



**THE  
UNIVERSITY OF  
NORTH CAROLINA  
SYSTEM**

**New Academic Degree Program  
Request to Establish**

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

**Degree Program Title (e.g., M.A. in Biology): Ph.D. in Data Science**

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

<b>Review</b>	<b>Name</b>	<b>Title</b>
<b>Faculty Senate Chair (Or appropriate body)</b>	Xiaoxia Newton	<b>Faculty President</b>
<b>Graduate Council (If applicable)</b>	Concepcion Godev	<b>Graduate Council Chair</b>
<b>Graduate/Undergraduate Dean (If applicable)</b>	Pinku Mukherjee	<b>Interim Associate Provost &amp; Graduate School Dean</b>
<b>Academic College/School Dean</b>	Bojan Cukic, Robert Keynton, Catrine Tudor-Locke, John Smail, Dolly King, Bernadette Donovan-Merkert	<b>Dean College of Computing and Informatics, Dean William State Lee College of Engineering, Dean College of Health and Human Services, Interim Dean College of Humanities &amp; Earth and Social Sciences, Interim Dean College of Business, Interim Dean College of Science</b>
<b>Department Head/Chair</b>	Douglas Hague	<b>Executive Director</b>
<b>Program Director/Coordinator</b>	Jean-Claude Thill and Monica Johar	<b>Knight Distinguished Professor of Geography and Earth Sciences, Professor of Management Information Systems</b>

**New Academic Program Process**

New academic programs are initiated and developed by faculty members. The Request to Establish a New Academic Degree Program must be reviewed and approved by the appropriate individuals listed above before submission to the UNC System Office for review.

Please provide a succinct, yet thorough response to each section. Obtain signatures from the Chancellor, Provost, and Chief Financial Officer, and submit the proposal via the PREP system to the UNC System Vice President for Academic Program, Faculty, and Research, for review and approval by the UNC System Office.

If the Request to Establish is approved by UNC System Office staff, it will be submitted the proposal for review and approval by the UNC Board of Governors.

<b>UNC Institution Name</b>	University of North Carolina Charlotte
<b>Joint Degree Program (Yes or No)? If so, list partner.</b>	No
<b>Degree Program Title (e.g., M.A. in Biology)</b>	Ph.D. 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
<b>Will this program be offered through an Online Program Manager (OPM)? If yes, list the OPM.</b>	NA
<b>If requesting site-based delivery, indicate address(es), city, county, state, and maximum % offered at site.</b>	NA
<b>Proposed Term to Enroll First Students (e.g., Fall 2023)</b>	Fall 2024

Do the following sections of your previously submitted and approved Request for Preliminary Authorization 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>	No	
<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>Access and Affordability</b>	No	
<b>Societal and Labor Market Demand</b>	No	
<b>Doctoral Specific Questions</b>	No	

**I. Program Summary**

- a. Describe the proposed program, including the overall rationale for its development. Include a discussion of how this program supports the specific mission of the institution and of the broader UNC System. Why is this program a necessary addition for the institution?

**Market and University Alignment**

The proposed doctoral program in Data Science (DTSC) fulfills a need created by the increasing demand at the high end of the marketplace for data scientists. While most needs for data science talent are fulfilled through undergraduate and Master’s programs like the existing B.S. and M.S. degrees in Data Science and Business Analytics (DSBA), Statistics, and Computer Science at UNC Charlotte, there is a gap in the production of Ph.D.s in the data science field. The proposed program offers rapid specialization for different profiles of data science professionals. The proposed Ph.D. program in Data Science will provide doctoral-level education to students seeking data science careers both in academia and in industry. As evidenced by the letters of support provided in Attachment III, Charlotte area industries, especially the finance industry, have long partnered with UNC Charlotte and are supporting this extension of the data science programs to include the Ph.D.. The proposed program is a terminal research degree that is transdisciplinary by design and lays emphasis on the mastery of the data science tools and methodologies and on responsible stewardship of data to cover the broad value of data science in various domains across society. Strong emphasis will be placed on providing students the opportunity to demonstrate mastery of knowledge in multiple data science application domains including, but not limited to, financial services, political science, sociology, marketing, management information systems, operations management, criminal justice, public administration and policy, geography, public health, earth and environmental sciences, engineering, urban management, economics, and education.

As North Carolina’s urban research university, UNC Charlotte is in an unparalleled position to deliver on career-building expertise. 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 maintains a particular commitment to addressing the cultural, economic, educational, environmental, health, and social needs of the greater Charlotte region and beyond. UNC Charlotte recently established the School of Data Science (SDS) as the home for transdisciplinary data science and analytics programs. SDS and its predecessor, the Data Science Initiative (DSI), are key strategic priorities of the University. Six colleges participate in program implementation within the School of Data Science: College of Computing and Informatics, College of Science, College of Humanities & Earth and Social Sciences, Belk College of Business, College of Health and Human Services, and The William States Lee College of Engineering, while the remaining colleges of Education and Arts + Architecture will be contributing as well.

## **Alignment with UNC Mission**

By exposing students to real-world data and problems in civil society and in business organizations, the DTSC Ph.D. program will emphasize educational and research opportunities that clearly align with UNC Charlotte’s mission, including social mobility, public policy, and urban analytics. The early acquisition of a \$2.1 million research grant has positioned UNC Charlotte to be a national leader in fundamental and applied research in data science. More recently, the North Carolina General Assembly has invested \$41.2M for “Engineering North Carolina’s Future.” This funding specifically calls for investments in data science along with engineering and cybersecurity. As a complement, SDS has a broad cadre of industrial and community partners including Wells Fargo, Bank of America, Lowe’s, Premier, Genpact, Atrium Health, Novant Health, Duke Energy, SAS, IQVIA as well as others. The surrounding hub of top financial services, energy, retail sales and distribution, advanced manufacturing, and technology companies provides an ideal ecosystem to utilize a suite of skills only an urban research university can accommodate— data science, innovation insights, business acumen, and critical problem solving. UNC Charlotte is also responding to this sector's large workforce demand through collaborations with other universities and business partners in the Research Triangle Park (RTP). Through collaborations with NC State, UNC Chapel Hill, Wake Tech, and NC Central, App State, Winston-Salem State, UNC Greensboro, Duke, and Wake Forest, UNC Charlotte SDS is working to weave a network and strategic workforce development pipelines to expand data science capability across North Carolina. While there are no existing transdisciplinary doctoral programs in Data Science in the UNC system<sup>1</sup>, we will continue to seek out and reinforce collaboration across UNC system institutions.

The UNC System mission is “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 existing tools and stimulate the development of new ones, 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 a key component in their long-term viability, resilience, and sustainability. The proposed DTSC program perfectly aligns with this mission by providing training at the cutting edge of data science practice and research today and for the generations to come.

## **Necessary addition for UNC Charlotte**

As detailed in the Student Demand section of the Request for Preliminary Authorization, the national and global popularity of Master’s programs in data science and our own surveys strongly suggest that there will be large student demand for a Ph.D. program in data science (details in Student Demand section). Not only is industry poised to support demand for data scientists with

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<sup>1</sup> While NC A&T has recently evolved their Computational Science and Engineering program to be a Ph.D. in Computational Data Science and Engineering, their degree's core is within Engineering with some interdisciplinary focus. The program UNC Charlotte is proposing is built from the ground up with a transdisciplinary focus. While related, we believe that these programs are very distinct and serve different markets.

doctoral level of training, but the growth of undergraduate and Master’s programs nationally will also require the hiring of faculty members ready to train the next generations of students in data science. In the UNC system, there are six Master’s programs in data science: UNC Charlotte, NC State, UNC Wilmington, Appalachian State University, East Carolina University and Winston-Salem State University. Duke University has a Master’s program in data science as well. In particular, three representative data science programs – the M.S. in DSBA at UNC Charlotte, the MSA program at NC State, and the Master’s in Interdisciplinary Data Science (MIDS) at Duke University are experiencing healthy enrollment. UNC Chapel Hill has recently launched an online M.S. in Data Science and the new Foundations of Data Science M.S. at NC State is expected to grow quickly. Finally, UNC Chapel Hill has formed a School of Data Science and Society, signaling increasing demand in this growing field.

With over 800 alumni, the DSBA program at UNC Charlotte will provide a natural pipeline of prospective students for this proposed Ph.D. program. In a recent survey of DSBA alumni, 15% indicated they would be interested in a Ph.D. program in Data Science at UNC Charlotte<sup>2</sup>. To be prepared for challenging coursework and rigorous research at the highest level, student applicants are expected to have demonstrable knowledge in calculus, linear algebra, probability and statistics along with proficiency in programming languages. They will be well qualified recruits for the planned Ph.D. program.

- b. What are the key objectives of the program? What are the expected benefits for the student who graduates from the program? What are the expected public benefits (at the local, regional, state, or national level) of this program?

### **Program objectives**

The goal of the proposed program is to produce researchers fluent in the emerging field of data science and to develop an environment for their education and training. The objectives of the Data Science Ph.D. include:

- Preparing research data scientists, professional data scientists, and scholars/academicians who will be leaders in developing, maintaining, and managing data ethically and effectually to sustain the economic and social vibrancy of North Carolina and the United States;
- Developing research data scientists who have a deep understanding of data, statistics, computing, and ethics frameworks such that they can build new knowledge across fields and society by appropriate data collection, methods development, and deep analysis.;
- Providing a range of educational and research experiences for a diverse group of students to participate in research initiatives at UNC Charlotte, Private, Public, and International institutions; and,
- Preparing future data science educators, and scholars, who are at the frontiers of understanding and disseminating data science knowledge.

### **Expected benefits to students, the region, state and nation**

The demand for doctoral education in data science within the state of North Carolina is

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<sup>2</sup> See the appendix of our Preliminary Authorization for complete survey results.

particularly acute. Only three tangentially related doctoral programs are located in the state of North Carolina: the Ph.D. in Geospatial Analytics at NCSU, the Ph.D. in Health Informatics at UNC at Chapel Hill, and the renamed Ph.D. in Computational Data Science and Engineering at NC A&T. Two of these programs are only concentrated on particular specialty domains (geospatial analytics and health informatics) and the third evolved from a Ph.D. in Computer Science and Engineering and retains its focus on engineering. While the proposed program is most similar to the NC A&T program, the proposed Ph.D. in Data Science at UNC Charlotte is a broader, transdisciplinary program capturing diverse application domains based on data science techniques such as marketing, management information systems, operations management, education, public policy, urban and environmental sciences, and computational social sciences; it will be the first comprehensive doctoral program in data science in the state of North Carolina. Producing higher numbers of Ph.D. graduates in this field is necessary to ensure sufficient supply of graduates to fill positions at academic institutions. With the demand for Ph.D.s in data science, the proposed program will provide a contribution to the labor force. As shown in the Preliminary Authorization, there has been a significant growth in the academic data science programs across the country. While academia has been pulling faculty from many fields to teach data science courses, the specialized education of a Ph.D. in data science would benefit the many programs across the country and allow data science faculty to teach across the curriculum. Today most faculty teaching in data science are limited to teaching a narrow portion of the courses offered within a curriculum. Having faculty with a data science Ph.D. will enable broader participation of faculty across the curriculum.

Another factor in play is the demand for data science Ph.D.s in industry. As an example, several of our industry partners in Charlotte have over 100 Ph.D. graduates in data science working inside their corporations. These teams are expected to continue to grow over time as more companies and industries are hiring data scientists. This results in a competition for data science Ph.D.s between industry and academia. As documented in the Preliminary Authorization, industry compensation is considerably higher than what is typically offered in academia. This difference necessitates the need to deliver even more graduates to serve the needs of North Carolina and our nation. Launching this program will enable our industry partners to directly support Ph.D. students and help UNC Charlotte provide funding and support to students and faculty research.

Across the nation, universities are launching data science Schools, Institutes and other forms of academic and research focused units. Enabling a Ph.D. in Data Science at UNC Charlotte will enable UNC Charlotte to better partner and collaborate with these emerging units. UNC Charlotte's School of Data Science has already initiated collaborations with Schools of Data Science at University of Virginia, University of Texas, San Antonio, and UNC Chapel Hill as well as other units at NC State and University of Michigan.

The proposed Ph.D. program is expected to be a key part of many new research centers at UNC Charlotte, including the Center for TAIM<sup>2</sup>ing AI, the Center for Leadership Science, the Center for GeoSpatial Sensing and Analytics as well as many research proposals related to AI, data science, and their applications.

## **II. 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 (use the 4-digit CIP as a guide). Show a four-year history of applications,

acceptances, enrollments, and degrees awarded in similar programs offered at other UNC institutions (using the format below for each institution with a similar program). If data was not available, mark not available. Programs at UNC institutions may be found on the [UNC System website](#).

There are only three tangentially related doctoral programs located in the state of North Carolina: the Ph.D. in Geospatial Analytics at NCSU, the Ph.D. in Health Informatics at UNC at Chapel Hill, and the renamed Ph.D. in Computational Data Science and Engineering at NC A&T. After review and discussions, NC A&T is the only one that we view as somewhat similar to our proposed degree (even though it is in CIP 14.9999 (Engineering, Other). None of them has the transdisciplinary breadth that is central to our proposed program.

Institution	North Carolina A&T University			
Program Title	Ph.D. in Computational Data Science and Engineering* (CIP 14.9999)			
Academic Year	AY19	AY20	AY21	AY22
Applications				
Acceptances				
New Enrollment	<12 (includes M.S.)	<7 (includes M.S.)	6	9
Total Enrollment	45	44	46	42
Total Degrees Awarded	4	1	6	2

- 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.

UNC Charlotte’s Executive Director of the School of Data Science, Dr. Hague, is a member of the national Board of Directors of the Academic Data Science Alliance. Through this group, there is active discussion on all levels of academic data science programs and research opportunities. Dr. Hague has a quarterly meeting to discuss programs and operations with the Dean of the School of Data Science at University of Virginia and the Executive Director of the School of Data Science at University of Texas at San Antonio. Dr. Hague has also had discussions with the leadership of the Ph.D. Program in Data Science at Kennesaw State University. UNC Charlotte expects to continue these collaborations. As one example of the information exchanged, for the Fall 2023, University of Virginia had 240 Ph.D. applications for 8 slots. Applications and enrollment have been strong in these programs, exceeding the expectations and with no sign of tapering in interest for doctoral education in Data Science.

- 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.

The UNC Charlotte School of Data Science has been collaborating with UNC System schools for over 5 years through the National Consortium for Data Science run by RENCI at UNC Chapel Hill.

We have a subcommittee on the academics of data science where we actively collaborate with the new School of Data Science and Society at UNC Chapel Hill and the Data Science Academy at NC State; other UNC System Schools periodically participate in these meetings as well (e.g., App State, NCCU). UNC Charlotte expects to continue 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.

Since there is only one somewhat similar program in the UNC System (the Computational Data Science and Engineering program at NC A&T, CIP 14.9999), there is no unnecessary duplication. This is especially the case in that the NC A&T program is very computationally based and focused on engineering. While we may have a small portion of students that research similar topics, our program is designed as a very broad based and transdisciplinary program that stretches across many topics, including business, health, social sciences, as well as engineering. In addition, the core foci of our universities (an Urban Research University and an HBCU, respectively) will attract a distinct set of students. Hence, the two programs meet complementary needs for doctoral education in North Carolina.

Separately, North Carolina State University recently started to offer a Ph.D. in Geospatial Analytics. In contrast to our proposed program, this program is narrowly focused on geospatial data and methods of analysis, and Data Science is a very small part of this program. This program currently enrolls 45 students advised by mentors who mainly have affinities with natural and environmental sciences. We have been in contact with Dr. Ross Meentemeyer, Program Director. This program does not overlap with our Data Science program.

- e. Admission. List the following:
  - i. Admissions requirements for proposed programs (indicate minimum requirements and general requirements).

The DTSC Ph.D. program seeks the following from successful applicants to the program:

- The equivalent to a U.S. baccalaureate and a Master's degree from a college or university accredited by an accepted accrediting body with a minimum undergraduate GPA of 3.20 and a minimum graduate GPA of 3.50 (on a 4.00 scale) in all graduate work. Outstanding applicants holding a baccalaureate degree with an undergraduate GPA of 3.75 or above may also be considered for admission.
- A satisfactory score (>50th percentile) from the aptitude portion of the GRE (optional).
- An acceptable TOEFL or IELTS score as required by UNC Charlotte for international students from select foreign countries. In addition, TOEFL iBT must be a minimum score of 18 on each section of the test while the IELTS must be a minimum score of 6.5 in each section.
- Any other appropriate credentials as required by the Graduate School.

Applicants with the equivalent to a Master's degree from a college or university accredited by an accepted accrediting body, in data science or in a related field with a minimum



undergraduate GPA of 3.20 and a minimum graduate GPA of 3.50 (on a 4.00 scale) in all graduate work are eligible to apply for the Advanced Standing (see Degree Requirements for details).

Students can be admitted to the program on a part-time basis, including under the Advanced Standing option.

ii. Documents to be submitted for admission (listing)

Application to the proposed DTSC program will follow existing UNC Charlotte Graduate School admissions processes. The UNC Charlotte application process is completely online. To apply for graduate studies, all applicants must submit the following application materials to the UNC Charlotte Office of Graduate Admissions:

- Graduate School Application for Admission (online)
- Application Fee (payable online)
- Unofficial transcripts from all previous college-level institution(s) attended (submitted online); If admitted, official transcripts must be submitted to the Graduate School prior to joining the program. Certified translations (if needed) and degree certifications are required if the degree was earned outside the U.S.
- Official TOEFL scores (for applicants from select foreign countries).
- A minimum TOEFL score of 83 (internet-based) or a minimum IELTS band score of 6.5 required from any applicant required to submit a language proficient score.
- A personal and original statement of purpose (essay indicating research interests and motivation and one or more potential faculty advisor) in the range of 500 words, submitted online as part of the application submission process.
- Three letters of recommendation, two of which must be from faculty members (submitted online by recommenders)
- Official GRE/GMAT test scores. A waiver is available upon request and subject to the approval of the Program Director under specific circumstances (professional experience, for instance).
- A resume (submitted online).

As an option, applicants can submit a writing sample from their most recent degree and a sample of their recent research activities and output.

f. Degree requirements. List the following:

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

The DTSC Ph.D. will require a minimum of 72 credit hours of study inclusive of 18 credit hours of dissertation research. Some applicants may be eligible to pursue the Ph.D. degree with advanced standing. Eligibility for this accelerated option must be made at the time of admission to the program, and is subject to review and approval by the Graduate School, the DTSC Admissions Committee, and the DTSC Program Director. Under the advanced standing option, students must complete 42 credit hours, including 18 credit hours of dissertation research. In addition to the 72 or 42 credit requirement mentioned above, students must complete the Responsible Conduct of Research course (GRAD 8302) and the Academic Integrity course (GRAD 8990).

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

The DTSC Program will follow the UNC Charlotte Graduate School requirements on residence (<https://ece.charlotte.edu/graduate-program/doctoral-program/degree-requirements>). A student may satisfy the residency requirement for the program by completing 18 hours, either coursework or research credits, by study-in-residence during the academic year and during the summer terms, as long as the study is continuous. Study-in-residence is deemed to be continuous if the student is enrolled in one or more courses (including research/dissertation credit) in successive semesters until eighteen hours of credit are earned.

Following the UNC Charlotte Graduate School policies (<https://ece.charlotte.edu/graduate-program/doctoral-program/degree-requirements>), in addition to demonstrating a high level of competence in coursework, the student must pass the Ph.D. qualifying examination. The qualifying examination should be taken no later than one semester after completion of required core courses of the program. The qualifying exams will consist of three parts: a written research prospectus (draft proposal), oral defense of the draft proposal, and a written response to a data science problem presented by an ad hoc committee. Failure to pass the qualifying examination in two tries will result in the termination of the student’s enrollment in the Ph.D. program.

After passing the qualifying examination, a student must propose a dissertation topic, prepare a written proposal, and submit it to the doctoral committee for review at least two weeks before the oral exam date. The oral exam, administered by the student’s doctoral research advisor and doctoral committee, will include a presentation and defense by the student of his or her proposed research topic in accordance with rules and policies of the UNC Charlotte Graduate School. The doctoral student advances to candidacy after the dissertation topic and proposal has been approved by the student’s doctoral committee and the Graduate School. The candidacy must be achieved at least 6 months before the doctoral degree is conferred.

The DTSC Program will allow the student’s dissertation to take either of two forms: a traditional monograph or a collection of three or more articles structured coherently around a common theme. For the latter option, the student will be expected to follow the protocols laid out by the UNC Charlotte Graduate School.

- 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>	8	0	0	7	1

<b>Year 3</b>	24	0	0	21	3
<b>Year 5</b>	32	0	0	28	4

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

<b>Grades required</b>	<p>Grades of A or B are acceptable, while grades of C or U are marginal and unacceptable, respectively. Per policies of the UNC Charlotte Graduate School, an accumulation of two “C” grades or one “U” grade will result in termination of enrollment from the DTSC Ph.D. program. DTSC Ph.D. students suspended or terminated from the doctoral program may appeal once to the Program Director to be reinstated by submitting an acceptable plan to improve their grades and successfully complete the program.</p>
<b>Amount of transfer credit accepted</b>	<p>Students applying for admission in the Advanced Standing option of the DTSC Program, and admitted to it, cannot transfer course credit hours.</p> <p>Within the established policies and protocols of the UNC Charlotte Graduate School, students not in the Advanced Standing option of the DTSC Program may be allowed to transfer up to 9 semester hours of graduate credit (coursework only) earned at UNC Charlotte or other recognized graduate programs, if they are deemed relevant to their study in the DTSC Ph.D. Program.</p> <p>While enrolled in the DTSC Ph.D. Program, students may take courses from the DSBA Master’s (6000/7000-level) at UNC Charlotte and have them transferred as credit towards the DTSC Ph.D. Program. These credits cannot be counted towards the requirements of another degree program. Transfers are subject to the approval of the Graduate School, Program Director and student’s academic advisor.</p>
<b>Language and/or research requirements</b>	<p>English language proficiency is required. The DTSC Ph.D. will conform to the established UNC Charlotte Graduate Admissions English Language Proficiency Requirements and Policies: <a href="https://gradadmissions.uncc.edu/admissions-info/doctoral/">https://gradadmissions.uncc.edu/admissions-info/doctoral/</a> and <a href="https://gradadmissions.charlotte.edu/admissions/international-applicants/english-language-proficiency">https://gradadmissions.charlotte.edu/admissions/international-applicants/english-language-proficiency</a>. These include official and satisfactory English language proficiency scores on the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). A minimum score of 83 on the Internet-based TOEFL or a minimum overall band score of 6.5 on the IELTS are required for admission to the doctoral program.</p> <p>As per UNC Charlotte Graduate Admissions policy, “Applicants who do not meet the minimum English language proficiency requirement will not be admitted to UNC Charlotte. They may, however, choose to enroll at UNC Charlotte’s English Language Training Institute (ELTI) and then re-apply to the Graduate School. See ELTI’s website: <a href="http://www.ielts.org">www.ielts.org</a> for details.</p>

	The DTSC Ph.D. program has no further language requirement. The Ph.D. in Data Science is a research degree requiring the completion of an original research dissertation. Therefore all students must complete a minimum of 18 credit hours of DTSC 8900 Dissertation Research.
<b>Any time limits for completion</b>	According to UNC Charlotte Graduate School policy, students are allowed a maximum of eight (8) calendar years from formal admission to the doctoral program to complete the program successfully. The Data Science Ph.D. Program will follow the same policy.

- 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.

The DTSC Ph.D. requires a total of 42 credit hours for students with advanced standing, and 72 credit hours for students without advanced standing. Students without advanced standing must complete 54 hours of coursework to include 18 hours of required core courses and 36 hours of electives. Students with advanced standing must complete 24 credit hours of coursework that must include 18 hours of required core courses and 6 hours of electives. Students must also complete the Responsible Conduct of Research course (GRAD 8302) and the Academic Integrity course (GRAD 8990).

All required core courses will be new courses, open only to doctoral students (8000-level courses). All students must take 18 credits of Doctoral Dissertation Research (DTSC 8900).

To satisfy the 36 credit-hours (or 6 credit-hours for the advanced standing option) of electives, the student will take a combination of DTSC 8000 (Special Topics in Data Science), other doctoral 8000-level classes, and other graduate courses at the 5000 to 7000 level when 8000-level equivalents are not available, provided that they would be relevant to their program of study and research. The student is allowed to take these electives from any graduate program or department at UNC Charlotte, subject to approval by the student’s advisor and the DTSC Program Director. Students can also take individual studies classes (usually DTSC 8800). Each doctoral student is limited to 6 credits of individual studies classes (DTSC 8800); students with advanced standing are limited to 3 credits of DTSC 8800. Transfer credit can be counted towards electives.

Courses numbered 8xxx or 9xxx are open to doctoral students only. Courses numbered 5xxx, 6xxx, or 7xxx are other graduate level courses.

Sample degree plan for a student in the Advanced Standing Option

<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>
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	DTSC 8600 (2 credits)	Research Design for Data Science	Y	Y	This course is designed to teach you about conducting data science research – the systematic application of scientific knowledge and procedures to the identification of relevant research questions and the design, organization, conduct, analysis, ethical considerations, and communication of research applied to rigorous, structured and purposeful problem solving. To do this, you will need to develop a number of useful skills including those associated with critical reading, writing, conception of an effective research design, argument and critique. All of these skills are required to help us (a) engage in evidence-based research; (b) investigate interesting, novel, forward-looking and compelling questions, (c) test existing theories and/or develop new theories, and (d) disseminate our research results.
	DTSC 8601 (2 x 1 credit)	Data Science Research Seminar	Y	Y	This course is a seminar exposing students to the frontier of data science research in various domains of applications. It is structured with 3 to 4 modules through the semester, each one dedicated to a different body of literature. Students will gain research proficient in the domains of application in focus during the semester. Topics will rotate with each offering.
	DTSC 8110 (3 credits)	Statistics for Data Science	Y	Y	The course provides students with fundamental statistical knowledge and examples

					solved with well-known statistical software in the context of data science. Topics include probability distributions, data and statistical models, estimation approaches, confidence region and hypothesis testing, variance analysis and linear regression, logistic regression.
	DTSC 8130 (3 credits)	Ethics, Security, Privacy, & Governance of Data for Social Good	Y	Y	This course consists of three parts. First, it pursues some of the most substantial ethical concerns that arise in data science, with attention to the ways that governance policies and technological developments can either ameliorate or increase them. Second, it provides a grounding of knowledge on data governance and data privacy, including the associated practices to assess data security and/or approaches to improve data security. Third, the course offers insights on the social impacts and potential benefits that data science and data scientists can provide to society, particularly from the individual and social engagement of principles of justice, diversity, equity, and inclusion.
	GRAD 8302 (2 credits)	Responsible Conduct of Research	Y	N	
	GRAD 8990 (0 credits)	Academic Integrity	Y	N	
	DTSC 8120 (3 credits)	Fundamentals of Machine Learning	Y	Y	This course is designed to give students a thorough grounding in the methods, mathematics, and algorithms needed to do research and applications in machine learning.

					<p>Practical perspectives and applications of machine learning methods will be covered, including the development of new skills through instruction and practice; combined with an overview of the business to identify, model, retrieve, and evaluate enterprise data and knowledge assets. Focuses on the understanding of data and knowledge management and data mining using techniques such as Markov Decision Processes, Decision Trees, Supervised and Unsupervised Learning, Reinforcement Learning, Logistic Regression, and other business intelligence concepts. The course will discuss machine learning from organizational, technological, and management perspectives.</p>
	DTSC 8150 (3 credits)	Fundamentals of AI	Y	Y	<p>The course covers the following topics: state space search algorithms, adversarial search, puzzles, zero-order and first-order logics, proof systems including Gentzen formal systems, soundness and completeness, Godel's completeness theorem, Horn clauses, resolution theorem proving (set of support, linear input, unit-preference, ancestry-filtered form strategy), knowledge discovery including actionability (action rules mining), explainable AI, recommender systems (collaborative filtering, content-based, group, knowledge-based, hybrid), AI applications in healthcare, business, music, and art.</p>

<b>Year 2</b>	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 8601 (2 x 1 credit)	Data Science Research Seminar	Y	Y	This course is a seminar exposing students to the frontier of data science research in various domains of applications. It is structured with 3 to 4 modules through the semester, each one dedicated to a different body of literature. Students will gain research proficient in the domains of application in focus during the semester. Topics will rotate with each offering.
	DTSC 8000 (3 credits)	Special Topics in Data Science	N	Y	Examination of major theories, methods, and issues in the area of Data Science. Instructional method(s) vary according to topic, course objectives, and instructor.
	DTSC 8800 (3 credits)	Independent Studies	N	Y	Individual research in specific topics of Data Science under the direction of a faculty member.
	DTSC 8900 (10 credits)	Dissertation Research	Y	Y	Under the direction of a dissertation advisor and committee, students design and execute an original research study. This study should address a significant issue or problem within the field of Data Science.

<b>Year 3</b>	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 8900 (8 credits)	Dissertation Research	Y	Y	Under the direction of a dissertation advisor and committee, students design and execute an original research study. This study should address a significant issue or problem within the field of Data Science.



Sample degree plan for a student not in the Advanced Standing option

Year 1	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 8600 (2 credits)	Research Design for Data Science	Y	Y	This course is designed to teach you about conducting data science research – the systematic application of scientific knowledge and procedures to the identification of relevant research questions and the design, organization, conduct, analysis, ethical considerations, and communication of research applied to rigorous, structured and purposeful problem solving. To do this, you will need to develop a number of useful skills including those associated with critical reading, writing, conception of an effective research design, argument and critique. All of these skills are required to help us (a) engage in evidence-based research; (b) investigate interesting, novel, forward-looking and compelling questions, (c) test existing theories and/or develop new theories, and (d) disseminate our research results.
	DTSC 8601 (3 x 1 credit)	Data Science Research Seminar	Y	Y	This course is a seminar exposing students to the frontier of data science research in various domains of applications. It is structured with 3 to 4 modules through the semester, each one dedicated to a different body of literature. Students will gain research proficient in the

					domains of application in focus during the semester. Topics will rotate with each offering.
	DTSC 8110 (3 credits)	Statistics for Data Science	Y	Y	The course provides students with fundamental statistical knowledge and examples solved with well-known statistical software in the context of data science. Topics include probability distributions, data and statistical models, estimation approaches, confidence region and hypothesis testing, variance analysis and linear regression, logistic regression.
	DTSC 8130 (3 credits)	Ethics, Security, Privacy, & Governance of Data for Social Good	Y	Y	This course consists of three parts. First, it pursues some of the most substantial ethical concerns that arise in data science, with attention to the ways that governance policies and technological developments can either ameliorate or increase them. Second, it provides a grounding of knowledge on data governance and data privacy, including the associated practices to assess data security and/or approaches to improve data security. Third, the course offers insights on the social impacts and potential benefits that data science and data scientists can provide to society, particularly from the individual and social engagement of principles of justice, diversity, equity, and inclusion.
	GRAD 8302 (2 credits)	Responsible Conduct of Research	Y	N	
	GRAD 8990 (0 credits)	Academic Integrity	Y	N	

	DTSC 8120 (3 credits)	Fundamentals of Machine Learning	Y	Y	<p>This course is designed to give students a thorough grounding in the methods, mathematics, and algorithms needed to do research and applications in machine learning.</p> <p>Practical perspectives and applications of machine learning methods will be covered, including the development of new skills through instruction and practice; combined with an overview of the business to identify, model, retrieve, and evaluate enterprise data and knowledge assets. Focuses on the understanding of data and knowledge management and data mining using techniques such as Markov Decision Processes, Decision Trees, Supervised and Unsupervised Learning, Reinforcement Learning, Logistic Regression, and other business intelligence concepts. The course will discuss machine learning from organizational, technological, and management perspectives.</p>
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	DTSC 8150 (3 credits)	Fundamentals of AI	Y	Y	The course covers the following topics: state space search algorithms, adversarial search, puzzles, zero-order and first-order logics, proof systems including Gentzen formal systems, soundness and completeness, Godel's completeness theorem, Horn clauses, resolution theorem proving (set of support, linear input, unit-preference, ancestry-filtered form strategy), knowledge discovery including actionability (action rules mining), explainable AI, recommender systems (collaborative filtering, content-based, group, knowledge-based, hybrid), AI applications in healthcare, business, music, and art.
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Year 2	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 8601 (1 credit)	Data Science Research Seminar	Y	Y	This course is a seminar exposing students to the frontier of data science research in various domains of applications. It is structured with 3 to 4 modules through the semester, each one dedicated to a different body of literature. Students will gain research proficient in the domains of application in focus during the semester. Topics will rotate with each offering.
	DTSC 8000 (3 credits)	Special Topics in Data Science	N	Y	Examination of major theories, methods, and issues in the area of Data Science. Instructional method(s) vary according to topic, course objectives, and instructor.

	DTSC 8800 (3 credits)	Independent Studies	N	Y	Individual research in specific topics of Data Science under the direction of a faculty member.
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	

Year 3	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	
	XXXX (3 credits)	Elective to be determined	N	N	

Year 4	Course No.	Course Title	Required (Y/N)	New (Y/N)	Brief Description (If New Course)
	DTSC 8900 (18 credits)	Dissertation Research	Y	Y	Under the direction of a dissertation advisor and committee, students design and execute an original research study. This study should address a significant issue or problem within the field of Data Science.

### III. 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.

N/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.

See Attachment #IV (Faculty Roster) for the list of faculty members who will be involved in the proposed program.

Each student enrolled in the DTSC Program will have an academic advisor. To foster trans-disciplinarity as a foundational principle of the program, two academic co-advisors from different disciplinary backgrounds are strongly encouraged. Advisors must be core or affiliate tenure-track faculty of the UNC Charlotte School of Data Science. One of the co-advisors must be tenured. If the student has a single advisor, the advisor must be tenured or a Research Full Professor. The student's dissertation committee is composed of the advisor (or co-advisors), two other appointed members, and a faculty member appointed by the UNC Charlotte Graduate School. Aside from the advisor/co-advisors, at least one member of the dissertation committee must be core or affiliate faculty of SDS. Advisor(s) and committee members (excluding the Graduate School appointed member) must be from at least two different colleges. Professors of Practice, Research Professors, and Teaching Professors (of any rank) who are members of the Graduate Faculty and hold a doctoral degree can serve on a DTSC doctoral committee.

- 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, and how the current teaching responsibilities of those faculty will be covered.

We have estimated that two new tenure track faculty positions will be required as we start the program, with one additional faculty added in year 4. The program will also be supported through existing faculty that are affiliated and joint within SDS. The new faculty will enable capacity to teach our core requirements within the program with the additional potential to blend DSBA 6115 into the DTSC 8110 Statistics for Data Science and cross-list this between our M.S. and Ph.D. programs. Since this is a course that is taught currently, it will not require additional capacity. For elective courses we expect the majority of the 8XXX course load to be taken through existing courses offered in faculty's home departments. This will likely result in courses increasing from 5-8 to 6-10 students per section. In discussion with department chairs across the university, they are uniformly supportive of this concept. There will be several new elective courses developed as documented in this program. These will be taught by the new faculty (or existing faculty where capacity trades are made with chairs by the Executive Director). Current practice when requesting capacity from a department is to either 1) utilize capacity committed to SDS by departments, 2) offer SDS homed faculty teach a course or cross-list a course for the department's students, 3) provide funding for departments to hire part time faculty to make up the capacity. In the three years of operations, this has worked well for SDS at both the B.S. and M.S. levels for course

scheduling. Experience has shown that this does not weaken other offerings and in fact strengthens them as 1) more courses can be offered through the additional students due to the cross-listing and 2) diverse teams and skills are present in the classroom, which enhances student learning in team projects and learning to reach a goal with divergent skills sets on a team.

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

This program will change faculty activity and make it much more transdisciplinary. Faculty will be working with faculty of other departments on a regular basis through research seminars, co-teaching, required co-Chairing of Ph.D. committees, and serving on doctoral committees designed to be transdisciplinary. This environment will foster transdisciplinary research collaborations that will extend beyond the specific activities needed for the proper functioning of the doctoral program, including the engagement in external funding activities.

Course loads, public service activity, and scholarly research requirements shall be identical to the home department requirements with the exception that the faculty are required to attend SDS faculty meetings. This is defined in each faculty's MOU that they sign to be an affiliated or joint faculty member of SDS.

**IV. 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.

N/A. The proposed program in Data Science will be offered 100% in face-to-face format, and no online or off-campus course will be offered.

- 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. What is the impact of online delivery on student access to the program, and what strategies are in place to support students who have internet limitations?

N/A. The proposed program in Data Science will be offered 100% in face-to-face format, and no online or off-campus course will be offered.

- 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.

N/A. The proposed program in Data Science will be offered 100% in face-to-face format, and no online or off-campus course will be offered.

- 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.

N/A.

## V. 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 (this should be developed in consultation with the University Librarian).

Since the offering of the DSBA (Masters of Data Science and Business Analyst) and HIA (Master's in Health Informatics and Analytics) degrees, the UNC Charlotte Atkins Library has continued to provide resources and materials to support these programs. With the recent addition of the Bachelor of Data Science, a materials budget has been provided to the School of Data Science as well as continued funding from the Colleges of Business, Health and Human Services, and Computing and Informatics budgets due to the multidisciplinary nature of the Data Science programs. Based on an analysis of the Data Science/Research Data Librarian, Reese Manceaux, the current holdings are satisfactory to support research and instruction for this program and its faculty and students.

Students have access to hundreds of thousands of physical books and e-books from Springer, Wiley, Elsevier, Cambridge, Business Expert Press Digital Library and other publishers. Also available are the latest scholarly articles from databases such as Web of Science, ScienceDirect, Business Source Complete, ACM, Compendex, INSPEC, and others.

- 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?

The library offers responsive support to research needs of the School of Data Science and to all existing programs in which the School participates. Faculty and graduate student researchers can contact the data science librarian directly for one-time purchase materials that are needed. For requests for ongoing subscriptions, the librarian will work with faculty affiliated with the School to prioritize and make requests of the library and university to support new research materials needed to propel the work forward.

In order to offer resources in line with other comparable programs, J. Murrey Atkins Library will need to acquire subscriptions to research databases and datasets that the library currently does not provide access to. This will require a permanent or recurring increase to the library budget, since the library cannot acquire and retain access to additional subscription resources with a flat or decreased library budget.



More detailed information about future needs is provided below in the systematic needs assessment for Ph.D. programs.

- c. Discuss the use of other institutional libraries (outside of your institution) in delivery of the program.

The library has a well-received Interlibrary Loan (ILL) Department. It is the highest rated service that the library offers. Faculty, students, and staff can make requests through an easy-to-use web interface, with the capability of auto-filling from any of our databases. Book chapters, conference proceedings, and journal articles are scanned and delivered electronically from other institutions as PDF files within 24-48 hours. Print books are mailed and delivered within 5 business days. Any materials that the library is unable to borrow from other libraries will be purchased if available for sale. We, along with other universities in the state, are also a site for NC LIVE, a statewide electronic resources consortium that makes digital resources accessible to North Carolina residents.

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

For this assessment, selected US institutions with doctoral programs in Data Science were used to evaluate the resources of the library and compare them with the University of North Carolina at Charlotte. They include Worcester Polytechnic Institute, Carnegie Mellon University, University of Virginia, UT-Austin, and Kennesaw State.

Databases of journal articles that Atkins Library currently subscribes to and are very important to the collections are below. These are mostly held by the other institutions as well:

- For Engineering/Statistics/Mathematics: Web of Science, ScienceDirect, ACM Digital Library, Compendex, INSPEC, IEEE Xplore, MathSciNet
- For Business: ABI-INFORM, Business Source Complete, Mergent Online, Mintel Academic Reports
- For Health: PubMed, Cochrane Library, CINAHL Complete, Liebert Online
- For Social Science, Humanities, and General Data/Statistics/Demographics: SimplyAnalytics, Data Axle, Proquest Statistical Abstract, Statista, Data Citation Index, Policy Map

Databases that other universities with Ph.D. Data Science programs have that Atkins current does not subscribe to but would greatly benefit the Data Science program 4 years or more into the future would be :

- For Engineering, Mathematics, and Health: **Scopus** which is the largest abstract and citation database of peer-reviewed literature.
- For Social Science, Humanities, and General Data/Statistics/Demographics: **Data Planet/SAGEData** (Access data on economics, crime, health, population, energy, the environment, and more in a single interface), **Social Explorer** (contains access to U.S. Census data dating back to 1790. Users can create maps and embed them as objects or download static images), **Proquest Historical Statistical Abstract Add-on** (back to 1878) and **Abstracts of the World** (50 countries worth of data).

**DATA SETS:** Atkins Library currently does not have the budget to purchase data sets which would aid research. These are quite varied depending on the topic of the researcher. A library fund for the purchase of these datasets would be helpful to purchase these on an as-needed basis. Also of use would be Text and Data Mining Collections that include:

- Proquest TDM Studio (ability to mine large volumes of published content from millions of pages of news and scholarly publications), Proquest Historical Newspapers and Congressional Record Text-as-Data Collection, and English-Corpora Text as Data.
- **OR** Nexis Daas (Data as a Service) to mine Nexis content

For an expanded selection of e-books, a subscription to the **O'Reilly Safari Technical Books** (a computer science focus) would be a helpful addition to our collection because of the wide variety of programming language, computer science, business analytics type books that the publisher prints.

## VI. Facilities and Equipment

- a. Describe the effect of this new program on existing facilities and indicate whether they will be adequate, in year one, five, and ten of the program's operation.
  - i. Will any new square footage be required at any point in the first ten years of the program's operation? If so, please provide an overview of requirements, timeline, projected costs, and projected funding sources.

Space for new faculty and research labs is being accounted for in a current renovation and expansion of Burson building on UNC Charlotte campus and part of our expansion of the interdisciplinary collaboration between the School of Data Science, the College of Engineering, and the College of Computing. This expansion has two foci, one of which is the expansion of interdisciplinary research. The expansion portion of this plan will be focused on interdisciplinary and transdisciplinary research and will complete 10,800 net square feet of space with an additional 30,000 square feet of shell built for future expansion (\$30M). The funding has already been allocated to UNC Charlotte for the Burson expansion through the North Carolina State Budgeting process. Tentative groundbreaking for the expansion is in 2024 with expected completion in 2027.

- ii. Will any existing square footage require repair, renovation, or retrofit? If so, please provide an overview of requirements, timeline, projected costs, and projected funding sources.

In addition to the Burson research expansion, the existing Burson building is in the initial design stage for refurbishment. This space will house the expansion of the School of Data Science and our classroom facilities and undergraduate programs in collaboration with programs from the College of Computing and Informatics and the College of Engineering. Finally, Colvard Building, where SDS is currently located, has \$4.5M in planning funds and a \$45M budget for refurbishment within the next 10 years. Any further growth needs of the programs within the School of Data Science will be considered within this refurbishment. Funding for the Burson refurbishment has already been allocated through the State budget (\$25.9M) with refurbishment timing expected to be aligned with the expansion. Planning funding for Colvard is expected in the second year of the current

state budget (FY 25). Further allocations are expected in future budgets with completion in the 7-10 year window.

- b. Describe the effect of this new program on existing technology, information technology, and services and indicate whether they will be adequate, in year one, five, and ten of the program's operation.

The Data Science Ph.D. Program will utilize the University Research Computing (URC) infrastructure. This provides high-performance computing and analytics capabilities to support the research and teaching missions at UNC Charlotte. HPC resources include clusters of powerful computers and storage tailored to diverse application requirements. Many applications are pre-installed and ready for use. These resources are provided "as a service" to registered users.

Our HPC team provides consulting and assistance with experimental software and hardware needs. Together, URC supports, configures and ports applications to University resources and liaises between those engaged in research. Additionally, URC offers training for parallel computing (as used at the facility) and administration of local high-performance systems. Our Research Computing clusters are primarily Intel Xeon-based Dell servers, but we do have some AMD EPYC based compute nodes. We have a mix of models and generations, but our primary compute nodes are Intel Xeon-based Poweredge R630s / R640s and AMD EPYC-based Poweredge R6525. We offer compute nodes with different compute capabilities, so if you need large memory nodes or GPU nodes, we've got you covered. Our GPU nodes provide a mix of NVIDIA cards: GTX-1080ti, Titan V, and Titan RTX, as well as Tesla V100S and A100 Tensor Core GPUs. Our large memory nodes range from 1.5TB to 4TB of RAM in a single system.

We have a high-speed Mellanox 100Gb/s EDR Infiniband fabric in one data center and a 200Gb/s HDR Infiniband fabric in our other data center. The fabrics are connected via dual redundant Mellanox Technologies MetroX-2 Long-Haul IB switches. Our Lustre Filesystem is served out over our IB fabric to provide incredible throughput performance for our high I/O compute jobs. For a more detailed overview of the types of systems that make up each cluster, please check out our Research Clusters and Educational Cluster pages. Research Computing provides an extensive set of applications and codes for use by our researchers on the cluster. More information can be found at <https://oneit.charlotte.edu/urc>.

SDS works closely with our OneIT group to project and manage capacity needs. In addition, we are developing methods and tools to utilize cloud based computing resources for cases where this may be more cost effective and timely for specific types of data science research needs. SDS currently has an AWS cloud environment that utilizes S3 for operational storage, Glacier for archival storage, and Athena for our primary processing capability. Additional AWS tools can be made available through the SDS Administrators in partnership with OneIT.

Existing facilities and services are adequate for the proposed Ph.D. in Data Science at the one and five year horizon. As for ten years, given the fast pace of evolution of the field of Data Science, it is difficult to gauge what the future needs may be within that time frame, but current collaborations and processes for infrastructure expansion are in place.

## VII. 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 housed within the UNC Charlotte School of Data Science. The School is a transdisciplinary academic unit governed by the College of Computing and Informatics, the Belk College of Business, The College of Health and Human Services, the College of Sciences, the College of Humanities, Earth, and Social Sciences, The William States Lee College of Engineering and the Provost. SDS was formed in January of 2020 and currently has more than 80 joint or affiliated faculty and 3 faculty fully housed within SDS. SDS is led by an Executive Director that reports to a Board of the governing deans and the Provost. The Provost reports to the Chancellor. SDS has its own By-Laws and faculty governance procedures.

The Data Science Ph.D. Planning Committee is expected to transition to a **Ph.D. Curriculum Committee** within SDS once the program is fully approved. This Planning Committee is currently composed of two Co-Chairs and several members who are faculty affiliated with SDS and hold Graduate Faculty standing with the UNC Charlotte Graduate School. The Planning Committee composition reflects the diversity of scholarly interests in the School (at least one faculty from each College involved in SDS). The Program Director will serve as Chair of this Committee. Members other than the Program Director will each serve two-year renewable terms. Curricular changes will go through an approval process consistent with UNC Charlotte and SDS current practice, including being reviewed and approved by a School Review Committee prior to being funneled into the larger university review process. The Curriculum Committee will also handle student appeals.

SDS will appoint a **Ph.D. Program Director** to manage the formation of an admissions committee, the program of study approvals, the student learning outcomes as well as overall operations of the Ph.D. program (student recruitment, admission review and decision, funding decision, management of qualifying exams, etc.), and liaise with the Graduate School and the External Advisory Board. The Program Director will report to the Executive Director of SDS and will be a member of the Curriculum Committee.

The **Admissions Committee** will review student applications for admission, and make admission recommendations to the Program Director. The Admission Committee will be composed of the Program Director and one tenure-track faculty member with Graduate School Faculty appointment and affiliation with SDS from each College that is part of the governance structure of SDS. Members other than the Program Director will each serve two-year renewable terms. Membership in both the Admissions and Curriculum Committees is possible, but not preferred. The Program Director will serve as Chair of this Committee.

The Program Director will establish an **External Advisory Board** composed of professionals and scholars of Data Science who will advise the Program Director on broad strategic matters concerning the structure of the program, its operation, and the mission and standing of the program within the national and international field of Data Science.

See the SDS formation document in Attachment V and the SDS organizational chart in Attachment VI.

- 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

N/A

### **VIII. Additional Program Support**

- a. Will additional administrative staff, new master's program graduate student assistantships, etc. be required that were not previously identified in the Request for Preliminary Authorization? If so, please describe 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.

One new administrative staff member is expected to be hired early in the program. Fully loaded costs are \$86k/yr. This staff member will be supporting the Ph.D. Program Director and ensuring Ph.D. students have space, computers, and a community supportive of their needs.

In addition, SDS and the Graduate School will support up to 10 Teaching Assistantships with an expected stipend of \$22k/yr. At maturity, this requires nearly \$370k/yr of funding. A portion of this funding will be allocated from current funding of M.S. level Teaching Assistantships (~\$75k/yr) while the remainder (~\$300k) will be allocated to the Graduate School for GASP funding through tuition, fees, and general fund appropriations from the student credit hours generated by the B.S. in Sports Analytics (currently in approval) and the B.S. in Data Science. The Teaching Assistants will support these undergraduate programs and courses. In addition, the proposed SBTI for the Ph.D. program (which is the same rate as the M.S. in Data Science and Business Analytics) will support the funding needs of the program (~\$224k/yr at maturity).

### **IX. 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.

The proposed Ph.D. program is not subject to licensure or professional accreditation standards.

- b. Indicate the names of all accrediting agencies normally concerned with programs similar to the one proposed. Describe plans to request professional accreditation.

UNC Charlotte is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (SACSCOC) to award baccalaureate, master's, and doctoral degrees. There

are no plans to request additional professional accreditation for the proposed DTSC Ph.D. program.

- 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?

As required by the Policy Statement on Substantive Change for Accredited Institutions of the Commission on Colleges, the University of North Carolina at Charlotte (UNC Charlotte) is required to submit a letter of notification for new degree programs prior to implementation. Notification of this new degree program will be provided to SACS after approval by the University of North Carolina Board of Governors and prior to implementation.

- 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. List what state(s) the institution has determined the program meets professional licensure requirements for and how that information will be communicated to students and prospective students.

N/A

**X. 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.

Program Student Learning Outcomes	Measurement Instrument	Criteria for Proficiency (score, percentage, level of performance, etc.)
<b>Students will describe and discuss the interdisciplinary and transdisciplinary foundations of Data Science</b>	Written answer of student to DTSC Foundations question on the Ph.D. qualifying exam, as graded by ad hoc faculty committee	90% of students “Meet expectations” or “Exceed expectations” on the related qualifying exam question
<b>Student will critically evaluate published scholarship in Data Science and allied knowledge fields</b>	a. Written answer of student to related question on the Ph.D. qualifying exam, as graded by ad hoc faculty committee b. Written dissertation report, as assessed by members of student’s dissertation examination committee	a. 90% of students “Meet expectations” or “Exceed expectations” b. 90% of students “Meet expectations” or “Exceed expectations”
<b>Students will critically use concepts, theories and methodologies relevant to data science in fostering new or</b>	Written dissertation report, as assessed by members of student’s dissertation	90% of students “Meet expectations” or “Exceed

<b>original knowledge in their primary area of scholarship</b>	examination committee	expectations”
<b>Students will effectively write and communicate orally Data Science scholarship to peers, students, and members of the broader community outside of the field</b>	Written dissertation report and dissertation presentation, as assessed by members of student’s dissertation examination committee	90% of students “Meet expectations” or “Exceed expectations” on their dissertation report submitted by the examining committee
<b>Students describe, discuss, and evaluate the responsibilities of Data Scientists regarding the ethics of data practices, security, privacy and governance of data, and action for social good</b>	Written answer of student to question on data ethics and social good on the Ph.D. qualifying exam, as graded by ad hoc faculty committee	90% of students “Meet expectations” or “Exceed expectations” on the related qualifying exam question
<b>Students will use appropriate data science tools and techniques, including applied statistical analysis, machine learning, artificial intelligence, to answer broader research questions in a data rich environment</b>	Written answer of student to related questions on the Ph.D. qualifying exam, as graded by ad hoc faculty committee	90% of students “Meet expectations” or “Exceed expectations” on the related qualifying exam questions
<b>Students will demonstrate the ability to identify, assess, select and/or develop appropriate data analytics methods and models for addressing a specific of real-world issue from an evidence-based perspective</b>	Written dissertation report and dissertation presentation, as assessed by members of student’s dissertation examination committee	90% of students “Meet expectations” or “Exceed expectations” on their dissertation report submitted by the examining committee

- 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 UNC Charlotte Ph.D. in Data Science will provide research intensive doctoral-level education for students seeking Data Science careers in practice, research and teaching/academia. Our evaluation plans for the proposed Ph.D. in Data Science encompass the criteria to evaluate the quality and effectiveness of the program, as well as the Student Learning Outcomes (SLO), Measures (Metrics), and Plan/Schedule. The program evaluation will be focused on the program objectives (restated below) and the SLOs. The program evaluation will be conducted through internal assessments and an external reviews process.

The objectives of the Data Science Ph.D. program include:

- Preparing research data scientists, professional data scientists, and scholars/academicians who will be leaders in developing, maintaining, and managing data ethically and effectually

- to sustain the economic and social vibrancy of North Carolina and the United States;
- Training research data scientists who have deep understanding of data, of knowledge production based on data and of subject matters that thrive on evidence-based research and practice;
- Providing a range of educational and research experiences for a diverse group of students to participate in research initiatives at UNC Charlotte, Private, Public, and International institutions; and,
- Preparing future data science educators, scholars, and professionals who are at the frontiers of understanding and leveraging the evolving data landscape.

The criteria that will be used to evaluate the planned Data Science Ph.D. program objectives including those that address operational efficiency as well as program impact are presented below.

- Criterion 1: Demonstrate mastery of the fundamental concepts, models, advanced research skills of Data Science.
- Criterion 2: Ability to recruit, retain, and graduate well qualified Ph.D. students.
- Criterion 3: Level of contribution of doctoral students and their advisors to advances in Data Science through impactful publications, presentations, and other scholarly activities.
- Criterion 4: Level of employment of graduates from the program and service of such graduates in leadership positions in academic, government, international agencies, and the private sector within and outside the State of North Carolina.

The following measures will be used to evaluate the performance and effectiveness of the proposed Data Science Ph.D. program with respect to the criteria described above.

Criterion 1: Over 90 % of students are assessed to “Meet expectations” or “Exceed expectations” on a series of sub-criteria on completion of their Ph.D. qualifying exam and and/or successful defense of their research dissertation (SLO assessment detailed in Section X.a above).

Criterion 2: Number of UNC Charlotte graduates recruited, retained, and graduated; number of non-UNC Charlotte graduates recruited, retained, and graduated; diversity of recruited Ph.D. students and local versus international institutions where they gained their B.S. and M.S. degrees; time to graduation.

Criterion 3: Number of research articles published in peer-reviewed and indexed outlets by doctoral students and their advisers on average; number of projects that were affected in North Carolina and elsewhere through research conducted by program students and their advisers; number of presentations and short courses taught by doctoral degree candidates.

Criterion 4: Number of program graduates who are gainfully employed in their field of study; number of program graduates who serve in leadership positions and/or win professional awards.

Since the proposed Ph.D. program is expected to take about 6 – 7 years to mature and achieve steady state, several of the measures for evaluating program success, listed above, will not be realized in four years. Therefore, evaluation of the program will assess progress towards the steady-state goals. The program will be evaluated internally at the end of each academic year for the first four years. SLOs will be assessed and reports will be submitted to the SDS Executive Director and to the Graduate School every year. In addition, the External Advisory Board and the



Director of the Ph.D. Program will be tasked to conduct an external review annually.

By the end of the fourth year, an evaluation report will be submitted to the SDS Executive Director and the UNC Charlotte Office of Academic Affairs. The report will include information on the extent to which UNC Charlotte has met projected enrollments and degrees conferred, and the readiness of the university to continue funding the program on the level provided at the end of the fourth year. This report will be submitted as a part of UNC Charlotte's long-range planning submission. Every 2 years of operation, an internal evaluation will be conducted by the Data Science Ph.D. Program Director. At the end of the second year, the evaluation report including all the components mentioned above will be submitted to the SDS Executive Director for their review. Based on the results of these reviews, deficiencies, structural and programmatic inconsistencies in the program will be addressed. The Graduate School and the Office of Academic Affairs at UNC Charlotte also have mechanisms and processes in place for providing oversight on all graduate programs. The proposed program will be assessed to determine if it is meeting the four-year milestones described below.

- Program enrollment in the fourth year should approach 30 students.
- During the fourth year of the proposed program, scholarly activities including presentations, journal publications, and grant activity by the CEE Faculty will be assessed. New external funding generated annually by the SDS affiliated faculty should exceed \$2.0M. External funding should be supporting a minimum of 10 RAs.
- The program should have produced its first graduates by the fourth year of operation.
- Changes in the proposed program will be implemented as necessary to allow achievement of program goals.

## **XI. Supporting Fields**

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

No additional subject-matter fields or cognate programs are required to support the proposed Data Science Ph.D. program. Faculty within SDS have over 25 different tenure homes. Responsibilities, including teaching load, are outlined for each faculty member through specific and unique joint or affiliate faculty MOUs. The Ph.D. in Data Science will be supported by the portion of faculty workload allocated through these agreements.

- 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?

We will capitalize on existing doctoral programs in the Colleges that are part of the Administrative Structure of the School of Data Science and on graduate school support to implement the program. After four years, an evaluation will be conducted to examine the efficacy of the curriculum. Potential changes in the curriculum may be identified at that time, but no significant changes are anticipated.

## **XII. Costs, Funding, and Budget**

Adding a new degree program will cost the institution some amount of money and will potentially generate new revenues. Calculating the costs and identifying the funding sources associated with

implementation of a new program requires several institutional offices (e.g., academic affairs, finance, institutional research, enrollment management) to collaborate to present an accurate estimate.

- a. Complete and attach the *UNC System Academic Program Planning Financial Worksheet* showing all costs required and revenues generated for each of the first five years of the program. Provide a budget narrative for each year addressing the following:

- i. UNC Academic Program Costs

Faculty costs include all faculty assigned to the proposed program, including faculty serving as program directors, coordinators, department chairs, etc., funded in the 101 instructional budget code. If an existing faculty member is reassigned to the program, the salary is reflected as a reallocated cost. New faculty salaries need to be competitive for the discipline, and figures should include all applicable fringe (e.g., retirement, medical). If the proposed program will hire new faculty, it is a new cost.

Graduate Assistant costs are identified either as new or reallocated, as appropriate, and should include all stipends, tuition remission, and benefits, as applicable.

EHRA Non-Faculty positions include non-instructional academic support costs directly associated with running the program, including amounts associated with the Dean's office, research support, etc. This should include salaries and all applicable fringe.

SHRA Non-Faculty positions include all positions specific costs associated with the new program. This includes the additional staff needed to organize applications, prepare for the proposed program, and for general administration of the proposed program. New staff or purchases of new equipment should be adequate to support the stated goals and enrollments for the proposed program. Other program costs identified in the proposal should be realistic.

- ii. UNC Academic Program Revenues

Funding sources may include enrollment growth formula funding, other state appropriation, regular tuition, tuition differential, general fees, special fees, reallocation of existing resources, federal funding, and other funding (such as awarded grants or gifts). The total projected revenue from the above categories should allow the proposed program to become self-sufficient within five years.

When estimating funding for new programs, institutions should take into account that students switching programs do not generate additional enrollment growth formula funds. For example, if a program projects enrollment of 20 students, by 12 of them switched into the program from an existing program at the institution, then only 8 of the students would generate additional formula funding.

Reallocation of Existing Resources includes the salary of faculty reassigned who may be partially or wholly reallocated to the new program. Explain how the current teaching obligations of those faculty are reallocated and include any faculty replacement costs as program costs in the budget. If substantial funds are reallocated, explain how existing undergraduate and graduate programs will be affected.

Federal Funding (In-hand only) refers to federal monies from grants or other sources

currently in hand. Do not include federal funding sought but not secured. If anticipated federal funding is obtained, at that time it can be substituted for funds designated in other funding categories. Make note within the text of the proposal of any anticipated federal funding. Provide evidence of sustainability after federal funds have been exhausted.

Narrative for financial costs and revenues (identical to Preliminary Authorization narrative).

**Year 1: Total costs \$889k.** Roughly 54% of the total costs are reallocations from current programs where the program can add seats to currently taught courses including courses from our Sports Analytics Certificate. New costs come from 1 new tenure track faculty. New costs also support one new graduate TA, one EHRA staff for operations, and other misc support. New tuition revenues of \$549k would offset new costs of \$412k.

**Year 2: Total costs \$1.7M.** 37% of the total costs continue to be reallocations from current programs. Incremental costs from Year 1 support 1 new tenure track and 2 new additional non-tenure track faculty to teach new courses in the program and add additional capacity to core coursework in statistics and computer programming as well as additional TA support. Total new revenues of \$1.6M easily offset the total new costs of \$1.0M.

**Year 3: Total costs \$2.3M.** Reallocated costs drop to 33% of the costs in Year 3 as new courses and sections require new faculty to teach. Incremental new costs from Year 2 support one new tenure track faculty, one new non-tenure track, and four new additional graduate assistantships. Total new revenues of \$2.6M easily offset the total new costs of \$1.5M.

**Year 4: Total costs \$2.6M.** 29% of the total costs in Year 4 are reallocation from current programs; the program costs and revenues are growing at similar rates. Incremental new costs over year 3 support one new non-tenure track faculty and 2 new graduate assistantships and one new EHRA student services to increase capacity. Total new revenues of \$2.5M offset the total new costs of \$999k.

**Year 5: Total costs \$2.9M.** 25% of the total costs in Year 5 are reallocation from current programs the program is reaching steady state. Incremental costs include one additional tenure track faculty, two new graduate assistantships, and one new students services person. Total new revenues of \$4.0M exceed the total new costs of \$2.2M.

i. UNC Academic Program Revenues

The program revenues are expected to be primarily supported by regular tuition and reallocation of one lecturer and current faculty that teach course courses in statistics, computer science, and kinesiology. We will expect some efficiency of faculty, staff, and support from SDS, but the majority of reallocated support is due to capacity in courses outside of this new program (Computer Science, Statistics, general education). Any F&A from external funding of research will be utilized back within the program, although this is expected to be a minor contributor. As the program grows, major fees will be utilized to support staff and student services. The tuition and appropriation revenues are determined at an institutional level. The numbers reflected may or may not reflect an

actual change in the university budget.

- b. Based on the institutions' 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.), please describe the following:

- i. How does the institution budget and allocate enrollment growth revenues? Is this program expected to generate new enrollment growth for the institution? If so, how will funds be allocated to the proposed program or be used to further other institutional priorities?

The budget review process is conducted by the colleges and the Office of Academic Affairs annually. Deans submit funding requests to Academic Affairs based on the prioritized needs of each college. The proposed program is expected to generate new enrollment growth for UNC Charlotte. Increases in enrollment and the corresponding increase in Student Credit Hours (SCH) are reviewed by the Dean's office and examined within the context of the UNC System Office funding formula and University priorities when determining allocation of enrollment growth funds and general tuition and fees. If available, funds will be used to hire additional faculty and staff to support teaching and research.

The vast majority of the students in this program are expected to attend UNC Charlotte specifically for this program. This assumption is based upon our experience with the other Ph.D. programs and the uniqueness of Data Science Ph.D. programs across the country. We do expect to be able to recruit nationally and internationally for this program.

- ii. Will the institution seek other additional state appropriations (both one-time and recurring) to implement and sustain the proposed program? If so, please elaborate.

No, data science was a focus on the request in the State budget in 2023. This consists of \$3M in recurring funding and \$6M in one time funding (split over 2 years). Assuming this comes through, the Ph.D. program will receive the required implementation and recurring funding necessary to sustain the program.

- iii. Will the institution 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.

The program will require an SBTI of \$420/hr. This is equivalent to the M.S. in Data Science and Business Analytics currently offered by SDS. DSBA is currently all self funded students. Having an identical rate will reduce incentives for incoming B.S. students to declare a Ph.D. when they in fact intend to leave with an M.S.; without an equivalent SBTI fee, there would be a financial incentive to be in the Ph.D. program rather than the M.S.. The funding would be used to support the TAs and EHRA-staff required to manage the program. At this time a major fee is not expected to be charged.

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

The funding (~\$224k/yr at maturity), would support 2 TAs, the EHRA Staff member hired for the program, and other needs of the students.

3. Describe the anticipated impact of the tuition differential or program-specific fee are expected to impact student access.

The SBTI is not expected to impact student access. The majority of students will be supported through stipends, tuition, and fee support. SBTI payment will be part of their support package offered. For the small number of self supported students, they will be required to pay SBTI; however, it is expected that all of these students will be Advanced Standing students and will be working data science professionals (at the M.S. levels) with several years of experience. Recent salary data from August 2023 has data scientists with M.S. degrees and several years of experience earning median salaries of \$130k/yr. Thus, the self supported students will be earning high salaries and will not likely make a decision to enroll or not based on the additional cost of SBTI.

- c. Provide a description of how the program can be implemented and sustained If enrollment increase funding, differential tuition, or other state appropriations noted in the budget templates are not forthcoming.

We would not offer this program if funding is not forthcoming.

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

**XIV. Attachments.** Attach *the UNC System Academic Program Planning Worksheet* as the first attachment following this document, the final approved Request for Preliminary Authorization as the second attachment, followed by any other relevant documents.

Attachment I. UNC System Academic Program Planning Worksheet.

Attachment II. Request for Preliminary Authorization and Response to Comments.

**XV. Signatures.** This proposal to establish a new program has been reviewed and approved by the appropriate campus committees and authorities and has my support.

Position Title	Signature	Date
Chancellor		
Provost		
Chief Financial Officer		

*(Only complete below for partner institution if this is a joint degree program proposal)*

Position Title	Signature	Date
Chancellor		
Provost		
Chief Financial Officer		

Appendix YYY School of Data Science Org Chart

