expected, state and local employers frequently express demand for data science professionals with data management skills such as 'data analysis,' 'SQL,' and 'data management.' Bachelor's-level data science programs frequently represent a partnership between two colleges such as a college of engineering and college of arts and sciences due to the emerging and interdisciplinary nature of the data science field.

### 3) Employer Demand Trends

#### Demand over Time

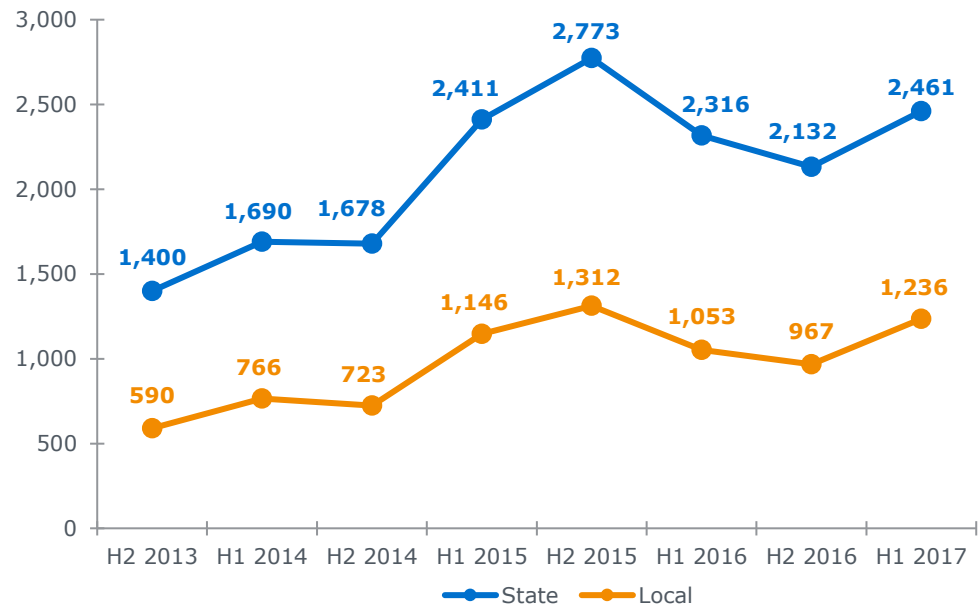
#### Launch a Bachelor’s-Level Data Science Program to Meet Growing State and Local Employer Demand

Growing state and local demand for bachelor’s-level data science professionals indicates an opportunity for the **University at North Carolina-Charlotte** to develop a bachelor’s-level data science program. Local demand for bachelor’s-level data science professionals rose 109 percent between H2 2013 and H1 2017 (i.e., 590 to 1,236 postings). A 122 percent increase in local demand for bachelor’s-level data science professionals occurred between H2 2013 and H2 2015 (i.e., 590 to 1,312 postings). After local demand peaked in H2 2015, demand decreased to 967 job postings in H2 2016 (i.e., a 26 percent decline). Most recently, demand for bachelor’s-level data science professionals rose 28 percent between H2 2016 and H1 2017 (i.e., 967 to 1,236 postings).

Across North Carolina, demand for bachelor’s-level data science professionals increased 76 percent between H2 2013 and H1 2017 (i.e., 1,400 to 2,461 postings). In H2 2013, North Carolina employers posted 1,400 relevant job opportunities, followed by a 65 percent increase in demand between H2 2014 and H2 2015 (i.e., 1,678 to 2,773 postings). Between H2 2015 and H2 2016, employer demand for bachelor’s-level data science professionals dropped 23 percent (i.e., 2,773 to 2,132 postings). Most recently, North Carolina employer demand increased 15 percent between the second half of 2016 and the first half of 2017 (i.e., 2,132 to 2,461 postings).

#### Historical Demand for Bachelor’s-Level Data Science Professionals

June 2013-July 2017, State and Local Data<sup>2</sup>



2) Burning Glass Labor/Insight™

## In-Demand Skills

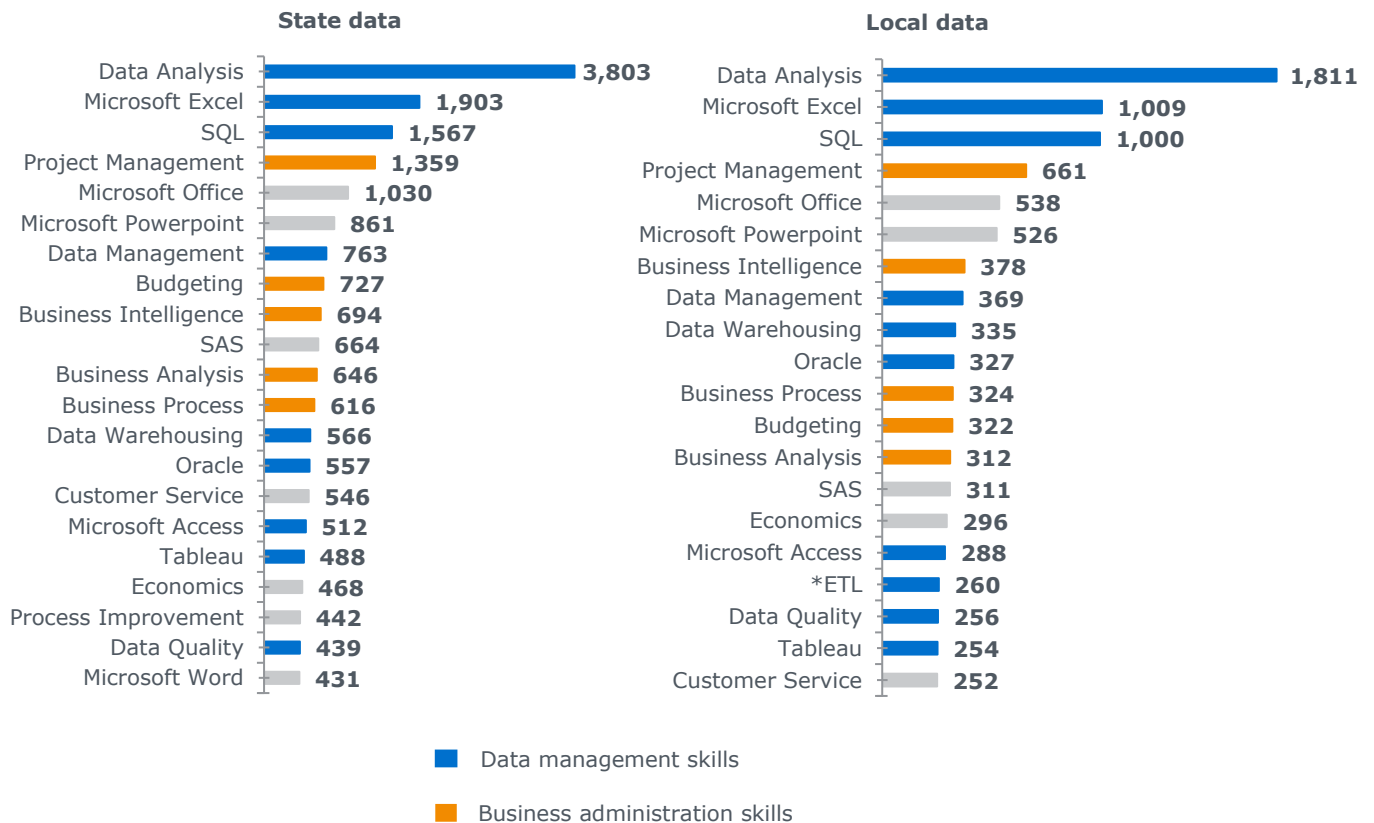
### Confer Business Administration and Data Management Skills to Meet Employer Demand

State and local employers seek bachelor’s-level data science professionals with business administration skills such as ‘project management,’ ‘business intelligence,’ and ‘budgeting.’ As expected, state and local employers also seek bachelor’s-level data science professionals with data management skills such as ‘data analysis,’ ‘data warehousing,’ and ‘data quality.’ Program graduates should also possess knowledge of ‘Microsoft Excel,’ ‘SQL,’ and ‘Tableau’ to prepare for employment. For example, state and local employers seek bachelor’s-level data science professionals with knowledge of ‘SQL’ in 1,567 and 1,000 job postings, respectively. **Bellevue University** offers a course titled “SQL Fundamentals” to confer in-demand ‘SQL’ skills to bachelor’s-level data analytics students.

### Commonly Requested Skills for Bachelor’s-Level Data Science Professionals

September 2016-August 2017, State and Local Data<sup>3</sup>

n (state)= 4,777 job postings, 0 unspecified postings; n (local)= 2,337 job postings, 0 unspecified postings



\*Extraction Transformation and Loading (ETL)

3) Burning Glass Labor/Insight™

## Commonly Posted Titles

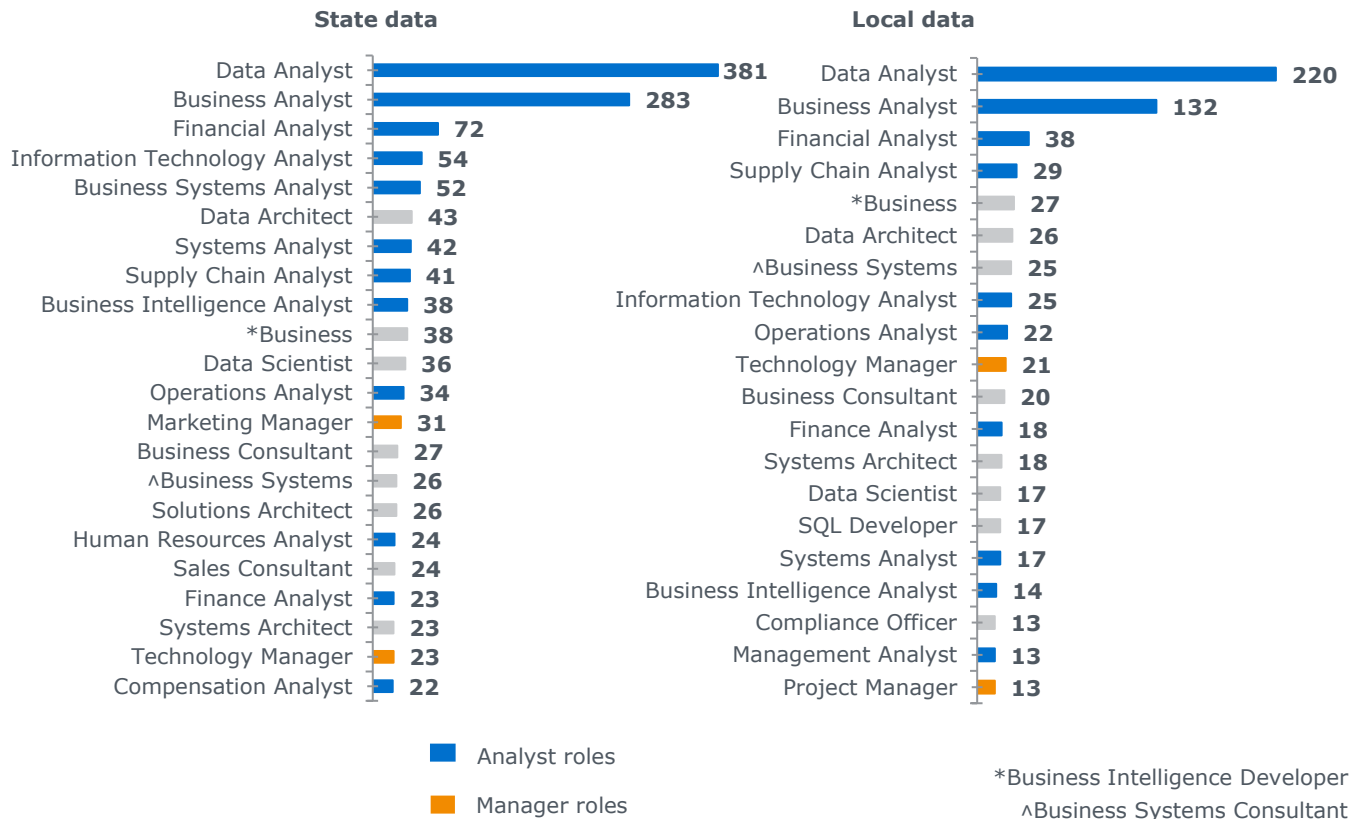
## State and Local Employers Often Seek Bachelor's-Level Data Science Professionals for Analyst Roles

Employers across North Carolina and in the Charlotte metropolitan area express demand for bachelor's-level data science professionals to fill analyst roles and a limited number of manager roles. State and local employers seek bachelor's-level data science professionals for 'data analyst' roles in eight and nine percent of relevant job postings, respectively (i.e., 381 and 220 postings, respectively). Local employers also express demand for bachelor's-level data science professionals to fill 'business analyst,' 'financial analyst,' and 'supply chain analyst' roles. In addition to analyst roles, employers seek bachelor's-level data science professionals for a limited number of manager roles such as 'marketing manager,' 'project manager,' and 'technology manager.'

### Frequently Posted Titles for Bachelor's-Level Data Science Professionals

September 2016-August 2017, State and Local Data<sup>4</sup>

n (state)= 4,777 job postings, 2 unspecified postings; n (local)= 2,337 job postings, 2 unspecified postings



4) Burning Glass Labor/Insight™

## Employers with High Demand

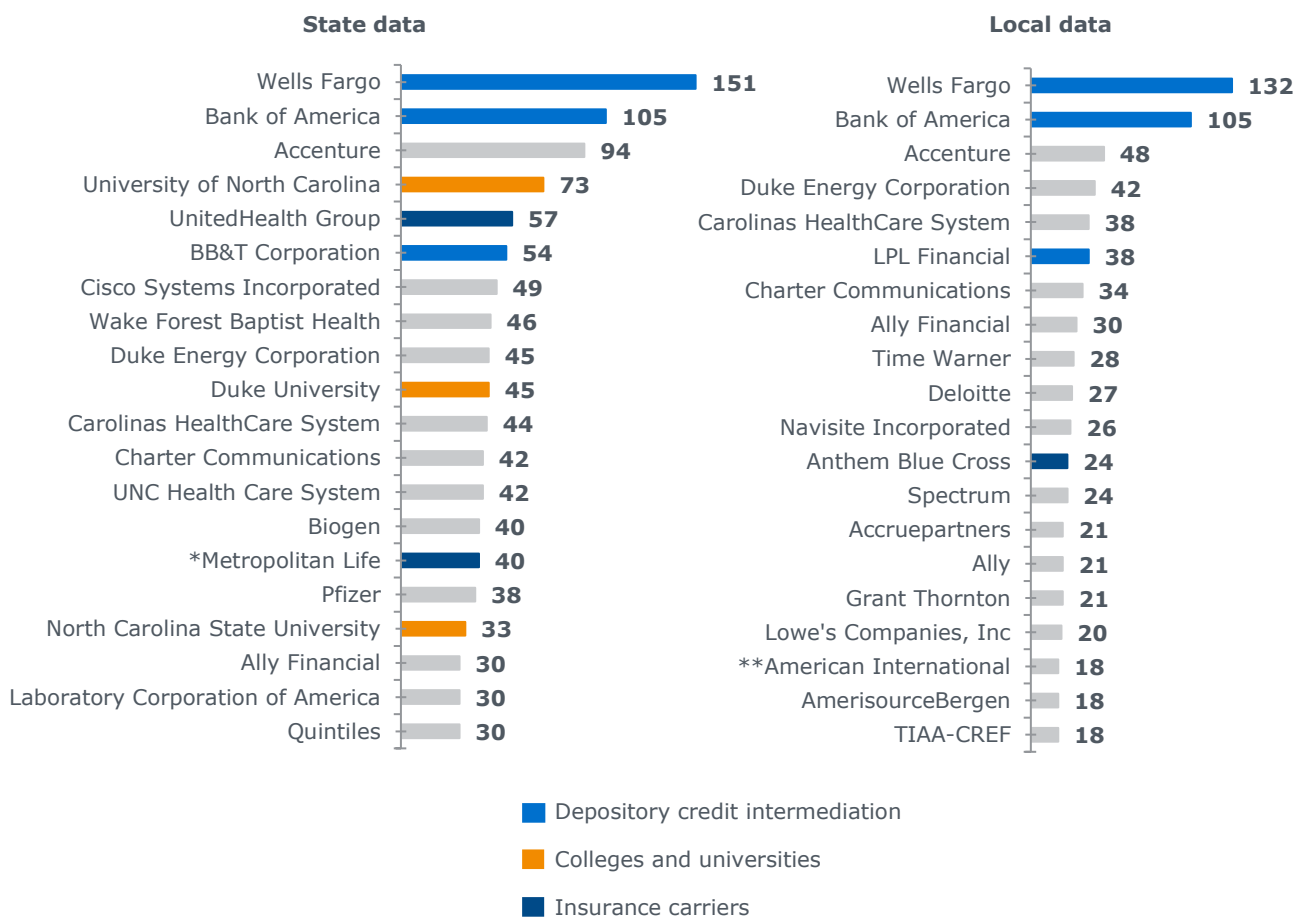
## Encourage Students to Seek Employment in the 'Depository Credit Intermediation' Industry

'Depository credit intermediation' companies rank among the top employers with demand for bachelor's-level data science professionals (i.e., nine and 14 percent of relevant state and local postings, respectively). For example, Wells Fargo seeks bachelor's-level data science professionals in 151 and 132 postings at the state and local levels (i.e., three and six percent of relevant postings, respectively). Program graduates may also find employment at higher education institutions. Colleges and universities in North Carolina express demand for bachelor's-level data science professionals in 203 relevant postings (i.e., four percent of relevant postings). For example, the University of North Carolina and Duke University seek bachelor's-level data science professionals in 73 and 45 postings in the last year, respectively.

### Employers that Seek Bachelor's-Level Data Science Professionals

September 2016-August 2017, State and Local Data<sup>5</sup>

n (state)= 4,777 job postings, 1,215 unspecified postings; n (local)= 2,337 job postings, 776 unspecified postings



\*Metropolitan Life Insurance Company

\*\*American International Group Incorporated

5) Burning Glass Labor/Insight™



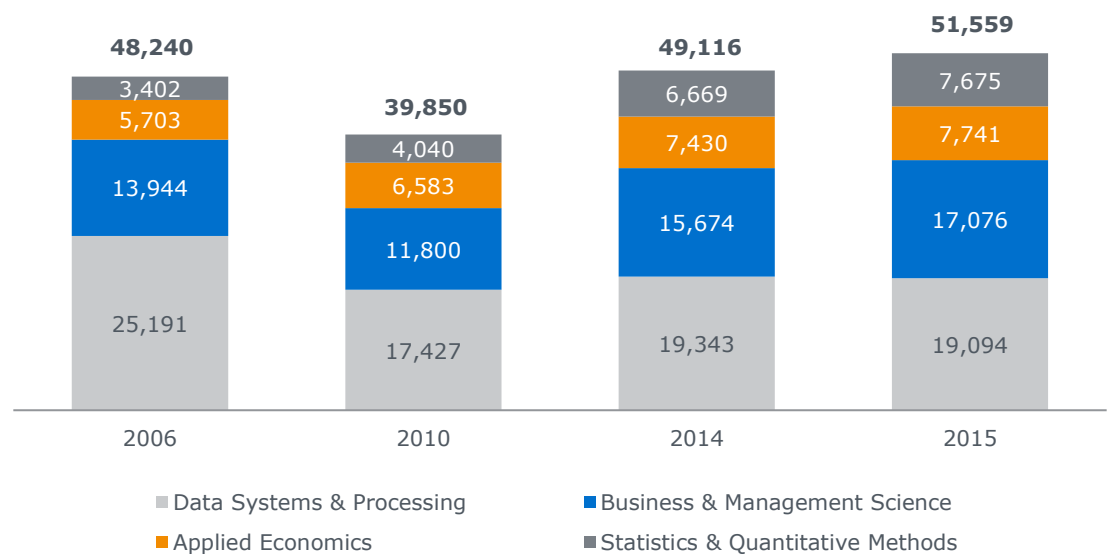
## Limited Competition Indicates an Opportunity for the University of North Carolina-Charlotte to Launch a Bachelor’s-Level Data Science Program

Few institutions nationwide offer bachelor’s-level data science programs.<sup>6</sup> Limited competition, coupled with growing demand for bachelor’s-level data science professionals, indicates a market for additional programs. Further, the master’s-level data science program at the **University of North Carolina-Charlotte** provides the University with infrastructure to launch a bachelor’s-level data science program. The Forum could not identify bachelor’s-level data science programs in North Carolina currently. However, the **University of North Carolina-Chapel Hill** [advertises](#) the possibility of a new bachelor’s-level data science minor.

National completions for programs related to data science and analytics grew seven percent between 2006 and 2015 (i.e., 48,240 to 51,559 completions). Although few institutions offer full bachelor’s-level data science programs currently, the number of bachelor’s-level data science programs increased in recent years. For example, **Western Michigan University** launched a bachelor’s-level data science program in 2015 to meet a rapidly growing need for data scientists. The **University of California-Berkeley** [plans](#) to launch a data science major and minor in the spring of 2018.

### National Completions for Programs Related to Data Science and Analytics

*National Center for Education Statistics, 2006-2015<sup>7</sup>*



6) Shepherd University, [Intent to Plan](#)  
 7) [National Center for Education Statistics](#)

## Program Structure

[EAB research](#) indicates “data science” may be perceived as a more technically sophisticated branch of “data analytics.”

## While Program Title and Location Vary, Bachelor’s-Level Data Science Curricula Remain Similar

Due to the emerging nature of the data science field, profiled bachelor’s-level data science programs range in title (i.e., “data science,” “data analytics”) and often reside in differing locations (e.g., college of arts and science, college of engineering). Bachelor’s-level data science curricula typically incorporate a similar mix of statistics, computer science (e.g., programming), and business administration coursework. The **University of Michigan** website describes the nature of the bachelor’s-level data science program as a combination of computer science and statistics. Similarly, **Utah Valley University** offers a mix of statistics, computer science, and business administration coursework such as “Business Intelligence Systems” and “Multivariate Analysis.” Two profiled programs (i.e., University of Michigan, **Western Michigan University**) exist as a collaboration between two colleges or schools, such as a college of engineering and a college of arts and sciences.

### Modality

[EAB research](#) indicates a data science program could be **delivered in-person or online**. Five of six profiled institutions do not report program modality. **Southern New Hampshire University** offers a bachelor’s-level data analytics program fully online.

## Characteristics of Existing Bachelor’s-Level Data Science Programs

*Profiled Institutions*

Institution	Program Title	Location	Modality	Required Credits
<b>Bellevue College</b>	<a href="#">Bachelor of Applied Science Degree in Data Analytics</a>	Institute for Business and Information Technology	Not reported	45 credit hours
<b>Western Michigan University</b>	<a href="#">Bachelor of Science in Data Science</a>	College of Engineering and Applied Sciences, College of Arts and Sciences	Not reported	45 credit hours
<b>University of Michigan</b>	<a href="#">Undergraduate Data Science Program</a>	College of Engineering and College of Literature, Science, and the Arts	Not reported	42 credit hours
<b>Columbia University</b>	<a href="#">Bachelor of Arts in Data Science</a>	School of Engineering and Applied Science	Not reported	24 points
<b>Utah Valley University</b>	<a href="#">Applied Data Analytics, Minor</a>	College of Technology and Computing	Not reported	18 credit hours
<b>Southern New Hampshire University</b>	<a href="#">Bachelor of Science in Data Analytics</a>	Science and Mathematics Program Online	Online	Not reported

This PDF is available at <http://nap.edu/25104>

SHARE    



## Data Science for Undergraduates: Opportunities and Options

### DETAILS

---

107 pages | 6 x 9 | PAPERBACK  
ISBN 978-0-309-47559-4 | DOI 10.17226/25104

GET THIS BOOK

FIND RELATED TITLES

### CONTRIBUTORS

---

Committee on Envisioning the Data Science Discipline: The Undergraduate Perspective; Computer Science and Telecommunications Board; Board on Mathematical Sciences and Analytics; Committee on Applied and Theoretical Statistics; Division on Engineering and Physical Sciences; Board on Science Education; Division of Behavioral and Social Sciences and Education; National Academies of Sciences, Engineering, and Medicine

Visit the National Academies Press at [NAP.edu](http://NAP.edu) and login or register to get:

---

- Access to free PDF downloads of thousands of scientific reports
- 10% off the price of print titles
- Email or social media notifications of new titles related to your interests
- Special offers and discounts



Distribution, posting, or copying of this PDF is strictly prohibited without written permission of the National Academies Press. (Request Permission) Unless otherwise indicated, all materials in this PDF are copyrighted by the National Academy of Sciences.

Copyright © National Academy of Sciences. All rights reserved.

**PREPUBLICATION COPY—SUBJECT TO FURTHER EDITORIAL CORRECTION**

# **DATA SCIENCE FOR UNDERGRADUATES: OPPORTUNITIES AND OPTIONS**

Committee on Envisioning the Data Science Discipline: The Undergraduate Perspective

Computer Science and Telecommunications Board  
Board on Mathematical Sciences and Analytics  
Committee on Applied and Theoretical Statistics  
Division on Engineering and Physical Sciences

Board on Science Education  
Division of Behavioral and Social Sciences and Education

A Consensus Study Report of

*The National Academies of*  
**SCIENCES • ENGINEERING • MEDICINE**

THE NATIONAL ACADEMIES PRESS

*Washington, DC*

**[www.nap.edu](http://www.nap.edu)**

**THE NATIONAL ACADEMIES PRESS      500 Fifth Street, NW      Washington, DC 20001**

This activity was supported by Award No. 1626983 from the National Science Foundation (Directorate for Computer and Information Science and Engineering; Directorate for Education and Human Resources; Directorate for Mathematical and Physical Sciences/Division of Mathematical Sciences; and Directorate for Social, Behavioral and Economic Sciences). Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project.

International Standard Book Number-13: \_\_\_\_\_

International Standard Book Number-10: \_\_\_\_\_

Digital Object Identifier: <https://doi.org/10.17226/25104>

Additional copies of this publication are available for sale from the National Academies Press, 500 Fifth Street, NW, Keck 360, Washington, DC 20001; (800) 624-6242 or (202) 334-3313; [http:// www.nap.edu](http://www.nap.edu).

Copyright 2018 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

Suggested citation: National Academies of Sciences, Engineering, and Medicine. 2018. *Data Science for Undergraduates: Opportunities and Options*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25104>.

**PREPUBLICATION COPY—SUBJECT TO FURTHER EDITORIAL CORRECTION**

*The National Academies of*  
**SCIENCES • ENGINEERING • MEDICINE**

The **National Academy of Sciences** was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, nongovernmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The **National Academy of Engineering** was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. C. D. Mote, Jr., is president.

The **National Academy of Medicine** (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the **National Academies of Sciences, Engineering, and Medicine** to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at [www.nationalacademies.org](http://www.nationalacademies.org).

**PREPUBLICATION COPY—SUBJECT TO FURTHER EDITORIAL CORRECTION**

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE

**Consensus Study Reports** published by the National Academies of Sciences, Engineering, and Medicine document the evidence-based consensus on the study's statement of task by an authoring committee of experts. Reports typically include findings, conclusions, and recommendations based on information gathered by the committee and the committee's deliberations. Each report has been subjected to a rigorous and independent peer-review process and it represents the position of the National Academies on the statement of task.

**Proceedings** published by the National Academies of Sciences, Engineering, and Medicine chronicle the presentations and discussions at a workshop, symposium, or other event convened by the National Academies. The statements and opinions contained in proceedings are those of the participants and are not endorsed by other participants, the planning committee, or the National Academies.

For information about other products and activities of the National Academies, please visit [www.nationalacademies.org/about/whatwedo](http://www.nationalacademies.org/about/whatwedo).

**PREPUBLICATION COPY—SUBJECT TO FURTHER EDITORIAL CORRECTION**

**COMMITTEE ON ENVISIONING THE DATA SCIENCE DISCIPLINE: THE  
UNDERGRADUATE PERSPECTIVE**

LAURA HAAS, NAE,<sup>1</sup> University of Massachusetts Amherst, *Co-Chair*

ALFRED O. HERO III, University of Michigan, *Co-Chair*

ANI ADHIKARI, University of California, Berkeley

DAVID CULLER, NAE, University of California, Berkeley

DAVID DONOHO, NAS,<sup>2</sup> Stanford University

E. THOMAS EWING, Virginia Tech

LOUIS J. GROSS, University of Tennessee, Knoxville

NICHOLAS J. HORTON, Amherst College

JULIA LANE, New York University

ANDREW McCALLUM, University of Massachusetts Amherst

RICHARD McCULLOUGH, Harvard University

REBECCA NUGENT, Carnegie Mellon University

LEE RAINIE, Pew Research Center

ROB RUTENBAR, University of Pittsburgh

KRISTIN TOLLE, Microsoft Research

TALITHIA WILLIAMS, Harvey Mudd College

ANDREW ZIEFFLER, University of Minnesota, Minneapolis

***Staff***

MICHELLE K. SCHWALBE, Director, Board on Mathematical Sciences and Analytics (BMSA), *Study  
Director*

JON EISENBERG, Director, Computer Science and Telecommunications Board (CSTB)

BEN WENDER, Director, Committee on Applied and Theoretical Statistics

AMY STEPHENS, Program Officer, Board on Science Education

LINDA CASOLA, BMSA, Associate Program Officer and Editor

RENEE HAWKINS, CSTB, Financial Manager

JANKI PATEL, CSTB, Senior Program Assistant

---

<sup>1</sup> Member, National Academy of Engineering.

<sup>2</sup> Member, National Academy of Sciences.



## COMPUTER SCIENCE AND TELECOMMUNICATIONS BOARD

FARNAM JAHANIAN, Carnegie Mellon University, *Chair*  
LUIZ ANDRE BARROSO, Google, Inc.  
STEVEN M. BELLOVIN, NAE,<sup>1</sup> Columbia University  
ROBERT F. BRAMMER, Brammer Technology, LLC  
DAVID CULLER, NAE, University of California, Berkeley  
EDWARD FRANK, Cloud Parity, Inc.  
LAURA HAAS, NAE, University of Massachusetts Amherst  
MARK HOROWITZ, NAE, Stanford University  
ERIC HORVITZ, NAE, Microsoft Corporation  
VIJAY KUMAR, NAE, University of Pennsylvania  
BETH MYNATT, Georgia Institute of Technology  
CRAIG PARTRIDGE, Raytheon BBN Technologies  
DANIELA RUS, NAE, Massachusetts Institute of Technology  
FRED B. SCHNEIDER, NAE, Cornell University  
MARGO SELTZER, Harvard University  
MOSHE VARDI, NAS<sup>2</sup>/NAE, Rice University

### *Staff*

JON EISENBERG, Director  
LYNETTE I. MILLETT, Associate Director  
EMILY GRUMBLING, Program Officer  
KATIRIA ORTIZ, Associate Program Officer  
RENEE HAWKINS, Financial and Administrative Manager  
JANKI PATEL, Senior Program Assistant  
SHENAE BRADLEY, Administrative Assistant

---

<sup>1</sup> Member, National Academy of Engineering.

<sup>2</sup> Member, National Academy of Sciences.

## BOARD ON MATHEMATICAL SCIENCES AND ANALYTICS

STEPHEN M. ROBINSON, NAE,<sup>1</sup> University of Wisconsin, Madison, *Chair*  
JOHN R. BIRGE, NAE, University of Chicago  
W. PETER CHERRY, Independent Consultant  
DAVID CHU, Institute for Defense Analyses  
RONALD R. COIFMAN, NAS,<sup>2</sup> Yale University  
JAMES CURRY, University of Colorado Boulder  
CHRISTINE FOX, Johns Hopkins Applied Physics Laboratory  
MARK L. GREEN, University of California, Los Angeles  
PATRICIA A. JACOBS, Naval Postgraduate School  
JOSEPH A. LANGSAM, Morgan Stanley (Retired)  
SIMON A. LEVIN, NAS, Princeton University  
ANDREW W. LO, Massachusetts Institute of Technology  
DAVID MAIER, Portland State University  
LOIS CURFMAN MCINNES, Argonne National Laboratory  
FRED S. ROBERTS, Rutgers, The State University of New Jersey  
ELIZABETH A. THOMPSON, NAS, University of Washington  
CLAIRE TOMLIN, University of California, Berkeley  
LANCE WALLER, Emory University  
KAREN WILLCOX, Massachusetts Institute of Technology  
DAVID YAO, NAE, Columbia University

### *Staff*

MICHELLE K. SCHWALBE, Director  
BEN WENDER, Program Officer  
LINDA CASOLA, Associate Program Officer and Editor  
BETH DOLAN, Financial Manager  
RODNEY N. HOWARD, Administrative Assistant

---

<sup>1</sup> Member, National Academy of Engineering.

<sup>2</sup> Member, National Academy of Sciences.

## COMMITTEE ON APPLIED AND THEORETICAL STATISTICS

ALFRED O. HERO III, University of Michigan, *Chair*  
ALICIA CARRIQUIRY, NAM,<sup>1</sup> Iowa State University  
MICHAEL J. DANIELS, University of Florida  
KATHERINE BENNETT ENSOR, Rice University  
AMY HERRING, Duke University  
NICHOLAS J. HORTON, Amherst College  
DAVID MADIGAN, Columbia University  
JOSÉ M.F. MOURA, NAE,<sup>2</sup> Carnegie Mellon University  
NANCY REID, NAS,<sup>3</sup> University of Toronto  
CYNTHIA RUDIN, Duke University  
AARTI SINGH, Carnegie Mellon University

### *Staff*

BEN WENDER, Director  
LINDA CASOLA, Associate Program Officer and Editor  
BETH DOLAN, Financial Manager  
RODNEY N. HOWARD, Administrative Assistant

---

<sup>1</sup> Member, National Academy of Medicine.

<sup>2</sup> Member, National Academy of Engineering.

<sup>3</sup> Member, National Academy of Sciences.

## BOARD ON SCIENCE EDUCATION

ADAM GAMORAN, William T. Grant Foundation, *Chair*  
SUNITA V. COOKE, MiraCosta College  
MELANIE COOPER, Michigan State University  
RODOLFO DIRZO, NAS,<sup>1</sup> Stanford University  
RUSH D. HOLT, American Association for the Advancement of Science  
MATTHEW KREHBIEL, Achieve, Inc.  
MICHAEL LACH, University of Chicago  
LYNN LIBEN, Pennsylvania State University  
CATHRYN (CATHY) MANDUCA, Carleton College  
JOHN MATHER, NAS, NASA Goddard Space Flight Center  
TONYA M. MATTHEWS, Michigan Science Center  
BRIAN REISER, Northwestern University  
MARSHALL (MIKE) SMITH, Carnegie Foundation for the Advancement of Teaching  
ROBERTA TANNER, Thompson School District (Retired)  
SUZANNE WILSON, Michigan State University

### *Staff*

HEIDI SCHWEINGRUBER, Director  
KERRY BRENNER, Senior Program Officer  
MARGARET HILTON, Senior Program Officer  
KENNE DIBNER, Program Officer  
AMY STEPHENS, Program Officer  
MATTHEW LAMMERS, Program Coordinator  
LETICIA GARCILAZO GREEN, Senior Program Assistant  
MARGARET KELLY, Senior Program Assistant  
COREETHA ENTZMINGER, Program Assistant

---

<sup>1</sup> Member, National Academy of Sciences.

## Preface

The National Academies of Sciences, Engineering, and Medicine established the Committee on Envisioning the Data Science Discipline: The Undergraduate Perspective to set forth a vision for the emerging discipline of data science at the undergraduate level (see Box P.1 for the committee’s statement of task).

### **BOX P.1** **Statement of Task**

A National Academies of Sciences, Engineering, and Medicine study will set forth a vision for the emerging discipline of data science at the undergraduate level. It will emphasize core underlying principles, intellectual content, and pedagogical issues specific to data science, including core concepts that distinguish it from neighboring disciplines. It will not consider the practicalities of creating materials, courses, or programs. It will develop this vision considering applications of and careers in data science. It will focus on the undergraduate level, addressing related issues at the middle and high school level as well as community colleges as appropriate, and will draw on experiences in creating master’s-level programs. It will also consider opportunities created by the emergence of a new science, technology, engineering, and mathematics (STEM) field to engage underrepresented student populations and consider ways to reduce the “leakage” seen in existing STEM pathways. Information gathering will center around two workshops, the first likely focused on principles and intellectual content, and the second likely focused on pedagogy and implications for middle and high schools and community colleges. To get material on the record quickly and spark community feedback, a rapporteur-authored workshop summary report will be issued following the first workshop. A final report will be issued following both workshops and committee deliberations setting forth a vision for undergraduate education in data science.

This study was sponsored by the National Science Foundation. The Committee on Envisioning the Data Science Discipline: The Undergraduate Perspective (see Appendix A for biographical sketches of the committee members) conducted a number of information-gathering activities and engaged a broad community in its conversations to address the statement of task shown in Box P.1 (see Appendix B for a list of the presentations given during these meetings and Appendix C for a list of those who contributed). In December 2016, the committee met to discuss possible future directions based on progress with current data science programs; societal implications of the evolving field of data science; approaches to expand diversity and inclusion in data science among students, staff, and topic areas; and perspectives on

envisioning the future of data science for undergraduates. In April 2017, the committee organized a webinar to collect further input from the public on topics of importance for this study.

In May 2017, the committee convened a workshop in which participants discussed educational models to build relevant foundational, translational, and professional skills for data scientists in various roles; the use of high-impact educational practices in the delivery of data science education; and strategies for broad participation in data science education that rely on formal modes of evaluation and assessment. Participants focused on the ways in which students, institutions, and programs could change in the coming decade, as well as how these changes will affect future plans for data science education.

The committee also held nine webinars throughout Fall 2017 as another means to engage the public in conversations about various aspects of data science education, which addressed the following topics:

1. Building data acumen;
2. Incorporating real-world applications;
3. Training faculty and developing curriculum;
4. Enhancing communication and teamwork skills;
5. Fostering interdepartmental collaboration and institutional organization;
6. Considering ethics;
7. Assessing and evaluating data science programs;
8. Emphasizing diversity, inclusion, and increased participation; and
9. Exploring 2-year colleges and institutional partnerships.

Although these nine webinars focused specifically on applications to data science programs, many of the discussions highlighted best practices relevant for all types of academic programming. The committee met for a final session in December 2017 to prepare for the writing of this report. During this session, the committee synthesized discussions from the webinar series and results from activities under way in the data science community. This final report, which was preceded by a September 2017 interim report, explores key questions about the future of the field of data science.

## Summary

Data science is emerging as a field that is revolutionizing science and industries alike. Work across nearly all domains is becoming more data driven, affecting both the jobs that are available and the skills that are required. As more data and ways of analyzing them become available, more aspects of the economy, society, and daily life will become dependent on data. As a result, the National Academies of Sciences, Engineering, and Medicine was asked to set forth a vision for the emerging discipline of data science at the undergraduate level. To that end, the committee considered core underlying principles, intellectual content, and pedagogical issues specific to data science, including the essential concepts that distinguish it from neighboring disciplines. All of this was anchored in exploration related to applications of and careers in data science.

Today, the term “data scientist” typically describes a knowledge worker who is principally occupied with analyzing complex and massive data resources. However, data science spans a broader array of activities that involve applying principles for data collection, storage, integration, analysis, inference, communication, and ethics. In future decades, all undergraduates will profit from a fundamental awareness of and competence in data science.

**Recommendation 2.3: To prepare their graduates for this new data-driven era, academic institutions should encourage the development of a basic understanding of data science in all undergraduates.**

The continued transformation of work requires both a larger population with a basic understanding of data science and a substantial cadre of talented graduates with highly developed data science skills and knowledge, acquired through substantial coursework and practice.

**Recommendation 2.1: Academic institutions should embrace data science as a vital new field that requires specifically tailored instruction delivered through majors and minors in data science as well as the development of a cadre of faculty equipped to teach in this new field.**

The new majors and minors will initially combine ingredients from existing courses, in areas such as computer science, statistics, business analytics, information technology, optimization, applied mathematics, and numerical computing. Over time, as features of the new data-driven era take shape, academic programs will be compelled to develop new skill clusters, and a body of distinctive courses and instructional materials will emerge.

**Recommendation 4.1: As data science programs develop, they should focus on attracting students with varied backgrounds and degrees of preparation and preparing them for success in a variety of careers.**

Graduates of these programs will work in virtually every job sector and will serve in a number of roles, including operating the systems on which analyses are run, preparing data for analysis, defining and coordinating the analysis, visualizing information, and supporting data-driven decision making to uncover the stories buried in the data. Others who use data science skills will be journalists, administrators, artists, lawyers, teachers, and other workers who need some ability to understand and use data. This need to prepare diverse students for various careers further increases the educational challenge.

A wide variety of instructional programs will be needed to prepare students for the data-enriched world of the coming years.

**Recommendation 2.2: Academic institutions should provide and evolve a range of educational pathways to prepare students for an array of data science roles in the workplace.**

These include introductory courses, full degrees at both associate and bachelor levels, and a range of minors and certificates. The forms of these programs and their scope will vary depending on the culture of a given institution and the aims of its students.

Regardless of the type of program, certain elements need to be covered, though perhaps to varying degrees and with varying emphases. A key goal is to give all students the ability to make good judgments, use tools responsibly and effectively, and ultimately make good decisions using data. The committee defines this collection of abilities as “data acumen.” To that end, students will need exposure to material from multiple disciplines—notably, mathematical, statistical, and computational foundations—and they will need training in data acquisition, modeling, management and curation, data visualization, workflow and reproducibility, communication and teamwork, domain-specific considerations, and ethical problem solving.

The committee underscores the centrality of studying the many ethical considerations that arise as workers engage in data science. These considerations include deciding what data to collect, obtaining permissions to use data, crediting the sources of data properly, validating the data’s accuracy, taking steps to minimize bias, safeguarding the privacy of individuals referenced in the data, and using the data correctly and without alteration. It is important that students learn to recognize ethical issues and to apply a high ethical standard.<sup>1</sup>

**Recommendation 2.4: Ethics is a topic that, given the nature of data science, students should learn and practice throughout their education. Academic institutions should ensure that ethics is woven into the data science curriculum from the beginning and throughout.**

**Recommendation 2.5: The data science community should adopt a code of ethics; such a code should be affirmed by members of professional societies, included in professional development programs and curricula, and conveyed through educational programs. The code should be reevaluated often in light of new developments.**

---

<sup>1</sup> For information about community efforts toward more transparent data-driven decision making for social good, see <http://datafordemocracy.org>, accessed March 12, 2018.



Academic institutions are stepping up to these educational challenges with a variety of programs and educational pathways. Several 4-year undergraduate institutions offer data science majors and/or minors—serving not only those students pursuing data science as a career but also those students who want to acquire data skills while majoring in another field. Two-year institutions are starting to introduce associate degrees and certificates in data science to prepare students to transfer to 4-year programs or to give them skills to compete in the workforce. Summer programs enable undergraduate students to build up data science skills rapidly. Boot camps and intensive training programs that aim to refresh or retool postgraduate students with the skills required of the growing data science workforce are now appearing. Massive open online courses in data science are proliferating and serve as stand-alone points of entry for all kinds of students (and flexible opportunities for professional development for instructors).

These pioneering examples of programs show what is possible, but there are significant challenges to developing data science programs more broadly and pervasively. The popularity of data science courses and programs will affect the entire academic institution by influencing enrollment, budgets, classroom allocation, computing resources, and scheduling. Institutions may need to consider how to create incentives for faculty in multiple departments and fields to collaborate to develop and deliver curricula that best meets students' needs. Today, there is a shortage of faculty in this rapidly evolving area. Enlisting and training existing faculty will be essential in the short term, and developing new faculty will be important in the long term. These challenges, among others, will need to be addressed to ensure the success of undergraduate data science students.

**Recommendation 5.1: Because these are early days for undergraduate data science education, academic institutions should be prepared to evolve programs over time. They should create and maintain the flexibility and incentives to facilitate the sharing of courses, materials, and faculty among departments and programs.**

The evolution of data science programs will be affected by a broad range of factors, including their initial home and structure, the needs and interests of students, and institutional culture. Although new programs could be launched by combining existing courses and materials, over time new classes and materials will need to be developed. Institutions will need to think through the pathways students are taking into data science and how to create bridges and remove barriers. Academic and career advising will be vital parts of data science programs; the advising programs will themselves need to evolve as the field and the market for graduates mature.

Data science itself provides the tools to continuously evaluate and improve data science education. Evaluation should include assessment of student learning and assessment of how well a program is meeting the needs of the market it aims to serve. Evaluation can be used to shape a program at a given institution, showing what is working and where improvement is needed. It can also be used comparatively to detect approaches, classes, or curricula that may be of value to other campuses or contexts.

**Recommendation 5.3: Academic institutions should ensure that programs are continuously evaluated and should work together to develop professional approaches to evaluation. This should include developing and sharing measurement and evaluation frameworks, data sets, and a culture of evolution guided by high-quality evaluation. Efforts should be made to establish relationships with sector-specific professional societies to help align education evaluation with market impacts.**

Much of the necessary data for evaluation could come from institutions' administrative records. These records, used in conjunction with other data sources such as economic information and survey data, could

enable effective transformation and generalization of programs and might even inform a cohesive national approach to undergraduate data science education.

In many fields, professional societies play a role in creating and nurturing community, in facilitating the sharing of resources and results, and in convening groups to set standards or determine best practices. Such capabilities are valuable to data science as well. However, it may be difficult for a single existing society to represent all the interests of the data science community. A structured collaboration of existing professional societies might work better, with potential development of sub-societies devoted to data science elements in any of many preexisting societies.

**Recommendation 5.4: Existing professional societies should coordinate to enable regular convening sessions on data science among their members. Peer review and discussion are essential to share ideas, best practices, and data.**

Conferences, workshops, training sessions, and other networking opportunities would benefit the joint communities. Other opportunities for the collaborating societies would be collecting materials; convening discussions around critical topics such as curriculum, evaluation, and ensuring broad participation; and potentially creating publication venues for the broad community. *As data science continues to evolve, it is essential that academic institutions and other stakeholders take steps to prepare students for a data-enabled world. The time to act is now.*