# New Academic Degree Program Request for Preliminary Authorization

**Institution** <u>University of North Carolina at Charlotte</u>

**Degree Program Title (e.g. M.A. in Biology)** <u>PhD in Data Science</u>

**CIP Code** <u>11.0701 Computer Science</u>

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

| Review | Name | Title |
|---|---|---|
| Provost | Alicia Bertone | Provost and Vice Chancellor for Academic Affairs |
| Chief Financial Officer | Richard Amon | Vice Chancellor for Business Affairs |
| Faculty Senate Chair (Or representative) | Susan Harden | Faculty President |
| Graduate Council (If applicable) | David Dalton | Graduate Council Chair |
| Graduate/Undergraduate Dean (If applicable) | Pinku Mukherjee | Interim Associate Provost & Graduate School Dean |
| Academic College/School Dean | Bojan Cukic, Robert Keynton, Catrine Tudor-Locke, John Smail, Jennifer Troyer | Interim Dean College of Computing and Informatics, Dean William State Lee College of Engineering, Dean College of Health and Human Services, Interim Dean College of Liberal Arts & Sciences, Dean College of Business |
| Department Head/Chair | Douglas Hague | Executive Director |
| Program Director/Coordinator | Jean-Claude Thill; Monica Johar | Knight Distinguished Professor of Public Policy; Professor of Management Information Systems |

## New Academic Proposal Process

New academic programs are initiated and developed by faculty members. The Request for Preliminary Authorization 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 and Provost, and submit the proposal via the PREP system to the UNC System Vice President for Academic Programs, Faculty, and Research, for review and approval by the UNC System Office. If the Request for Preliminary Authorization is approved, the institution may begin work on the formal Request to Establish a New Academic Degree Program.

**NOTE: If an institution is requesting preliminary authorization for a degree program at a higher level than their current Carnegie Classification (e.g. a Master's institution proposing a doctoral degree), then a request for a mission review must first be submitted to the UNC Board of Governors Committee on Educational Planning, Programs, and Policies, through the Senior Vice President for Academic Affairs. If approved by the Board, then the institution may proceed with the Request for Preliminary Authorization.**

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|---|---|
| **UNC Institution Name** | University of North Carolina Charlotte |
| **Joint Degree Program (Yes or No)? If so, list partner institution.** | No |
| **Degree Program Title (e.g. M.A. in Biology)** | PhD in Data Science |
| **CIP Code and CIP Title (May be found at National Center for Education Statistics)** | 11.0701 Computer Science |
| **Require UNC Teacher Licensure Specialty Area Code (Yes or No). If yes, list suggested UNC Specialty Area Code(s).** | No |
| **Proposed Delivery Mode (campus, online, or site-based distance education). Add maximum % online, if applicable.** | Campus |
| **Will this program be offered through an Online Program Manager (OPM; Yes or No)? If so, list the online OPM.** | No |
| **Proposed Term to Enroll First Students (e.g. Fall 2023)** | Fall 2024 |

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

The new program is a significant departure. As a result, a prospectus is required to be submitted and approved six months prior to the intended start date, either in January for a fall start date or July for a spring start date.

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

Include the following in your narrative:
a. How this program supports specific university and UNC System [missions](missions).
b. Collaborative opportunities with other UNC institutions as appropriate.
c. Ways in which the proposed program is distinct from others already offered in the UNC System. Information on other programs may be found on the UNC System [website](website), and all similar programs should be listed here (use the 4-digit CIP as a guide).

The proposed doctoral program in Data Science fulfills a need created by the increasing demand in the marketplace for data scientists at all levels of university education, including undergraduate, master's, and doctoral degrees. Currently, market needs are met mainly through existing BS and MS degrees in Data Science, Business Analytics (DSBA), Statistics, and Computer Science at UNC Charlotte.  These programs offer rapid specialization for different profiles of data science professionals. The proposed PhD program in Data Science will provide doctoral-level education to students seeking data science careers both in academia and in industry. The program is a terminal research degree that is trans-disciplinary 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, economics, financial services, political science, sociology, marketing, management information systems, operations management, criminal justice, public policy, geography, public health, earth and environmental sciences, engineering, urban management, 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 trans-disciplinary data science and analytics programs. SDS and its predecessor, the Data Science Initiative (DSI), are key strategic priorities of the University. Five colleges participate in program implementation within the School of Data Science: College of Computing and Informatics, College of Liberal Arts & Sciences, Belk College of Business, College of Health and Human Services, and William States Lee College of Engineering, while the remaining colleges of Education and Arts + Architecture will be contributing as well.

By exposing students to real-world data and problems in the civil society and in business organizations, the data science PhD 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 Bank of America, Lowe's, Microsoft, 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 provide an ideal ecosystem to utilize a suite of skills only an urban research university can accommodate—data analytics, 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 other UNC System universities (including HBCU institutions), 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 doctoral programs in Data Science in the UNC system, we will 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.

Currently, there are no PhD programs in Data Science at any campus of the University of North Carolina. As detailed in the Student Demand section, the national and global popularity of master's programs in data science[1] and our own surveys strongly suggest that there will be large student demand for a PhD program in data science (details in Student Demand section). Not only is industry poised to support demand for data scientists with doctoral level of training, but the growth of undergraduate and masters 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 five master's programs in data science: UNC Charlotte, NC State, UNC Wilmington, Appalachian State 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 MS in DSBA at UNC Charlotte,[2] the MSA program at NC State,[3] and the Master's

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[1] NC State Institute for Advanced Analytics MS Program Tracking  https://analytics.ncsu.edu/?page_id=4184

[2] https://datascience.charlotte.edu/

[3] https://analytics.ncsu.edu/

in Interdisciplinary Data Science (MIDS) at Duke University[4] are experiencing healthy enrollment. UNC Chapel Hill is preparing an online version of their MS in Data Science and the new Foundations of Data Science MS at NC State[5] is expected to grow quickly. Finally, UNC Chapel Hill announced their intent to form a School of Data Science and Society, signaling increasing demand in this growing field.

With over 600 alumni, the DSBA program at UNC Charlotte will provide a natural pipeline of prospective students for this proposed PhD program. In a recent survey of DSBA alumni, 15% indicated they would be interested in a PhD program in Data Science at UNC Charlotte. 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 PhD program.

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

Several years ago, a university-wide Data Science PhD Committee partnered with the Data Science External Advisory Board (EAB) to conduct student demand research. The product of this effort is a report on the student demand for a PhD in Data Science (see Appendix B). Because there was no CIP (Classification of Instructional Programs) code devoted to data science programs at that time, EAB's report identified these closely related fields: computer science, statistics, and management information systems and services. In the previous five years of available data, nationwide institutions reported an 18% increase in doctoral-level degree completions related to data science with computer science showing the most completions. A current review of existing PhD programs in or related to data science included[6]:

Arizona State University: PhD in Biomedical Informatics
Bentley University: PhD in Business – Business Analytics Specialization
Brown University: PhD in Computer Science – Concentration in Data Science
University at Buffalo: PhD in Computational and Data-Enabled Science and Engineering
California Institute of Technology: PhD in Computing and Mathematical Science focusing on Data Sciences
Carnegie Mellon University: PhD in Machine Learning
University of Nevada – Reno: PhD in Statistics and Data Science
Clemson University: PhD in Biomedical Data Science & Informatics
Indiana University-Purdue University-Indianapolis: PhD in Data Science

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[4] https://datascience.duke.edu/
[5] NC State Foundations of Data Science Request to Establish
[6] Master's in Data Science on www.mastersindatascience.org/schools/doctorate

Kennesaw State University: PhD in Analytics & Data Science
University of Massachusetts Boston: PhD in Business Administration - Information Systems for Data Science Track
New York University: PhD in Data Science
NCSU: PhD in Geospatial Analytics
University of Southern California: PhD in Data Sciences & Operations
University of Tennessee: PhD in Analytics
University of Maryland-College Park: PhD in Information Studies – Concentration in Big Data/Data Science
University of Nevada-Reno: PhD in Statistics & Data Science
UNC at Chapel Hill: PhD in Health Informatics
University of Southern California: PhD in Data Sciences & Operations
University of Washington-Seattle: PhD in Mechanical Engineering - Data Science
Worcester Polytechnic Institute: PhD in Data Science
Yale University: PhD in Statistics and Data Science

The demand for Data Science programs, including PhD, has continued to soared since our original study[7]. The above list, which is only a sample of PhD programs related to data science, demonstrates the increasing demand for data science programs. The Big Data emergence in academia and industries and the ubiquitous and real-time harvesting of data have been driving the growth of these new programs.

UNC Charlotte School of Data Science is fielding a consistent flow of inquiries from current students and alumni about when they can expect to enroll in a PhD in data science. Given these inquiries, our survey of alumni, and discussion with Kennesaw State's PhD administrators, we expect student demand for this program from three areas, 1) current Data Science MS holders from UNC Charlotte as well as other US based MS programs for which we expect to offer an advanced standing entry point for qualified applicants (Statistics, Computer Science, etc.); 2) direct entry from US based data science and other technically based undergraduate degree holders including the BS in Data Science offered by UNC Charlotte; and 3) international students. We expect a small, but material demand for part time participation from current Charlotte based MS holders, likely our own DSBA alumni, that want to return to complete a PhD, but are unwilling to give up the high salaries they are currently earning.

UNC Chapel Hill's preliminary assessment of student and labor market demand[8] for their proposed data science master's program shows high demand for master's programs in data science. According to that study, "nationally, master's completions in data science have doubled over the past eight years (101.9% growth), which is 10 times the rate of master's degree growth across all disciplines over the same time period (10.1% growth). Similar trends exist in North Carolina, where master's completions in data science have increased 580.5% over the last 8 years."

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[7] NC State Institute for Advanced Analytics MS Program Tracking  https://analytics.ncsu.edu/?page_id=4184
[8] Appendix A

In line with this Data Science phenomenon, we expect that the DSBA program at UNC Charlotte will be a major applicant pool for the proposed PhD program. Many DSBA students have shown their strong desire to continue their studies on data science at the doctoral level, but have often struggled to find appropriate PhD programs in terms of their personalized interests. Because of the anticipated connection of the DSBA master's program and our proposed program, a steady number of DSBA students are expected to apply to the proposed program. The table below demonstrates enrollment in the DSBA program since the establishment of the program in 2014.

In addition, a survey of the current cohort of DSBA students was recently conducted to gauge their interest in the PhD program in Data Science (over 25% of our 341 alumni responded). According to the survey that was conducted upon graduation, 84% would have been moderately (28%) or very (56%) interested in continuing to a PhD program in Data Science. Of these alumni, 61 (71% of respondents) are still interested in applying when we start a PhD in Data Science at UNC Charlotte.

The demand for doctoral education in data science within the state of North Carolina is particularly astute. Only three similar doctoral programs are located in the state of North Carolina: the PhD in Geospatial Analytics at NCSU, the PhD in Health Informatics at UNC at Chapel Hill, and the renamed PhD in Computational Data Science and Engineering at NC A&T.[9] Two of these programs are only concentrated on particular specialty domains (geospatial analytics and health informatics) and the third evolved from a PhD 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 PhD in Data Science at UNC Charlotte is a broader, multidisciplinary 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 PhD graduates in this field is necessary to ensure sufficient supply of graduates to fill positions at academic institutions. As an example, several of our industry partners in Charlotte have over 100 PhD graduates in data science working inside their corporations. These teams are expected to continue to grow over time.

While there is no comprehensive data science program at the doctoral level in the UNC system, there are six master's programs in data science in the state of North Carolina: UNC Charlotte, NC State, UNC Wilmington, Appalachian State University, Winston-Salem State University and Duke University. In particular, two representative UNC system data science programs – the MS in DSBA at UNC Charlotte (https://dsba.charlotte.edu/) and the MSA program at NC State (analytics.ncsu.edu) are experiencing steadily increasing enrollment growth. The following table shows the consistently strong enrollment growth in both programs.

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[9] https://www.ncat.edu/news/2020/12/coe-department-changes-name-expands-curriculum.php

| Year | NC State MSA Graduates[10] | UNC Charlotte DSBA Graduates |
|---|---|---|
| 2008 | 23 | 0 |
| 2009 | 35 | 0 |
| 2010 | 39 | 0 |
| 2011 | 39 | 0 |
| 2012 | 38 | 0 |
| 2013 | 81 | 0 |
| 2014 | 79 | 0 |
| 2015 | 86 | 1 |
| 2016 | 113 | 24 |
| 2017 | 118 | 42 |
| 2018 | 111 | 57 |
| 2019 | 111 | 54 |
| 2020 | 118 | 82 |
| 2021 | 116 | 81 |

IV. **Access, Affordability, and Student Success**: (*Provide an analysis of the impact of the program on student access and affordability. Maximum length 1,000 words. Reference sources such as College Scorecard, Census postsecondary outcomes data, etc. For graduate programs, focus on areas relevant to the institution's strategic plan.*)

a. Analysis of the impact of the proposed program on student access, including key metrics identified in the UNC System Strategic Plan and statewide initiatives (such as myFutureNC).
b. ***Analysis of student debt levels*** for similar programs and programs at the same academic level at the institution.
c. Provide an analysis of indebtedness, repayment, and relationship to potential earnings.

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[10] https://analytics.ncsu.edu/reports/alumni/MSA2021.pdf

a. The North Carolina General Assembly has invested $41.2M for "Engineering North Carolina's Future,"[11] with UNC Charlotte committing to 2,000 additional data science, engineering and computer science graduations in the next 5 years. While undergraduate education will be the bulk of these graduates, our proposed PhD program completes a full set of educational opportunities for students at UNC Charlotte. This program also aligns with the UNC System goals[12] to provide critical workforce credentials to our graduates as well as increase productivity.

In addition, the progression of students at UNC Charlotte will assist in increasing the diversity of students in the PhD program. A recent study by Harnham indicated that the current data science practitioners are not very diverse (9% are underrepresented minorities); UNC Charlotte's Data Science undergraduate and MS programs on the other hand have significantly more ethnic diversity (ranging from 24% in the DSBA to 33% in the BS). With the significant number of our MS alums expressing interest in the proposed PhD program, we expect the high underrepresented proportion of our students to carry through to our PhD program. In addition, our industry partners, such as Wells Fargo, Genpact, Bank of America, Microsoft, and Sia Partners have all supported our development of the current PhD proposal and currently sponsor our diversity and inclusion efforts in the form of the annual Women in Data Science conference. Our partners are also supporting us through the development of advanced special topics courses (e.g., model risk management) and have provided support letters for NSF-NRT programs that indicated that they would hire our data science related PhD graduates. They have also set up externships for PhD and MS students to better attract data science related PhDs to their teams. We have designed the proposed program to be a mix of part-time and full time students to provide opportunities for working data science professionals. Part-time students may want to continue working as the salaries data science professionals receive are over $116k for MS students, even with limited experience.[13]

b. The anticipated debt level for students enrolled in the proposed program is comparable to that of programs offered at UNC Charlotte ($56,761). Notably, fees at UNC Charlotte are significantly lower than the fees in other North Carolina institutions offering PhDs. To further reduce the debt burden and reduce time to graduation, the proposed data science PhD program at UNC Charlotte will have an Advanced Standing track. This structure allows students entering with a relevant Master's (e.g. our DSBA) degree to have a plan of study with a minimum of 42 credit hours instead of 72 (including 18 credit hours of dissertation research), shortening time to degree. We also expect our full time students to be fully supported through Teaching or Research Assistantships and receive a stipend. While total tuition and fees over the expected mix of students is expected to be $44k for residence students (primarily Advanced Standing students) and $112k for non-resident students (mix

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[11] https://inside.charlotte.edu/news-features/2022-03-11/engineering-north-carolinas-future

[12] https://www.northcarolina.edu/impact/strategic-plan/

[13] https://www.burtchworks.com/big-data-analyst-salary/big-data-career-tips/the-burtch-works-study/ (Individual contributor data scientist with 3 years experience).

of Advanced Standing and direct entry), any need for assuming debt would be primarily due to fees that are not covered through their assistantships and living expenses.

c.  Doctoral education has a strong correlation (r = .82) with gainful employment earnings compared with IRS Scorecard earnings by credential level in all categories evaluated for doctoral students. In fact, the proportion of median debt is less than the proportion of median earnings (median debt 7.7-59.9% and median earnings 11.6-72.8%). The indebtedness from the proposed program is in relation to the amount of time to complete the dissertation and the amount of support received. In 2021, the average annualized salary ranges for a PhD-prepared data scientist ranged from $110k to $150k ($144k according to NSF). Therefore, we anticipate the proposed program will be affordable and attractive to a large cohort of applicants. The high salaries within industry point to a secondary issue that universities are working through in this field.  With starting salaries in academic fields related to data science (mathematics and computer science) averaging $79k,[14] the pay differential is expected to drive many though not all of the PhD graduates into industry.

**V.     Societal, Labor Market and Employability:** *(Provide **external** evidence of societal demand and employability of graduates from each of the following source types. Must include external estimates. Maximum length 1,000 words)*

a.  Labor market information (projections, job posting analyses, and wages)
    i.   Specific to North Carolina (such as ncworks.gov, nctower.com, or outside vendors such as Lightcast.)
    ii.  Available from national occupational and industry projections (such as the U.S. Bureau of Labor Statistics).
b.  Projections from professional associations or industry reports (including analysis
c.  Other (alumni surveys, insights from existing programs, etc.)

a. *Labor market information:* The Bureau of Labor Statistics predicts[15] that data scientists will experience one of the highest job growths between 2020 and 2030 (>30%). Currently the vast majority of data science practitioners have graduate degrees (93%). Of data science jobs today, 12% hold a PhD degree (40% of artificial intelligence positions, a type of data scientists). NC State Institute for Advanced Analytics regularly tracks the job supply and demand across North Carolina as well as the nation[16]. Given the large percentage of jobs that require a PhD, the limited number of PhD programs in data science, and the anticipated trajectory of job market growth, UNC Charlotte is proposing a new PhD program in Data Science.  In concurrence, a UNC Chapel Hill preliminary study showed:[17]

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[14] table 49 from https://ncses.nsf.gov/pubs/nsf22300/data-tables
[15] https://www.bls.gov/emp/images/growing_occupations.png and
https://www.bls.gov/emp/tables/occupational-projections-and-characteristics.htm
[16] NC State Institute for Advanced Analytics Job Tracking https://analytics.ncsu.edu/?page_id=14518
[17] Appendix A

"high labor market demand for individuals with a master's degree in data science. All five of the occupations identified as being most closely aligned with a master's degree in data science are projected for more than double the growth (14%) over the next decade than the projected growth across all occupations nationwide over the same time period (5.8% growth). Statewide occupational projections mirror national projections among likely occupations for an individual with a master's degree in data science, providing a promising outlook on occupations utilizing data science skills. Pairing long-range occupational projections with recent job posting data, employers nationwide were looking to hire Data Scientists nearly twice as often over the past year as the second most-common job title (Biostatisticians). A trend at both the state and national level is the emergence of biostatistics, as job titles including the term account for the second and third most-common titles (Biostatisticians and Biostatistics Managers) over the last year."

b. *Projections from professional associations or industry reports:* Companies seeking doctoral-level data scientists are broad, ranging from IT companies (e.g., Amazon) to finance companies (e.g., Capital One) to management consulting companies (e.g., Booz Allen Hamilton). The Bureau of Labor Statistics (BLS)[18] highlighted this growing demand as follows:

"The Rapid growth in data collection by businesses will lead to an increased need for data-mining services. Computer scientists will be needed to write algorithms that help businesses make sense of very large amounts of data. With this information, businesses understand their consumers better, making the work of computer and information research scientists increasingly vital (Source: BLS Occupational Outlook Handbook: Computer and Information Research Scientists)."

The proposed program is aimed at focusing on theories and techniques pertaining to data collection, data organization, and analytics for applications to real-world problems in a variety of domains of use, while instilling good societal stewardship of data. Our real-world applications will be multidimensional in the sense that the program will cover multiple domains such as marketing, operations management, public policy, education, urban and environmental management, engineering, and others.

As a PhD program in an emerging field where increasing numbers of universities are creating data science programs at the undergraduate, master's, and doctoral levels.  In consultation with Kennesaw State about their experience with Data Science PhD graduates[19], we do expect a portion of our graduates to seek academic positions even

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[18] BLS Computer and Information Scientists Job Outlook

[19] Kennesaw State University was one of the early Data Science PhD programs.  As of Spring 2022, they had graduated 14

though the industry job market and compensation is strong.

c. *UNC Charlotte sponsored survey:* An EAB report (see Appendix A) also described in-demand skills related to data science, specifically programming languages employers most often seek from doctoral-level data scientists such as Java, Python, SQL, R, C++, and others. This is confirmed by a more recent study from Burtch Works[20] where Python continues to gain popularity with data science practitioners.  More generally, there is a strong demand from employers for knowledge in statistics, mathematics, computer science, and data mining. In addition to such technical proficiencies, employers are seeking doctoral-level data science professionals with management and leadership skills to supplement their technical and analytical skills (such as software programming, statistics, and data mining skills). Our proposed multi-disciplinary program would provide education and training for such professionals through a broad range of real-world applications related to data management and storage, analytics, information-based decision making in disciplines as diverse as marketing, operations management, political science, policy, education, public health, social and environmental management, financial services, defense, engineering, and computational sciences, to name but a few. The balance between technical skills and decision-making leadership will be even more important in the near future, with Artificial Intelligence (AI) growing rapidly to replace some of human data skills. Our program will strive to strike the balance to be a sustainable program even in the full-fledged AI era.

**VI.** **Costs, Funding, and Budget** (*Maximum length 1,000 words*)
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
  **Year 1: Total costs $1.1M.**  Roughly 50% of the costs are reallocations from current programs where the Data Science PhD program can add seats to currently taught courses. We will also receive some efficiency from utilizing SDS funds that currently support 2 TA positions in the MS to TAs within the PhD program.  We would reassign a portion of current SDS staff to the PhD program.  New costs come from 2 new tenure track faculty.  New costs to support 2

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students.  4 went to tenure track assistant professor positions, 2 to post-docs (one has since found a tenure track position), and 8 to industry.

[20] https://www.burtchworks.com/2021/08/03/2021-survey-python-the-tool-of-choice-for-data-scientists-analytics-pros/

additional graduate assistantships, one EHRA staff for operations, and other miscellaneous support (library, travel, student computing). New revenues from tuition and SBTI of $249k would not totally offset new costs of $565k.

**Year 2: Total costs $1.2M.** Roughly 46% of the costs continue to be reallocations from current programs. Incremental costs from Year 1 support 2 new additional graduate assistantships. Total new revenues of $515k are closer to offsetting the total new costs of $638k.

**Year 3: Total costs $1.4M.** More than 50% of the costs in Year 3 are reallocation from current programs as more electives are now being taken in the 8000 courses already taught by other programs. Incremental new costs from Year 2 support 2 new additional graduate assistantships. Total new revenues of $799k now fully offset the total new costs of $712k.

**Year 4: Total costs $1.7M.** The proportion of reallocated costs drops to 43% of the total costs as the program stabilizes and new one additional faculty. Incremental new costs over year 3 support 2 new additional graduate assistantships and one additional tenure track faculty required to fully enable the curriculum. Total new revenues of $1.1M continue to offset the total new costs of $951k.

ii.  UNC Academic Program Revenues
The program revenues are expected to be primarily supported by regular tuition and a tuition increment. We will reallocate some TA funding from current support of the DSBA program. As the MS program in Data Science and Business Analytics has grown to nearly 250 students, the efficiency of faculty, staff, support (e.g., full classrooms for faculty, no additional staff, etc.) will enable SDS to reallocate one faculty and limited funding additional funding as required. The Data Science PhD program is expecting the UNC Charlotte Division of Academic Affairs to provide up to 8 Graduate Assistantships. While the School of Data Science is still very new (2020), it is expected that the more than 80 affiliated faculty will routinely seek external grant funding that will provide financial support to a number of PhD students in the program (a potential upside with limited additional cost). SDS will also receive a portion of the F&A returned to the Colleges. These financial resources are expected to be utilized to support graduate students and faculty within the PhD. program. As a starting point, SDS faculty were awarded $5.6M in external funding in AY 21 and $8.4M in AY 22.

b. Based on the institution's 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 PhD 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 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.

  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.

  UNC Charlotte is seeking $12M in legislative funding for data science. This request has been approved by the UNC System and is under consideration by the General Assembly for appropriation in the FY23-24 and FY24-25 budgets. As part of that request, $1.2M in recurring funds and $600K in one-time funds will be used to launch the proposed program. If this funding is approved, the budget will be adjusted accordingly. If the appropriation does not occur, the institution will reassess financial support needed for the program which may result in the inability to proceed.

  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.

    A requested tuition differential of $388.89/credit hour will be requested. This is consistent with that of the current DSBA MS program at UNC Charlotte. We expect to keep the tuition differential consistent between the programs as to eliminate any arbitration between programs.

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

We will invest the generated revenue to support fixed-term faculty, a part-time/full-time administrative coordinator, provide aid to students, support program advertising, research, and activities and experiences contributing to the richness of the doctoral learning engagement (speaker series, workshops, conference attendance) and dissemination of findings.

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.

The current faculty at the University has the expertise needed to teach the courses in the proposed program. Many of the courses in the proposed program are or will be shared with the existing degree programs in the colleges participating in the School of Data Science. Such sharing will create synergy between the proposed program and existing programs, and also between the colleges involved. This synergy, we believe, will help to strengthen the existing programs and the vision of transdisciplinary learning.

Although there are nearly enough faculty to cover courses in the program, some of the core courses are approaching capacity. Therefore, we expect to hire new faculty to teach additional sections of these courses needed for the sake of manageability. In addition, for some of the existing DSBA courses we will have to develop an 8000-level counterpart. Consequently, we expect to hire three new faculty members in the first four years of the program to cover additional sections as well as to meet increased demand for these courses from existing degree programs.

The program will not be able to be implemented without approval of the tuition differential. With only SBTI approved, but no other funding, the program would depend very heavily on external grant funding for the PhD students, which may jeopardize the stability and sustainability of the program as it seeks to establish itself in a quickly changing technology-focused advanced learning landscape. This would severely limit the expected number of students, impact to the regional job market, and possibly temper the engagement of faculty in student advising responsibilities. Additionally, funding for this program is projected to come from a legislative budget request for data science approved by the UNC System and under consideration by the General Assembly for appropriation in the FY23-24 and FY24-25 budgets. If the appropriation does not occur, the institution will reassess financial support needed for the program which may result in the inability to proceed.

**VII.    For Research Doctoral Programs Only:**

Describe the following (maximum length 1,000 words):

a. The research and scholarly infrastructure in place (including faculty) to support the proposed program.

UNC Charlotte offers 24 doctoral and 66 master's programs. Fall 2022 enrollment in these programs stands at 6,090, 978 of which are doctoral students. During the 2021-2022 academic year, 178 doctoral degrees were awarded. The Graduate School houses the Center for Graduate Life and Learning (CGLL), which supports a host of services and programs focused on strengthening competencies in communication, leadership, teaching, cultural engagement, and ethics. CGLL is essential to the success of graduate students and works collaboratively with the University Libraries, program directors and Colleges, and the office of Research and Economic Development (RED). RED houses a number of programs and resources to foster and sustain research, innovation, and talent development accessible to faculty and students.

The transdisciplinary School of Data Science (SDS) consists of over 90 full time, joint, and affiliated faculty representing 6 colleges and 23 departments. While primarily joint and affiliated faculty, each faculty member has assigned responsibilities, including teaching load, that are defined. In addition, SDS hosts an AWS environment with Twitter, local WiFi, and other data sets for our faculty and students. Each faculty member has access to the UNC Charlotte High Performance Computing infrastructure as well. SDS assists in defraying costs of publication, travel to conferences, and other similar support. In addition, we host two conferences each year (Women in Data Science and Analytics Frontiers) with 300-500 attendees each.  Faculty have the opportunity to present their research and interact with many local corporations at these conferences. Research seminars with local and external guest speakers are regularly scheduled.

b. Any aspects of financing the proposed new program not included in the above section.

Primary funding for the proposed program will be through tuition and tuition differential as described.  Additional funding is expected through extramural research as data science is one of the key focuses of most funding agencies. The National Science Foundation plays a leadership role in this respect (https://www.nsf.gov/cise/bigdata/),  with SDS faculty receiving NSF 2022 grants in video analytics, AI understanding business performance, and natural language processing of leadership statements.  SDS faculty also received 2022 awards from the National Institutes of Health (https://datascience.nih.gov/) where faculty are using data science to study childrens' activity, peptide interference, and suicide detection and intervention. SDS faculty are leading an Intelligence Community Center of Excellence for the Department of Defense as well as receiving 2022 grants from industry partners like Intel, Alair Engineering and Electrical Power Research Institute. Our faculty also

work within the larger academic community with 2022 funding from projects led within North Carolina by NC State,  NC A&T, UNC Pembroke, UNC Chapel Hill, as well as outside of NC with Western Michigan, Northeastern, Northwestern, and University of Sheffield.  SDS faculty have received 2022 grants from Mecklenburg County and the NC Department of Justice as well as additional funding and support from the NC General Assembly which has previously been allocated to support SDS through "Engineering North Carolina's Future."

 c. State the number, amount, and source of proposed graduate student stipends and related tuition benefits that will be required to initiate the program.

  SDS is expecting to initially provide 5 graduate student stipends of $22k each with related tuition, SBTI, fees and healthcare support.  This is expected to grow to 10 stipends being supported by SDS and Academic Affairs at UNC Charlotte (2 SDS, 10 AA). AA is expected to provide their standard GASP package for 3 students growing to 8 in the first few years, with SDS covering any additional funding necessary to complete the support package. We do expect a portion of the students to matriculate with Advanced Standing (especially those transitioning from our DSBA program).  We also expect a small, but material portion of these advanced standing students to not be supported by graduate student stipends since it is highly likely that they will be fully employed in Charlotte while they are studying part-time in the new program. We anticipate that, at maturity, in excess of 30% of our full-time students will be supported on external funding.

**VIII.** **For Professional Practice Doctoral Programs Only:**

Describe the following (maximum length 1,000 words):

 N/A

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

| Position Title | Name | E-mail Address | Telephone |
|---|---|---|---|
| Executive Director SDS | Doug Hague | dhague@uncc.edu | 704-687-5666 |
| Knight Distinguished Professor of Public Policy | Jean-Claude Thill* | jfthill@uncc.edu | 704-687-5973 |
| Professor | Monica Johar* | msjohar@uncc.edu | 704-687-7658 |

| | | | |
|---|---|---|---|
| Professor | Zbigniew Ras | ras@uncc.edu | 704-687-8574 |
| Professor | Jiangcheng Jiang | Jjiang1@uncc.edu | 704-687-6415 |
| Associate Professor | Monika Sawhney | msawhney@uncc.edu | 704-687-0963 |
| Assistant Professor | Ming Chen | mchen37@uncc.edu | 704-687-7626 |
| Professor | Srinivas Pulugurtha | sspulugu@uncc.edu | 704-687-1233 |

* Denotes primary contacts

**Signatures**. This Request for Preliminary Authorization has been reviewed and approved by the appropriate institutional committees and authorities and has my support.

| Position Title | Signature | Date |
|---|---|---|
| Chancellor | | 4/6/23 |
| Provost | | 4/5/2023 |

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

| Position Title | Signature | Date |
|---|---|---|
| Chancellor | | |
| Provost | | |

Appendix A: Chapel Hill Report
Appendix B: EAB Report
Appendix C: Letters of Support

| | Rate | Year 0 (Start Up) | 1st Year | 2nd year | 3rd Year | 4th Year | 5th Year | TOTALS |
|---|---|---|---|---|---|---|---|---|
| **Current Program Sources (if applicable)** | | | | | | | | |
| 1 General Fund Appropriation | | | | | | | | $ - |
| 2 NC Promise Appropriation | | | | | | | | $ - |
| 3 *Resident Enrollment (FTE)* | | | | | | | | |
| 4 Regular Resident Tuition (Annual Rate) | $ 4,337 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 5 *Nonresident Enrollment (FTE)* | | | | | | | | |
| 6 Regular Nonresident Tuition (Annual Rate) | $ 18,482 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 7 Tuition Differential (Annual Rate) | $ 7,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 8 Special Fees | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 9 External Funding (In-Hand Only) | | | | | | | | $ - |
| 10 Other Funding (Identify) | | | 100,000 | 75,000 | 50,000 | 50,000 | 50,000 | $ 325,000 |
| 11 **Total Current Sources** | | $ - | $ 100,000 | $ 75,000 | $ 50,000 | $ 50,000 | $ 50,000 | $ 325,000 |
| | | | | | | | | |
| **Proposed New Program Sources** | | | | | | | | |
| 12 *Incremental Resident SCH* | | | 36 | 72 | 108 | 126 | 144 | |
| 13 Enrollment Funding Appropriation | $ 965 | $ - | $ - | $ 17,370 | $ 52,110 | $ 86,850 | $ 112,905 | $ 269,235 |
| 14 *Resident Enrollment (FTE)* | | | 2 | 4 | 6 | 7 | 8 | |
| 15 Regular Resident Tuition (Annual Rate) | $ 4,337 | $ - | $ 8,674 | $ 17,348 | $ 26,022 | $ 30,359 | $ 34,696 | $ 117,099 |
| 16 NC Promise Appropriation (Resident) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 17 *Nonresident Enrollment (FTE)* | | | 6 | 12 | 18 | 21 | 24 | |
| 18 Regular Nonresident Tuition (Annual Rate) | $ 18,482 | $ - | $ 110,892 | $ 221,784 | $ 332,676 | $ 388,122 | $ 443,568 | $ 1,497,042 |
| 19 NC Promise Appropriation (Nonresident) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 20 Tuition Differential (Annual Rate) | $ 7,000 | $ - | $ 56,000 | $ 112,000 | $ 168,000 | $ 196,001 | $ 224,001 | $ 756,002 |
| 21 Special Fees | | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 22 External Funding (In-Hand Only) | | | | | | | | $ - |
| 23 Other Funding (Identify) | | | 73,480 | 146,960 | 220,440 | 293,920 | 293,920 | $ 1,028,721 |
| 24 **Total New Sources** | | $ - | $ 249,046 | $ 515,462 | $ 799,249 | $ 995,252 | $ 1,109,090 | $ 3,668,099 |
| | | | | | | | | |
| 25 **Total Proposed Program Sources** | | $ - | $ 349,046 | $ 590,462 | $ 849,249 | $ 1,045,252 | $ 1,159,090 | $ 3,993,099 |

**Comments**

Program is set up to be a split of advanced standing students and direct entry to PhD (50/50).

We have a successful MS program where many have wanted to return for PhD.  MS program is all self pay for all students

We estimated an entry of 8 students/year (75% non-resident)

SBTI for PhD program is consistent with MS program.

We expect 75% non resident and 25% in state residents.

The in state students will be a mix of full time and part time.  Full time will be supported through TA or grants.  Part time will be self pay.

Blend of part time and full time in state gets us to the FTE estimate

Other current funding source: efficiencies gained by housing the program with the MS program (DSBA).

| | Year 0 (Start Up) | 1st Year | 2nd year | 3rd Year | 4th Year | 5th Year | TOTALS |
|---|---|---|---|---|---|---|---|
| **Current Program Uses (if applicable)** | | | | | | | |
| 1 Tenure/Tenure-Track Faculty | | $ 373,524 | $ 373,524 | $ 560,286 | $ 560,286 | $ 560,286 | $ 2,427,905 |
| 2 Non Tenure-Track Faculty | | | | | | | $ - |
| 3 Graduate Student Support | | 73,480 | 73,480 | 73,480 | 73,480 | 73,480 | $ 367,400 |
| 4 EHRA Non-Faculty Positions | | 86,198 | 86,198 | 86,198 | 86,198 | 86,198 | $ 430,989 |
| 5 Student Support (Scholarships) | | | | | | | $ - |
| 6 Libraries | | | | | | | $ - |
| 7 Supplies and Materials | | | | | | | $ - |
| 8 Travel, Communications, and Fixed Charges | | | | | | | $ - |
| 9 Equipment and Technology | | | | | | | $ - |
| 10 Facility Repair and Renovation | | | | | | | $ - |
| 11 Other (Identify) | | | | | | | $ - |
| 12 **Total Current Uses** | $ - | $ 533,202 | $ 533,202 | $ 719,964 | $ 719,964 | $ 719,964 | $ 3,226,294 |
| | | | | | | | |
| **Proposed New Program Uses** | | | | | | | |
| 13 Tenure/Tenure-Track Faculty* | | 330,425 | 330,425 | 330,425 | 495,637 | 495,637 | $ 1,982,549 |
| 14 Non Tenure-Track Faculty* | | | | | | | $ - |
| 15 Graduate Student Support* | | 73,480 | 146,960 | 220,440 | 293,920 | 293,920 | $ 1,028,721 |
| 16 EHRA Non-Faculty Positions* | 86,198 | 86,198 | 86,198 | 86,198 | 86,198 | 86,198 | $ 517,187 |
| 17 Student Support (Scholarships) | | | | | | | $ - |
| 18 Libraries | | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | $ 50,000 |
| 19 Supplies and Materials | | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | $ 25,000 |
| 20 Travel, Communications, and Fixed Charges | | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | $ 25,000 |
| 21 Equipment and Technology | | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 | $ 200,000 |
| 22 Facility Repair and Renovation | | | | | | | $ - |
| 23 Facility New Construction or Expansion | | | | | | | $ - |
| 24 Other (Identify) | | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 | $ 75,000 |
| 25 **Total New Uses** | $ 86,198 | $ 565,103 | $ 638,583 | $ 712,063 | $ 950,755 | $ 950,755 | $ 3,903,457 |
| | | | | | | | |
| 26 **Total Proposed Program Uses** | $ 86,198 | $ 1,098,304 | $ 1,171,784 | $ 1,432,026 | $ 1,670,719 | $ 1,670,719 | $ 7,129,751 |

**Comments**

Reallocation of 2 Tenure track in beginning with additional one later in program

Note majority of positions that support this PhD will be joint faculty as is the practice in our School of Data Science

TT and NTT faculty positions are in FTE not headcount due to joint nature

New capacity is 6 courses of core curriculum eventually taught twice per year + 2 seminar courses + 4 new topics courses/yr ( 16 sections + seminars = 50 credit hours /yr new)

Graduate student support is for Teaching Assistants (tuition, fees, SBTI, + $22k stipend)

E&T is computing equipment for new students and ongoing compute capacity

"Other" is Graduate Program Director Stipend

Non Faculty is for student support (advising, labs, recruiting, etc)

Reallocation of SDS staff include portions of many postions (marketing, EA, analytics, etc).

| | | |
|---|---|---|
| Benefits multiplier | 1.44 | |
| Estimated portion of current SDS staff members that will support PhD program | | |
| PhD student tuition, fees, SBTI, $22k stipend | $ 36,740 | escalating number of students at Tuition, fees, SBTI, $22k stipend (starts at 2, max of 10) |
| cost/TT of current TT | $ 130,000 | |
| cost/TT new hires | $ 115,000 | 1 TT and then a second TT: Need capacity to teach 6 core courses twice a year + 2 seminars + 2 new courses = 44 credit hours |
| cost/NTT | $ 90,000 | |
| cost of EHRA non faculty | $ 60,000 | |
| Program Director Stipend | $ 15,000 | |
| Cost of new student laptop, misc | $ 5,000 | |

# PRELIMINARY MARKET ASSESSMENT: MASTER'S DEGREE IN DATA SCIENCE

*An assessment of student and labor market demand for the proposed data science master's program*

Prepared for the Data Science Planning Group
by Digital and Lifelong Learning

July 2021

Any questions about this report? Contact us at dll@unc.edu

# TABLE OF CONTENTS

# EXECUTIVE SUMMARY

**Student Demand:** The data show high demand for master's programs in data science. Nationally, master's completions in data science have doubled over the past eight years (101.9% growth), which is 10 times the rate of master's degree growth across all disciplines over the same time period (10.1% growth). Similar trends exist in North Carolina, where master's completions in data science have increased 580.5% over the last 8 years. Meanwhile, the academic marketplace for master's degrees in data science is becoming increasingly saturated; eight peer institutions nationwide offer a master's degree in data science (p. 8), and many in-state institutions have existing programs (p. 10).

In North Carolina, opportunity is still available for UNC-Chapel Hill to join the marketplace with a unique differentiator: a 100% online master's degree. Currently, no such program exists in North Carolina.

Even though an online program typically recruits from a larger pool than a residential program, program stakeholders at UNC-Chapel Hill should expect significant competition from existing programs at peer institutions across the country. These existing programs operate relatively large data science programs, with five peer institutions graduating over 100 students from their respective program in 2019. For the proposed program at UNC-Chapel Hill to be successful, opportunities to demonstrate and communicate program differentiation will be necessary.

**Societal and Labor Market Demand:** Similarly, the data show high labor market demand for individuals with a master's degree in data science. All five of the occupations identified as being most closely aligned with a master's degree in data science are projected for more than double the growth (14%) over the next decade than the projected growth across all occupations nationwide over the same time period (5.8% growth). Statewide occupational projections mirror national projections among likely occupations for an individual with a master's degree in data science, providing a promising outlook on occupations utilizing data science skills.

Pairing long-range occupational projections with recent job posting data, employers nationwide were looking to hire Data Scientists nearly twice as often over the past year as the second most-common job title (Biostatisticians). A trend at both the state and national level is the emergence of biostatistics, as job titles including the term account for the second and third most-common titles (Biostatisticians and Biostatistics Managers) over the last year. Program stakeholders at UNC-Chapel Hill could strategically partner with academic units in the health sciences to provide interdisciplinary learning outcomes to support program graduates in this emerging field.

Other opportunities for program stakeholders to prepare graduates for careers in the workforce could include utilizing in-demand workforce skills in program outcomes (pp. 21-24) and partnering with companies in North Carolina frequently hiring for jobs associated with master's degrees in data science to create both enrollment and employment pipelines (p. 19).

# INTRODUCTION & OBJECTIVE

The information in this study is intended for the group at UNC-Chapel Hill tasked with investigating a new potential academic program: a master's degree in data science.

This preliminary market assessment is split into two distinct sections:[1]
- **Student Demand** to understand student interest and enrollment trends in master's programs in data science from multiple perspectives
- **Societal and Labor Market Demand** to recognize the occupations and industries hiring students who have earned a master's degree in data science including salary data, occupational trends, real-time job posting data, and in-demand skills

While the information in this market analysis is intended to inform the data science planning group in their program planning, it is meant to be a resource used to augment prior institutional knowledge and expertise for the proposed program at UNC-Chapel Hill.

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[1] See Appendices for background on data and methodological approach for each section.

# STUDENT DEMAND ANALYSIS[2]

## Summary

> **Main Idea**: Master's degrees in data science have grown at a considerable rate, with completions nationwide doubling over the past eight years, and completions in North Carolina increasing more than six times over the same time period. Inevitably, the growth in popularity of this credential means that the academic market is becoming more saturated. Eight peer institutions of UNC-Chapel Hill currently offer a program, and 6 institutions across the state have an existing data science master's program. However, with the proposed program, UNC-Chapel Hill would be offering a first-of-its-kind program in North Carolina, as no existing program across the state is fully online. Additionally, many peer institutions with an existing data science master's degree do not offer their program online (see p. 8). UNC-Chapel Hill could differentiate from these peer programs by offering an online program.

- **National Outlook**
  - Master's completion growth over time
    - 101.9% growth in data science master's completions across all formats between 2012-2019
      - Nearly 10x the growth of master's completions across all disciplines (10.1%) over the same time period
    - 359.6% growth in online completions over the same 8-year time span
      - Online master's programs account for 40% of all completions in 2019
    - 8 peer institutions with similar programs
- **North Carolina Outlook**
  - No online data science master's programs exist statewide
  - 6 institutions offer comparable degrees statewide
    - Largest competition in-state comes from Duke, NC State, and UNC Charlotte
  - 580.5% growth in master's completions in data science between 2012-2019
    - Over the same time span, master's degrees across all disciplines grew 17.5%
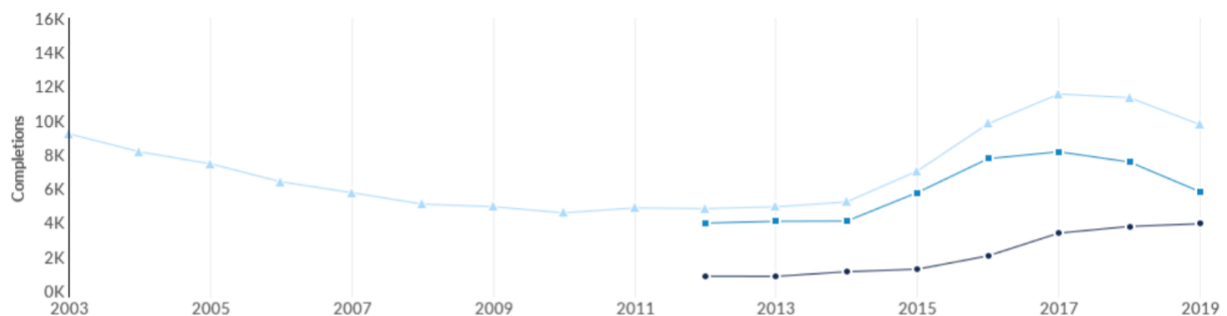
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[2] See Appendix B for methodology

## National Outlook

**Data Science Master's Completions Nationwide[3]**

| | Completions (2019) | % Completions | Institutions (2019) | % Institutions |
|---|---|---|---|---|
| All Programs | 9,751 | 100% | 180 | 100% |
| Distance Offered Programs | 3,939 | 40% | 43 | 24% |
| Non-Distance Offered Programs | 5,812 | 60% | 137 | 76% |

**9,751** Completions

**Growth in Master's Completions in Data Science Nationwide**



| | 2012 Completions | 2019 Completions | % Change |
|---|---|---|---|
| Distance Offered Programs | 857 | 3,939 | +359.6% |
| Non-Distance Offered Programs | 3,972 | 5,812 | +46.3% |
| All Programs | 4,829 | 9,751 | +101.9% |

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[3] The Classification of Instructional Programs (CIP) is developed by the U.S. Department of Education's National Center for Education Statistics (NCES). CIP codes are seen as industry standards to compare program enrollments and completions. CIP codes are typically updated every 10 years in response to changing curriculum, emerging programs, and market demand. For comparison and analysis, the specific CIP code "11.0101: Computer and Information Sciences, General" will be used to encompass master's degrees in Data Science, as this specific CIP code is used by the data science planning group in their program planning documents.

**Institutions with the Most Master's Completions in Data Science Nationwide**

| Institution | Modality | Master's Completions (2019) | % Change Year-Over-Year (2019 vs. 2018) | 3 Year % Change (2017-2019) | 5 Year % Change (2015-2019) | Market Share | Tuition & Fees (2019)[4] |
|---|---|---|---|---|---|---|---|
| Georgia Tech | Online | 1,114 | 18% | 91% | 791% | 11.4% | $16,088 |
| New York University | Online | 487 | 20% | 26% | -2% | 5% | $35,562 |
| University of Texas at Dallas | Classroom | 400 | -6% | -13% | 10% | 4.1% | $13,874 |
| Southern New Hampshire University | Online | 354 | -12% | -17% | 35% | 3.6% | $18,810 |
| Northeastern University | Classroom | 310 | 51% | 31% | 30% | 3.2% | $25,085 |
| Stony Brook University | Classroom | 299 | 85% | 65% | 85% | 3.1% | $13,558 |
| Columbia University | Classroom | 277 | -15% | N/A[5] | N/A | 2.8% | $49,968 |
| The University of Texas at Arlington | Classroom | 260 | -10% | -27% | 94% | 2.7% | $10,248 |
| Johns Hopkins University | Online | 257 | 14% | 27% | 45% | 2.6% | $57,556 |
| University of Buffalo | Classroom | 216 | -5% | -7% | -33% | 2.2% | $14,130 |

[4] Tuition and fees are specific to graduate students at the institution, but do not vary based on academic program. Where applicable, tuition and fees figures come from in-state tuition. Source: National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS).
[5] Columbia University didn't report completions for this program in 2017 or 2015.

**Peer Institutions[6] with Master's Completions in Data Science**

| Institution | Modality | Master's Completions (2019) | % Change Year-Over-Year (2019 vs. 2018) | 3 Year % Change (2017-2019) | 5 Year % Change (2015-2019) | Tuition & Fees (2019)[7] |
|---|---|---|---|---|---|---|
| Duke University[8] | Classroom | 379 | N/A[9] | N/A | N/A | $56,888 |
| Johns Hopkins University | Online | 257 | 14% | 27% | 45% | $57,556 |
| University of Florida | Classroom | 160 | -60% | -38% | 63% | $12,737 |
| University of Wisconsin | Classroom | 133 | 5% | -5% | 138% | $12,180 |
| University of Washington | Classroom | 128 | 28% | 20% | 23% | $19,293 |
| University of Virginia | Classroom or Online | 59 | 28% | 119% | 269% | $19,528 |
| University of Texas at Austin | Online | 36 | 16% | -22% | -27% | $11,998 |
| University of California, Berkeley[10] | Online | 23 | 35% | 15% | 64% | $14,187 |

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[6] Institutions selected in 2021 by the General Administration of the University of North Carolina System as official peers for UNC-Chapel Hill. More info: https://oira.unc.edu/strategic-planning/unc-system-defined-peer-group/

[7] Tuition and fees are specific to graduate students at the institution, but do not vary based on academic program. Where applicable, tuition and fees figures come from in-state tuition. Source: National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS).

[8] Although Duke University doesn't have a program with the same CIP code as the proposed program at UNC-Chapel Hill, the "Master of Quantitative Management, Business Analytics" program is included due to feedback from program stakeholders identifying the Duke program as direct competition.

[9] Duke University didn't have any program graduates prior to 2019.

[10] Although UC-Berkeley doesn't have a program with the same CIP code as the proposed program at UNC-Chapel Hill, the online "Master of Information and Data Science" program is included after due to feedback from program stakeholders identifying the UC-Berkeley program as direct competition.
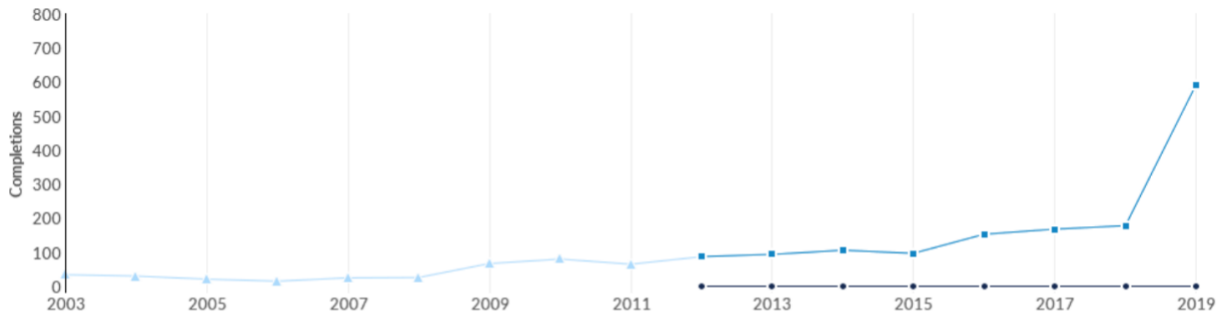
# North Carolina Outlook[11]

**Master's in Data Science Completions in North Carolina**

| | | Completions (2019) | % Completions | Institutions (2019) | % Institutions |
|---|---|---|---|---|---|
| ● | All Programs | 592 | 100% | 6 | 100% |
| ○ | Distance Offered Programs | 0 | 0% | 0 | 0% |
| ● | Non-Distance Offered Programs | 592 | 100% | 6 | 100% |

**592 Completions**

**Growth in Master's Completions in Data Science in North Carolina**



| | | 2012 Completions | 2019 Completions | % Change |
|---|---|---|---|---|
| ● | Distance Offered Programs | 0 | 0 | 0.0% |
| ■ | Non-Distance Offered Programs | 87 | 592 | +580.5% |
| ▲ | All Programs | 87 | 592 | +580.5% |

Note: There is a significant increase in completions in 2019 in North Carolina. This is largely due to Duke University's "Master of Quantitative Management, Business Analytics" degree which graduated its first cohort in 2019.

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[11] There are only 12 completions in North Carolina under the CIP code "11.0101: Computer and Information Sciences, General." However, there are similar programs in North Carolina classified under the following adjacent CIP codes: "11.0802: Data Modeling/Warehousing and Database Administration" and "52.1399: Management Sciences and Quantitative Methods, Other." These additional CIP codes are utilized in this section for a more comprehensive view of state-level competition and student demand. Additionally, these CIP codes are referenced in official program planning documentation as similar programs across the UNC System.

**North Carolina Institutions with Master's Completions in Data Science**

| Institution | Program Name | Master's Degree Completions (2019) | % Change Year-Over-Year (2019 vs. 2018) | 3 Year % Change (2017-2019) | 5 Year % Change (2015-2019) | Market Share | Tuition & Fees (2019) |
|---|---|---|---|---|---|---|---|
| Duke University | Master of Quantitative Management, Business Analytics | 379 | N/A[12] | N/A | N/A | 64% | $56,888 |
| NC State University | M.S., Analytics | 111 | 0% | -6% | 29% | 18.8% | $11,673 |
| UNC Charlotte | PSM, Data Science and Business Analytics | 54 | -5% | 29% | 5,300% | 9.1% | $7,430 |
| UNC Wilmington | M.S., Data Science | 25 | 317% | 525% | 257% | 4.2% | $7,457 |
| Appalachian State University | M.S., Applied Data Analytics | 19 | 533% | N/A[13] | N/A | 3.2% | $7,976 |
| Winston-Salem State University | Master of Computer Science & Information Technology | 4 | 300% | 0% | 33% | 0.7% | $6,412 |

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[12] Duke University didn't have any program graduates prior to 2019.

[13] Appalachian State didn't have any program graduates prior to 2018.

# SOCIETAL & LABOR MARKET DEMAND ANALYSIS[14]

## Summary

**Main Idea**: Jobs most commonly occupied by data science program graduates are poised for notable growth over the next decade. All five representative occupations project for at least 2x the projected growth across all occupations both nationally and at the state level. Additionally, the median annual earnings for these occupations are all above $90k. Pairing strong occupational projections with healthy compensation provides a strong outlook for the future of these occupations. Among the studied occupations in the past year, employers were looking for "Data Scientists" at the state and national level more than any other job title, demonstrating the relative demand for that position in the workforce. An emerging trend statewide and nationally was the emergence of "biostatistics," as the term is included in the second and third most-common job titles, as employers are looking for employees to apply statistical methods and data projections to further research in medicine, public health, environmental sciences, and related fields. The proposed program at UNC-Chapel Hill could pair industry projections with real-time job posting data to create a program that is responsive and attractive to fill labor market needs.

- **Occupational Outlook**
  - Nationwide
    - Higher-than-average growth projected (14%) in representative occupations for data science graduates over the next decade
      - All five sample occupations for data science program graduates projected for at least 2x more growth over the next decade than the projected growth across all occupations[15]
    - "Statisticians" projected as the sample occupation with the largest growth (30.3%) over the next decade
  - North Carolina
    - Higher-than-average growth projected (13%) in representative occupations for data science graduates over the next decade
      - However, North Carolina projected as the state with the second-lowest growth rate among representative occupations throughout the Southeast, and slightly less growth projected than nationwide (14%).[16]
    - Raleigh-Cary and Charlotte-Concord-Gastonia MSAs poised for the largest growth among representative occupations over the next decade

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[14] See Appendix C for methodology

[15] National projected growth across all occupations over the next decade is 5.8%

[16] The reason for a lower projected growth rate in North Carolina may be due to the large amount of data science jobs already existing in the state in 2021 (see p. 15).

- All five sample occupations for data science program graduates projected for between 10-30% growth over the next decade, which is higher-than-average growth among all occupations statewide over the same time period[17]
- **Salary Outlook**
  - Among the occupations studied, the highest median annual earnings were for "Computer and Information Systems Managers" with an average median earning of $150k nationally
  - All five representative occupations had median annual earnings above $90k, with four of the five representative occupations for data science graduates earning more than 2x the average median earnings of all occupations nationwide[18]
- **National Job Posting Data**
  - Industry
    - The three industries hiring the most employees in data science careers are:
      - Professional, Scientific, and Technical Services
      - Information
      - Manufacturing
  - Occupations
    - The "Computer Systems and Information Managers" occupation was hiring more than twice as often as jobs within the second most-frequent occupation over the past year (Computer and Information Research Scientists)
  - Job Titles
    - "Data Scientist" was the most frequent job title over the past year
      - Employers were looking to hire Data Scientists nearly 2x as often as the next most frequent job title (Biostatisticians)
    - "Biostatistics" emerges as a common job title, as the term represents 2 of the top 3 most-common titles in job postings over the past year
- **North Carolina Job Posting Data**
  - Companies
    - 5 of the 10 employers with the most job postings were software companies
  - Industry
    - The three industries hiring the most employees in data science careers over the past year are "Professional, Scientific, and Technical Services," "Information," and "Manufacturing," matching national trends
  - Occupations
    - The "Computer Systems and Information Managers" occupation hired than three times as often as jobs within the second most-frequent

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[17] North Carolina projected growth across all occupations over the next decade is 5.1%

[18] The average median annual earning for all 773 occupations in the United States is $47,423.

occupation over the past year (Computer and Information Research Scientists), matching national job posting data

- The "Database Administrators and Architects" occupation only hired 5.5% of all jobs within the occupations studied, showing lack of demand for jobs within this occupation
  - o Job Title
    - "Data Scientist" was the most frequent job title over the past year, matching national job posting data
    - Similar to national job posting data, "biostatistics" is represented in the second and third-most common job titles in North Carolina over the past year
- **In-Demand Skills**
  - o Nationwide
    - "Computer science" was the most-desired hard skill[19] in job postings
    - "Communications" and "leadership" were the two most-desired soft skills[20] in job postings, with both skills represented in more than 50% of job postings
  - o North Carolina
    - "Computer science" was the most-desired hard skill statewide in job postings, mirroring national skills data
    - "Leadership" was the most-desired soft-skill in job postings (56% of all postings)

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[19] Well-defined and specific skills that are often highly technical, subject-matter specific, or acquired through on-the-job training.
[20] Typically broad competencies that include character traits, general cognitive or physical abilities, and interpersonal skills.

# Occupational Outlook

**North Carolina Outlook for Master's in Data Science Graduate Occupations**
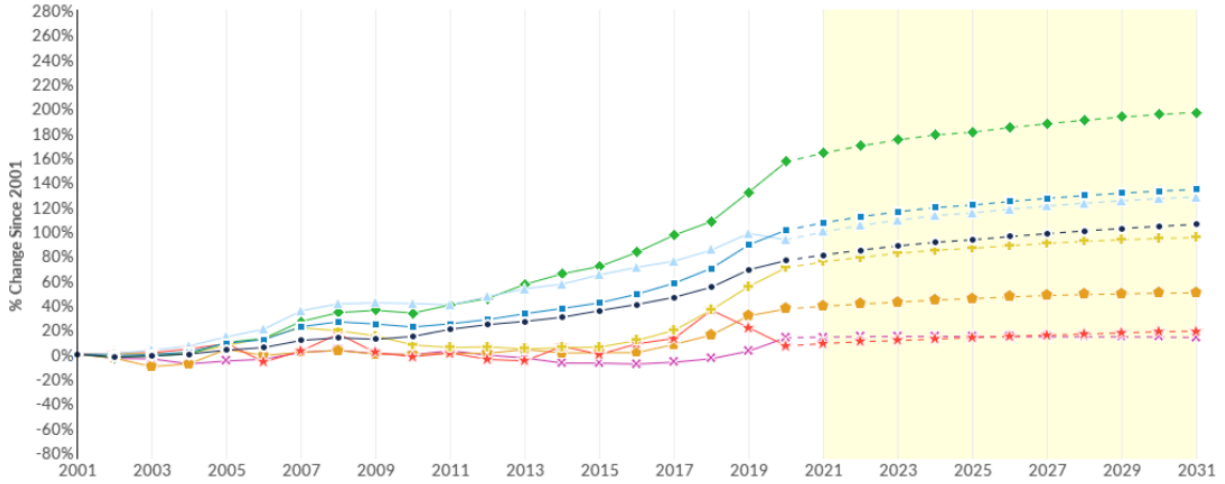


| Region | 2021 Jobs | 2031 Jobs | Change | % Change | Median Hourly Earnings |
|---|---|---|---|---|---|
| ● United States | 777,783 | 884,857 | 107,074 | 14% | $63.16 |
| ■ North Carolina | 25,610 | 28,970 | 3,360 | 13% | $60.14 |
| ▲ Raleigh-Cary, NC | 5,079 | 5,804 | 725 | 14% | $60.47 |
| ◆ Charlotte-Concord-Gastonia, NC-SC | 9,113 | 10,259 | 1,146 | 13% | $62.88 |
| ✚ Durham-Chapel Hill, NC | 4,025 | 4,480 | 455 | 11% | $59.26 |
| ★ Fayetteville, NC | 369 | 404 | 35 | 9% | $51.09 |
| ⬠ Winston-Salem, NC | 953 | 1,027 | 74 | 8% | $56.73 |
| ✖ Greensboro-High Point, NC | 1,087 | 1,084 | -3 | 0% | $60.94 |

**Southeast Regional Outlook for Master's in Data Science Graduate Occupations**
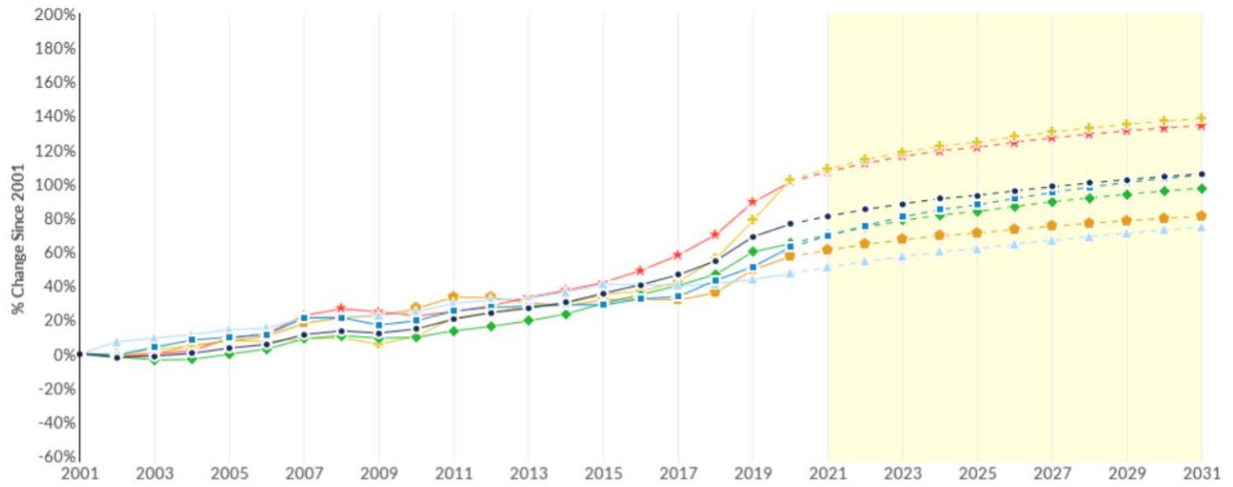


| Region | | 2021 Jobs | 2031 Jobs | Change | % Change | Median Hourly Earnings |
|---|---|---|---|---|---|---|
| ● | United States | 777,783 | 884,857 | 107,074 | 14% | $63.16 |
| ■ | South Carolina | 6,452 | 7,821 | 1,369 | 21% | $51.49 |
| ▲ | District of Columbia | 8,011 | 9,268 | 1,257 | 16% | $72.61 |
| ◆ | Georgia | 25,849 | 30,012 | 4,163 | 16% | $59.73 |
| + | Tennessee | 13,618 | 15,554 | 1,936 | 14% | $49.69 |
| ★ | North Carolina | 25,610 | 28,970 | 3,360 | 13% | $60.14 |
| ⬠ | Virginia | 31,787 | 35,705 | 3,918 | 12% | $67.51 |

## Salary Outlook

**Master's in Data Science Graduate Occupations by Average Salary Nationwide**

| Occupation | 2021 Jobs | 2031 Jobs | Percent Change[21] | Median Annual Earnings[22] [23] |
|---|---|---|---|---|
| Computer and Information Systems Managers | 493,607 | 549,484 | 11.3% | $150,613 |
| Computer and Information Research Scientists | 33,938 | 38,840 | 14.4% | $126,818 |
| Database Administrators and Architects | 141,582 | 156,869 | 10.8% | $98,740 |
| Statisticians | 43,954 | 57,274 | 30.3% | $91,983 |
| Data Scientists and Mathematical Science Occupations, All Other | 64,702 | 82,391 | 27.3% | $97,899 |

**Master's in Data Science Graduate Occupations by Average Salary in North Carolina**

| Occupation | 2021 Jobs | 2031 Jobs | Percent Change[24] | Median Annual Earnings[25] [26] |
|---|---|---|---|---|
| Computer and Information Systems Managers | 16,063 | 17,723 | 10.3% | $138,632 |
| Computer and Information Research Scientists | 480 | 600 | 25% | $94,307 |
| Database Administrators and Architects | 4,621 | 5,088 | 10.1% | $104,007 |
| Statisticians | 1,985 | 2,507 | 26.3% | $100,242 |
| Data Scientists and Mathematical Science Occupations, All Other | 2,462 | 3,051 | 23.9% | $109,661 |

---

[21] The average projected change for all 773 occupations over the next 10 years in the United States is 5.8% growth.

[22] Nationally, the median advertised salary for these five sampling occupations over the past year is $118,700, based on 8,440 advertised salary observations nationwide (5% of the 154,703 matching postings) that required a master's degree for applicants.

[23] The average median annual earning for all 773 occupations in the United States is $47,423.

[24] The average projected change for all 773 occupations over the next 10 years in the United States is 5.8% growth.

[25] In North Carolina, the median advertised salary for these three sampling occupations over the past year is $111,400, based on 253 advertised salary observations in NC (5% of the 4,672 matching postings) that require a master's degree for applicants.

[26] The average median annual earning for all 773 occupations in the United States is $47,423.

## National Job Posting Data[27] [28] [29]

**Top Job Postings by Industry Nationwide**

| Industry | Total/Unique (July 2020-June 2021)[30] | Posting Intensity[31] | Median Posting Duration[32] |
|---|---|---|---|
| Professional, Scientific, and Technical Services | 239,216/42,765 | 6:1 | 27 days |
| Information | 173,816/30,100 | 6:1 | 42 days |
| Manufacturing | 121,166/17,517 | 7:1 | 38 days |
| Finance and Insurance | 116,413/17,448 | 7:1 | 32 days |
| Administrative and Support and Waste Management and Remediation Services | 48,794/8,851 | 6:1 | 38 days |

**Top Job Postings by Occupation Nationwide**

| Occupation | Total/Unique (July 2020-June 2021) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Computer and Information Systems Managers | 515,123/87,809 | 6:1 | 35 days |
| Computer and Information Research Scientists | 249,282/39,084 | 6:1 | 41 days |
| Statisticians | 98,976/20,525 | 5:1 | 16 days |
| Database Administrators and Architects | 45,040/7,285 | 6:1 | 41 days |

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[27] The period of time measured using real-time national job posting data is July 2020-June 2021. COVID-19 had a significant effect on job posting data during this time, especially in terms of the number of job postings.

[28] See Appendix D for methodology.

[29] All job postings are full-time and require a master's degree for the applicant, providing the most likely fit for graduates of the data science program in these specific jobs while notably decreasing the number of total and unique job postings analyzed.

[30] Total job postings denote the total and unduplicated number of online job advertisements listed by different companies on career sites and job boards. Unique job postings denote the number of de-duplicated job advertisements listed by different companies on career sites and job boards

[31] The ratio for total job postings to unique, de-duplicated job postings. For example, the "Information" industry has six postings online for each position. A higher than average (5:1) posting intensity can mean that industry is putting more effort than normal into hiring that position.

[32] Median posting duration for these five occupations nationwide is 34 days.

**Top Posted Job Titles Nationwide**

| Job Title | Total/Unique (July 2020-June 2021) | Posting Intensity | Median Posting Duration |
| --- | --- | --- | --- |
| Data Scientists | 68,305/10,609 | 6:1 | 38 days |
| Biostatisticians | 26,553/6,120 | 4:1 | 16 days |
| Biostatistics Managers | 17,869/4,657 | 4:1 | 10 days |
| Managers/Data Scientists | 31,658/4,618 | 7:1 | 42 days |
| Principals | 13,405/2,422 | 6:1 | 15 days |
| Directors of Software Development | 16,190/2,289 | 7:1 | 49 days |
| Clinical Data Scientists | 9,349/1,553 | 6:1 | 48 days |
| Research Scientists | 10,107/1,481 | 7:1 | 46 days |
| Program Managers | 7,944/1,391 | 6:1 | 41 days |
| Database Administrators | 7,392/1,215 | 6:1 | 38 days |

## North Carolina Job Posting Data[33] [34]

**Top Companies Hiring Data Science Graduate Occupations in North Carolina**

| Company | Total/Unique (July 2020-June 2021)[35] | Posting Intensity[36] | Median Posting Duration[37] |
|---|---|---|---|
| Oracle Corporation | 3,364/627 | 5:1 | 45 days |
| Wells Fargo & Company | 2,442/157 | 16:1 | 28 days |
| Parexel International Corporation | 478/147 | 3:1 | 9 days |
| IQVIA | 856/129 | 7:1 | 23 days |
| IBM | 743/82 | 9:1 | 35 days |
| Microsoft Corporation | 453/73 | 6:1 | 35 days |
| Ernst & Young, LLP | 363/72 | 5:1 | 40 days |
| Cytel Inc. | 251/69 | 4:1 | 7 days |
| Anthem, Inc. | 175/67 | 3:1 | 32 days |
| Cisco Systems, Inc. | 354/58 | 6:1 | 42 days |

**Top Job Postings by Industry in North Carolina**

| Industry | Total/Unique (July 2020-June 2021) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Professional, Scientific, and Technical Services | 8,245/1,374 | 6:1 | 31 days |
| Information | 5,036/935 | 5:1 | 40 days |
| Manufacturing | 3,141/544 | 6:1 | 41 days |
| Finance and Insurance | 4,842/522 | 9:1 | 35 days |
| Administrative, Support, Waste Management and Remediation Services | 1,519/261 | 6:1 | 41 days |

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[33] The period of time measured using real-time national job posting data is July 2020-June 2021. COVID-19 had a significant effect on job posting data during this time, especially in terms of the number of job postings.

[34] All job postings are full-time and require a master's degree for the applicant, providing the most likely fit for graduates of the data science program in these specific jobs while notably decreasing the number of total and unique job postings analyzed.

[35] Total job postings denote the total and unduplicated number of online job advertisements listed by different companies on career sites and job boards. Unique job postings denote the number of de-duplicated job advertisements listed by different companies on career sites and job boards

[36] The ratio for total job postings to unique, de-duplicated job postings. For example, Wells Fargo has 16 postings online for each position. A higher than average (6:1) posting intensity can mean employers are putting more effort than normal into hiring that position.

[37] Median posting duration for these five occupations in North Carolina is 36 days.

**Top Job Postings by Occupation in North Carolina**

| Occupation | Total/Unique (July 2020-June 2021) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Computer and Information Systems Managers | 16,627/2,721 | 6:1 | 36 days |
| Computer and Information Research Scientists | 5,605/879 | 6:1 | 40 days |
| Statisticians | 4,491/815 | 6:1 | 28 days |
| Database Administrators and Architects | 1,925/257 | 7:1 | 47 days |

**Top Posted Job Titles in North Carolina**

| Job Title | Total/Unique (July 2020-June 2021) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Data Scientists | 2,256/307 | 7:1 | 44 days |
| Biostatisticians | 1,598/251 | 6:1 | 29 days |
| Biostatistics Managers | 1,172/210 | 6:1 | 22 days |
| Managers/Data Scientists | 818/121 | 7:1 | 40 days |
| Directors of Software Development | 576/90 | 6:1 | 45 days |
| Principals | 455/85 | 5:1 | 22 days |
| Database Administrators | 302/44 | 7:1 | 52 days |
| Oracle Database Administrators | 350/43 | 8:1 | 33 days |
| Clinical Data Management Managers | 144/39 | 4:1 | 11 days |
| Program Managers | 204/39 | 5:1 | 50 days |

## In-Demand Skills

The following data provide insight into the supply and demand of relevant skills by comparing the frequency of skills present in job postings against skills present[38] in today's workforce. The juxtaposition between skills present in job postings and those present in the workforce may reveal gaps in learning that could be filled through education.

**National Hard Skills[39] in Job Postings vs. Workforce Profiles**
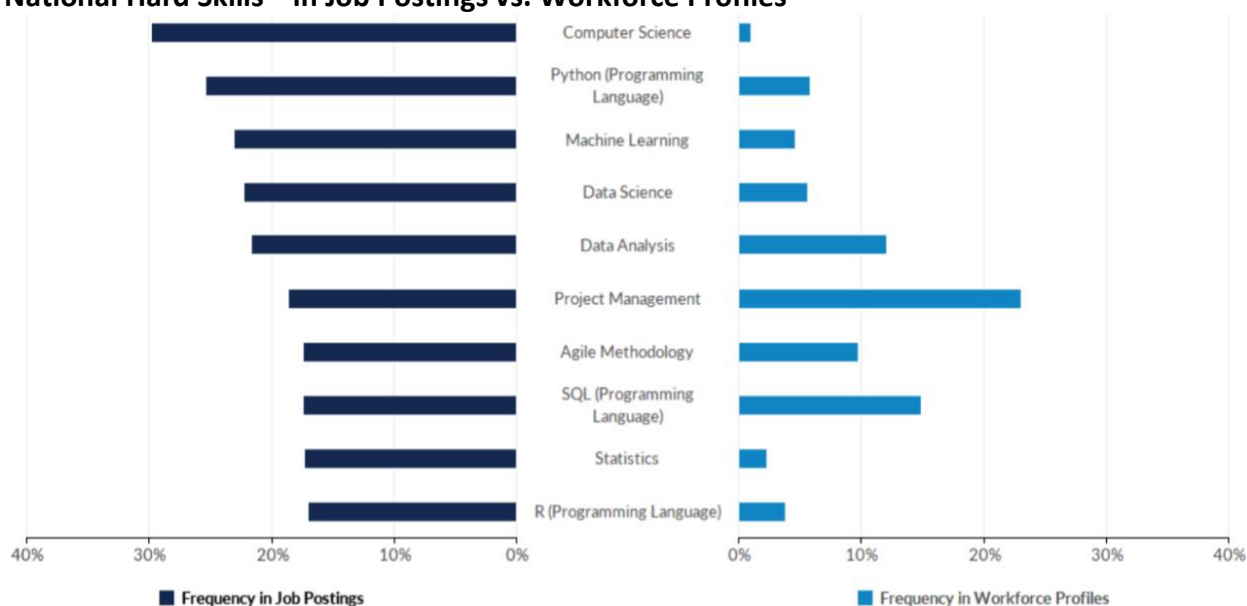


| Skill | Frequency in Postings[40] | Frequency in Profiles[41] |
|---|---|---|
| Computer Science | 30% | 1% |
| Python (Programming Language) | 25% | 6% |
| Machine Learning | 23% | 5% |
| Data Science | 22% | 6% |
| Data Analysis | 22% | 12% |
| Project Management | 19% | 23% |
| Agile Methodology | 17% | 10% |
| SQL (Programming Language) | 17% | 15% |
| Statistics | 17% | 2% |
| R (Programming Language) | 17% | 4% |

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[38] The skills associated with workforce profiles represent workers of all education and experience levels, not just bachelor's-level employees

[39] Well-defined and specific skills that are often highly technical, subject-matter specific, or acquired through on-the-job training.

[40] Based on 154,703 unique job postings for the sampling of five data science-related occupations between July 2020 and June 2021. All job postings require a master's degree for applicants.

[41] Based on aggregated public résumés of United States employees with occupations in the sampling of five data science graduate occupations with updates résumés since 2019. Workforce profiles represent workers of all education and experience levels, not just master's-level employees.

**National Soft Skills[42] in Job Postings vs. Workforce Profiles**
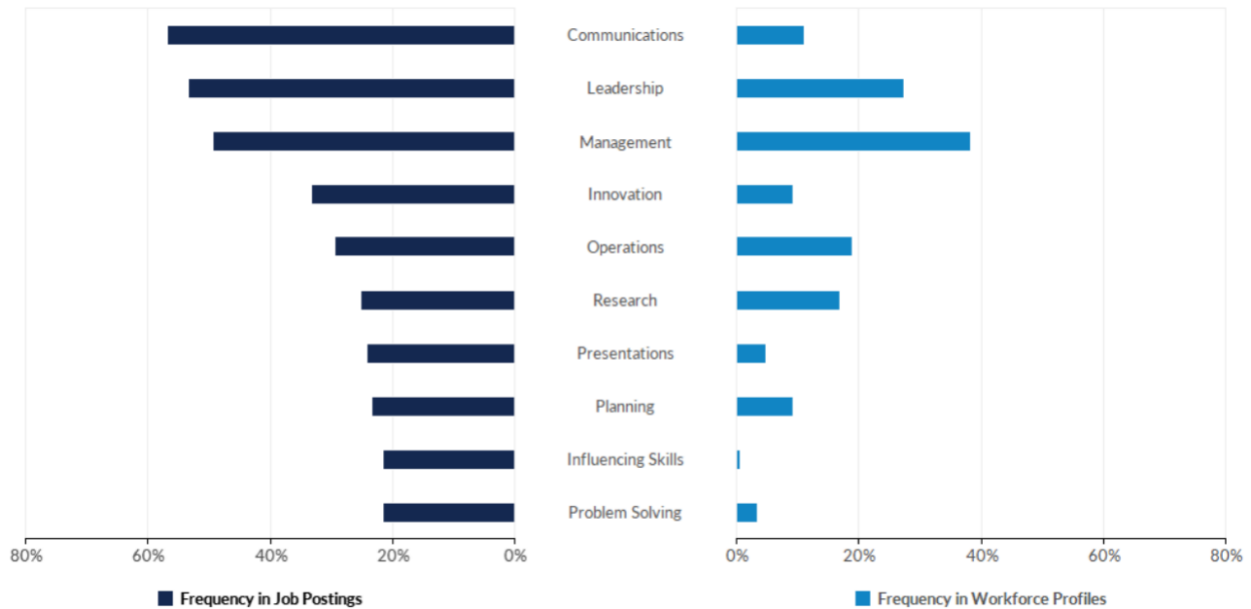


| Skill | Frequency in Postings[43] | Frequency in Profiles[44] |
|---|---|---|
| Communications | 57% | 11% |
| Leadership | 53% | 27% |
| Management | 49% | 38% |
| Innovation | 33% | 9% |
| Operations | 30% | 19% |
| Research | 25% | 17% |
| Presentations | 24% | 5% |
| Planning | 23% | 9% |
| Influencing Skills | 22% | 1% |
| Problem Solving | 21% | 4% |

---

[42] Typically broad competencies that include character traits, general cognitive or physical abilities, and interpersonal skills.

[43] Based on 154,703 unique job postings for the sampling of five data science-related occupations between July 2020 and June 2021. All job postings require a master's degree for applicants.

[44] Based on aggregated public résumés of United States employees with occupations in the sampling of five data science graduate occupations with updates résumés since 2019. Workforce profiles represent workers of all education and experience levels, not just master's-level employees.

**North Carolina Hard Skills in Job Postings vs. Workforce Profiles**
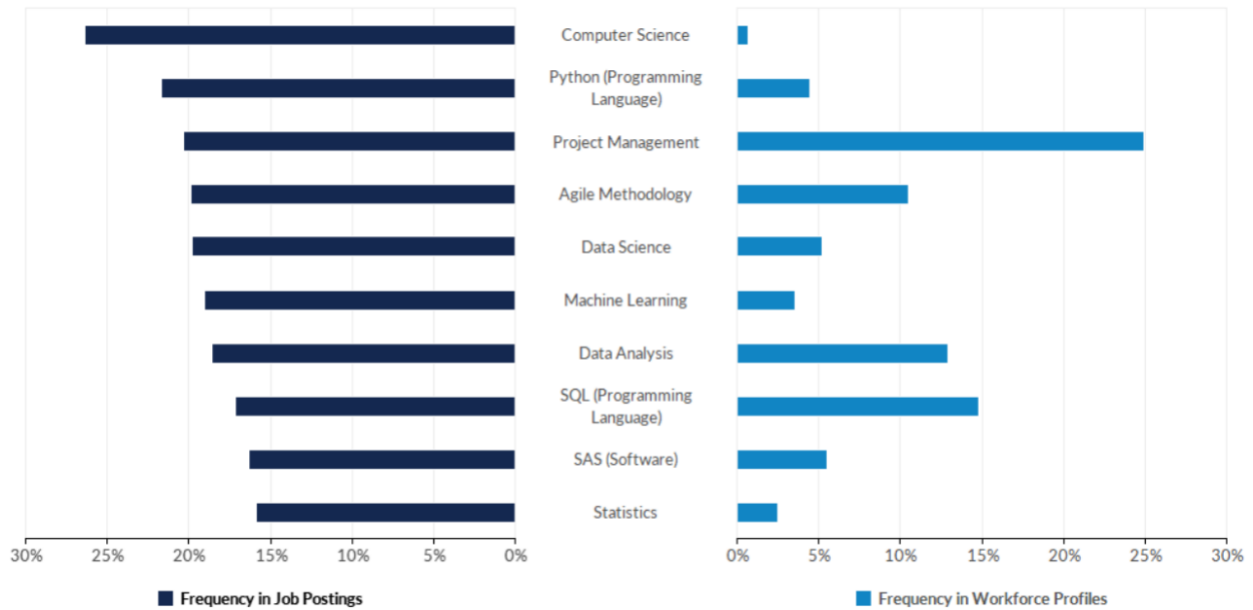


| Skill | Frequency in Postings[45] | Frequency in Profiles[46] |
|---|---|---|
| Computer Science | 26% | 1% |
| Python (Programming Language) | 22% | 4% |
| Project Management | 20% | 25% |
| Agile Methodology | 20% | 10% |
| Data Science | 20% | 5% |
| Machine Learning | 19% | 4% |
| Data Analysis | 19% | 13% |
| SQL (Programming Language) | 17% | 15% |
| SAS (Software) | 16% | 6% |
| Statistics | 16% | 2% |

[45] Based on 4,672 unique job postings for the sampling of five data science-related occupations between July 2020 and June 2021. All job postings require a master's degree for applicants.
[46] Based on aggregated public résumés of United States employees with occupations in the sampling of five data science graduate occupations with updates résumés since 2019. Workforce profiles represent workers of all education and experience levels, not just master's-level employees.

**North Carolina Soft Skills in Job Postings vs. Workforce Profiles**
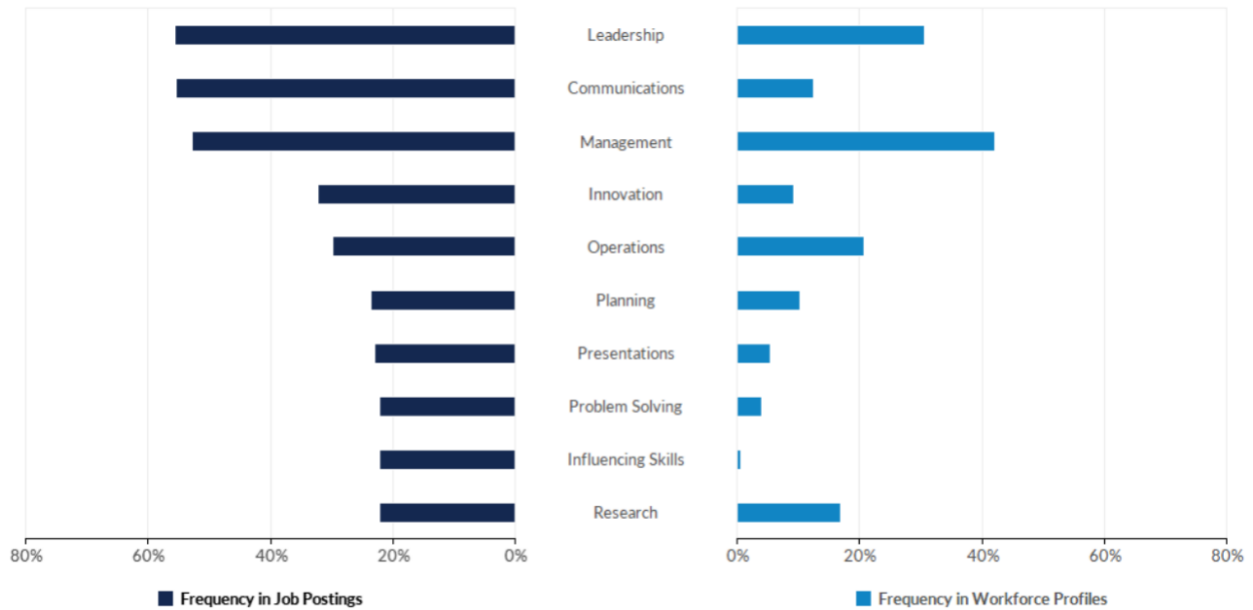


| Skill | Frequency in Postings[47] | Frequency in Profiles[48] |
|---|---|---|
| Leadership | 56% | 31% |
| Communications | 55% | 12% |
| Management | 53% | 42% |
| Innovation | 32% | 9% |
| Operations | 30% | 21% |
| Planning | 24% | 10% |
| Presentations | 23% | 6% |
| Problem Solving | 22% | 4% |
| Influencing Skills | 22% | 1% |
| Research | 22% | 17% |

[47] Based on 4,672 unique job postings for the sampling of five data science-related occupations between July 2020 and June 2021. All job postings require a master's degree for applicants.

[48] Based on aggregated public résumés of United States employees with occupations in the sampling of five data science graduate occupations with updates résumés since 2019. Workforce profiles represent workers of all education and experience levels, not just master's-level employees.

# APPENDICES

**Appendix A: Background on Data**

After conducting initial conversations with faculty and program administrators, the data in this preliminary market assessment comes from the following sources:

- National Center for Education Statistics Integrated Postsecondary Education Data System (IPEDS)
    - Enrollment data
    - Conferral data
- North Carolina Department of Commerce Labor and Economic Analysis (LEAD)
    - Economic data
    - Labor market data
    - Employment projections
    - Geographical data
- Bureau of Labor Statistics
    - Employment data
    - Wage data
    - Employment projections
    - Population projections
- Economic Modeling Specialists, Inc. (Emsi)
    - Occupational projections
    - Job postings data
    - Geographical data
- O*Net National Occupational Information
    - Occupation data
    - Skill attainment data
- North American Industry Classification System (NAICS)
    - Industry data

**Appendix B: Student Demand Analysis Methodology**

To compare data science programs, data is aggregated in two distinct ways:
- National level: Data is aggregated using the specific CIP code "11.0101: Computer and Information Sciences, General." [49] This is the specific CIP code used by the data science planning group in their program planning documents.[50]
- State level: Data is aggregated using three specific CIP codes:
    - 11.0101: Computer and Information Sciences, General
    - 11.0802: Data Modeling/Warehousing and Database Administration
    - 52.1399: Management Sciences and Quantitative Methods, Other

Three CIP codes are utilized at the state level due to the low number of completions (12) in North Carolina under CIP code 11.0101: Computer and Information Sciences, General. The two additional CIP codes provide a more comprehensive view of state-level competition and student demand. Additionally, these three CIP codes are all referenced in official program planning documentation as similar programs across the UNC System.

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[49] The Classification of Instructional Programs (CIP) is developed by the U.S. Department of Education's National Center for Education Statistics (NCES). CIP codes are seen as industry standards to compare program enrollments and completions and are updated every 10 years in response to changing curriculum, emerging programmatic areas, and market demand.

[50] Note: Data science programs may be classified under a different CIP code, as institutions self-assign CIP codes. To best compare programs at the national level, CIP code 11.0101 is utilized. A new CIP code, "30.7001: Data Science, General" was added in 2020 to reflect the growth of data science programs. Completion data utilizing this new CIP code won't be available until late 2021. More info: https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=56&cipid=92953

**Appendix C: Societal and Labor Market Demand Analysis Methodology**

This section details the demand for employees who have earned a master's degree in data science in the workforce. Relevant information such as job postings, required skills, salaries, as well as emerging trends in the industry are studied. For comparison, data is aggregated using SOC codes.[51] Resources such as the CIP to SOC Crosswalk, conversations with program stakeholders, and industry-leading economic modeling data informed selection of the following SOC codes. These codes are most closely related to master's degree in data science labor market outcomes and provide a representative sample of the varied occupations for which someone with this academic credential may work:

- Computer and Information Systems Managers
    - Sample job titles: Data Processing Manager, IT Director, Information Systems Director
- Computer and Information Research Scientists
    - Sample job titles: Computer Scientist, Research Scientist, Scientific Programmer Analysts
- Database Administrators and Architects[52]
    - Sample job titles: Database Administration Manager, Data Officer, Database Analyst
- Statisticians
    - Sample job titles: Research Scientist, Statistical Analyst, Biostatistician
- Data Scientists and Mathematical Science Occupations, All Other[53]

These five occupations will be used throughout this analysis to provide a sampling outlook for master's degree recipients in data science in the workforce.

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[51] Standard Occupational Classification (SOC) codes are a federal statistical standard developed by the Bureau of Labor Statistics for collecting, calculating, and disseminating data. All workers are classified into one of 773 occupations according to their occupational definition. The SOC codes were updated in 2018 to reflect the changing nature of the workforce. More info: https://www.bls.gov/soc/2018/major_groups.htm

[52] CIP codes "15-1141: Database Administrators" and "15-1243: Database Architects" are combined in the economic modeling software due to upcoming changes in the SOC code classifications. More info: https://kb.emsidata.com/faq/why-cant-i-find-the-soc-code-i-need/

[53] This is a combination of individual SOC codes which is utilized in the economic modeling software due to upcoming changes in the SOC code classifications. More info: https://kb.emsidata.com/faq/why-cant-i-find-the-soc-code-i-need/

**Appendix D: Job Posting Data Methodology**

Looking at real-time job posting data, there are three distinct ways in which the data can be organized. The hierarchy of job posting data fits the following format:

- Industry[54]
  - Occupation[55]
    - Job Title

In this hierarchy, occupations fit within industries and specific job titles fit within occupations. For this market analysis, Data science jobs are organized from most general (industry) to most specific (job title) for a better understanding of both the scope and granularity of available jobs in the workforce for a potential employee with a master's degree in data science.[56]

Note: The combined occupational classification used by economic modeling software, "Data Scientists and Mathematical Science Occupations, All Other," is not represented as a stand-alone occupation in the job posting data due to its role as a classification representative of multiple SOC codes.

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[54] A group of businesses that produce similar goods and services and share similar production processes for creating the goods and services they sell. Classified using the North American Industry Classification System (NAICS) by the U.S. Census Bureau.

[55] Standard Occupational Classification (SOC) codes are a federal statistical standard developed by the Bureau of Labor Statistics for collecting, calculating, and disseminating data. All workers are classified into one of 773 occupations according to their occupational definition. The SOC codes were updated in 2018 to reflect the changing nature of the workforce. More info: https://www.bls.gov/soc/2018/major_groups.htm

[56] All job postings are full-time and require a master's degree for the applicant, providing the most likely fit for graduates of the data science program in these specific occupations while notably decreasing the number of total and unique job postings analyzed.

**Appendix E: Intake Notes from Kickoff Meeting**

DLL staff met with program stakeholders in July 2021 to better understand the purpose of developing this program and to ask questions to help guide and focus the creation of this market assessment. The following notes capture the high-level takeaways from the discussion:

- Rethinking this program from scratch, as first iteration was not online
    - What changes in the market due to the online nature of the program?
- Industries where program graduates may work
    - Healthcare
    - Banking
    - Pharmacy
    - Purely technology roles
- Competition
    - UC-Berkeley, Master of Data Science (MDS)
        - Aggressive marketing, 2U-supported program
    - Georgia Tech
    - UVA
    - NC State, although focus is different
    - UNC-Charlotte, PSM program, different program outcomes
- Program differentiation
    - More holistic perspective
        - Social sciences
        - Arts and humanities leaders as part of the degree
    - Healthcare (utilizing UNC Health)
- Potential feeder academic programs
    - Social science, economics, political science
- Still weighing PSM nomenclature as part of program
    - External identification vs. internal classification
- Tuition pricing as off-model, unsure of price differentiation strategies in-state vs. out-of-state or blanket pricing
- Difference between degree types
    - Master's in Computer Science
        - Rigorous degree, heavy math
        - Not experts in a particular industry
    - Master's in data science
        - Not as many computer science courses
        - Inherently works with the skills in data analysis coupled with the data for some specific industry
- Interested in skill attainment in program, skill gaps and in-demand skills in the workforce

# Market Demand for a PhD in Data Science

Analysis of National Employer Demand

# COE Forum

**Grace Anderson**
*Market Research Manager*

# Table of Contents

# 1) Research Methodology

## Project Challenge

Leadership at the University of North Carolina-Charlotte approached the Forum to assess demand for a PhD program in data science. Through a combination of quantitative data analytics and secondary research, the Forum sought to assess the market demand for a data science PhD program.

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

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

## Methodology and Definitions

**Methodology:** Unless stated otherwise, this report includes data from online job postings from March 2017 to February 2018. The Forum identified the top titles, skills, and employers for doctoral-level data science professionals.

To best estimate demand for graduates of a data science PhD program the Forum analyzed job postings in the "computer and information research scientist" occupation that require a doctoral degree and include the term "data science."

**Definitions:** Growth in job postings is measured in the total number of jobs posted each month over the last five years of data (i.e., this report includes historical data from March 2013 to February 2018).

## Emsi Analyst™ and Emsi Alumni Insight™

**EAB's Partner for Comprehensive Labor Market Data**

This report includes data made available through EAB's partnership with Emsi (Economic Modeling Specialists International), a labor market analytics firm serving higher education, economic development, and industry leaders in the U.S., Canada and the United Kingdom.

Emsi curates and maintains the most comprehensive labor market data sets available for academic program planning, providing real-time job posting data, workforce and alumni outcomes data, and traditional government sources of data. Under this partnership, EAB may use Emsi's proprietary Analyst™ and Alumni Insight™ tools to answer member questions about employer demand, the competitive landscape, in-demand skills, postings versus actual hires, and skills gaps between job postings and professionals in the workforce. The Emsi tools also provide EAB with in-depth access to unsuppressed, zip-code-level government data for occupations, industries, programs, and demographics. For more complete descriptions of the Emsi tools, visit:

- http://www.economicmodeling.com/analyst/

- https://www.economicmodeling.com/alumni-insight/

To learn more about Emsi and its software and services, please contact Bob Hieronymus, Vice President of Business Development at bob.hieronymus@economicmodeling.com or (208) 883-3500.

## Project Sources

The Forum consulted the following sources for this report:

- EAB's internal and online research libraries ([eab.com](eab.com))
- National Center for Education Statistics (NCES) ([http://nces.ed.gov/)](http://nces.ed.gov/))
- US Bureau of Labor Statistics ([http://bls.gov](http://bls.gov))

# 2) Executive Overview

**Increasing employer demand for doctoral-level data science professionals and projected employment growth in the "computer and information research scientist" occupation indicate opportunity for program development.** Nationwide demand for doctoral-level data science professionals tripled in the last five years, from 550 job postings in March 2013 to 1,654 in February 2018. Demand reached a peak of 2,914 job postings in September 2017 then decreased across the rest of that year. Despite the recent decline, nationwide employment of "computer and information research scientists" is expected to grow 12.6 percent between 2017 and 2027. The Bureau of Labor Statistics (BLS) explains the faster-than-average projected growth in this occupation:

> "The Rapid growth in data collection by businesses will lead to an increased need for data-mining services. Computer scientists will be needed to write algorithms that help businesses make sense of very large amounts of data. With this information, businesses understand their consumers better, making the work of computer and information research scientists increasingly vital."[1]

The BLS also notes a growing national emphasis on cybersecurity will contribute to growing employment opportunities for computer and information research scientists.

**Relevant completions rose 18 percent in the last five years, suggesting growing student interest in doctoral-level data science programs.** Though the National Center for Education Statistics does not yet include a categorization to track completions in data science programs, doctoral-level completions in related fields increased over the last five years (e.g., computer science, statistics). Total completions in related fields rose from 1,193 in 2012 to 1,409 in 2016 (i.e., the most recent year of available data).

**Employers seek doctoral-level data science professionals with management and leadership skills to supplement their technical and research skills.** As expected, employers demonstrate significant demand for doctoral-level data science professionals with programming, software, mathematics, statistics, and data mining skills. In addition to these, employers frequently list 'leadership' and related skills as desirable in job postings (e.g., 'management,' 'decision making'). Ensure the PhD program offers graduates the chance to hone their leadership skills. The presence of director-level roles (e.g., 'director of research') among the most commonly posted job titles for doctoral-level data science professionals confirms the need for candidates with leadership and management skills.

---

1) Bureau of Labor Statistics Occupational Outlook Handbook: Computer and Information Research Scientists

# 3) Trends in Employer Demand

## Increasing Employer Demand for Doctoral-Level Data Science Professionals and Projected Job Growth in Related Occupations Indicate Opportunity for Program Development

In the last five years, demand for doctoral-level data science professionals increased 200.7 percent, from 550 jobs posted in March 2013 to 1,654 posted in February 2018. Despite some fluctuation, the positive trend indicates growing demand for doctoral-level data science professionals. Demand reached a peak of 2,914 job postings in September 2017. Demand then decreased monthly with the exception of a rise in November 2017.

**Historical Demand** for Doctoral-Level Data Science Professionals

*March 2013-February 2018, Nationwide Data[1]*
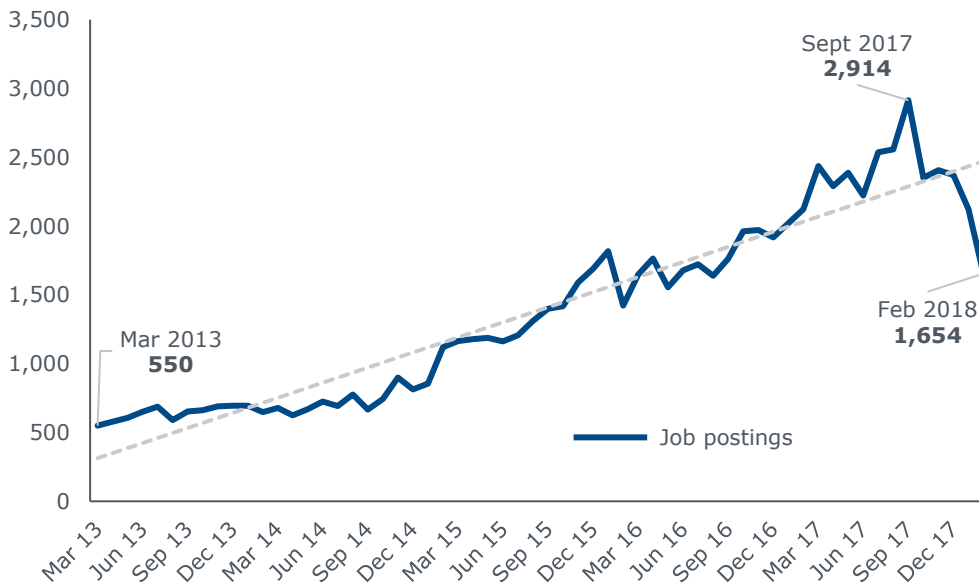


Broader occupational data also indicates employment growth. Between 2013 and 2017 (i.e., the most recent year of available data), employment in the "computer and information research scientists" occupation, one of the occupations available to data science professionals, grew 7.7 percent, from 26,110 jobs in 2013 to 28,133 in 2017. Employment in this occupation is projected to grow a further 12.6 percent in the next 10 years (i.e., from 28,133 jobs in 2017 to 31,674 jobs in 2027).

**Occupational Trends** for Computer and Information Research Scientists

*2013-2027, National Data[3]*
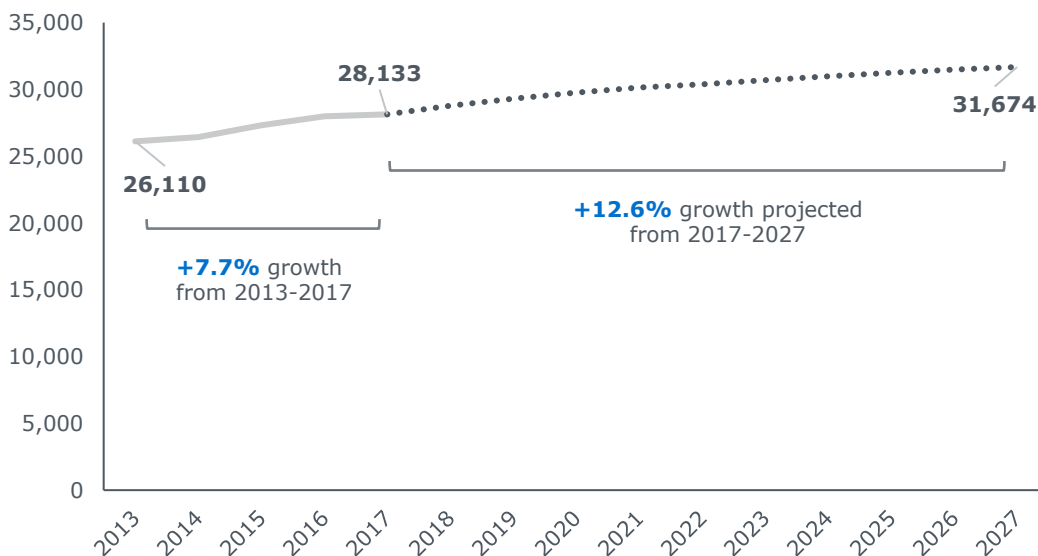


Please note the data in this chart is jobs for computer and information research scientists at all education levels and is not limited to jobs related to data science. "Computer and information research scientists" is one of the occupations most commonly available to doctoral-level data science professionals.

2) Emsi Analyst™

3) Emsi Analyst™; Computer and Information Research Scientists is SOC occupation code 15-1111.

## In Addition to Honing High-Demand Programming and Software Skills like Java and SAS, Help Data Science PhD Students Develop Leadership Skills to Meet Employer Demand

Of programming languages, employers seek doctoral-level data science professionals with 'Java' skills most often. 'Java' appears in 3,911 job postings for doc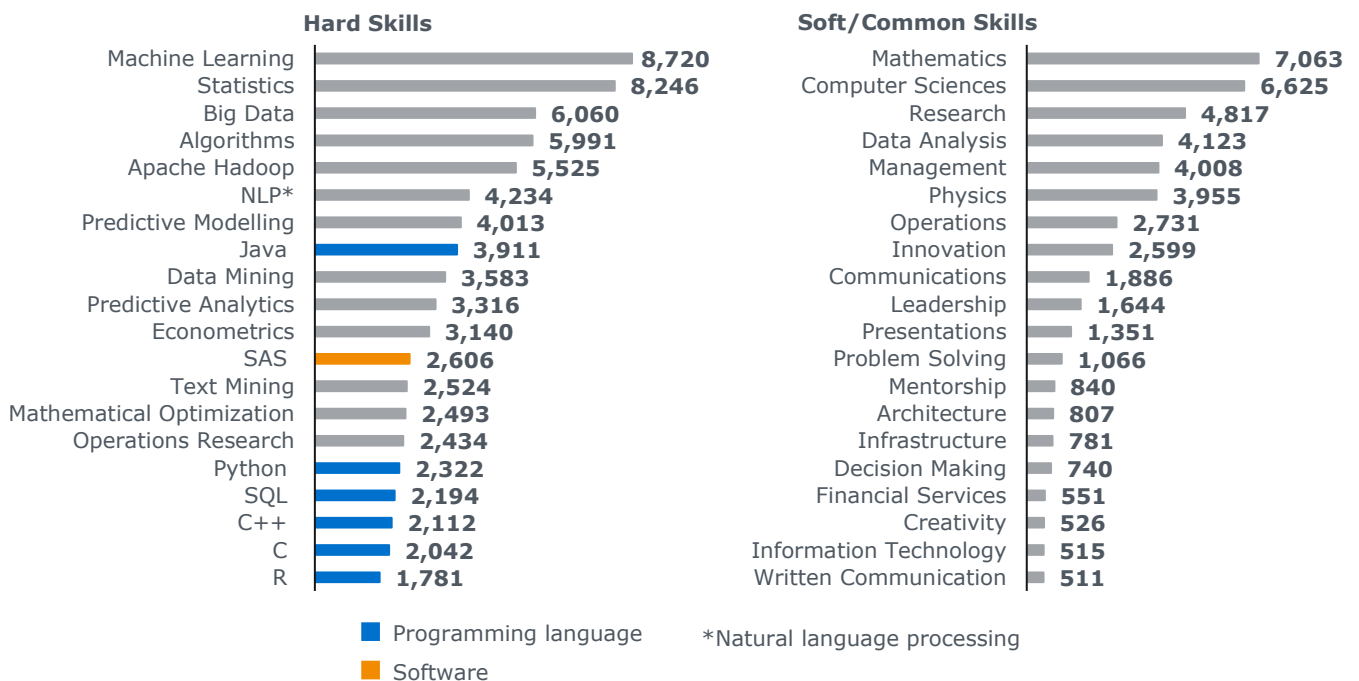toral-level data science professionals in the last 12 months. Other in-demand programming languages include 'Python,' 'SQL,' and 'C++.' Employers also posted 2,606 jobs in the last 12 months seeking professionals proficient in 'SAS.' 'SAS' represents the only software skill to rank among the top 20 most commonly requested hard skills for doctoral-level data science professionals. As expected, employers also demonstrate significant demand for skills like 'statistics,' 'mathematics,' 'computer sciences,' and 'data mining.'

In addition to technical proficiency, employers frequently seek doctoral-level data science professionals with 'leadership' and related skills. Nationwide employers posted 4,008 jobs in the last 12 months for doctoral-level data science professionals with 'management' skills, making it the most commonly sought leadership skill. Other leadership-related skills in high demand include 'mentorship' and 'decision making.' In addition to research and technical training, ensure the PhD program at the **University of North Carolina-Charlotte** prepares students to take on leadership roles and responsibilities. Specifically, the program should help students hone their written and oral presentation skills: employers posted 1,351 relevant jobs seeking 'presentations' skills in the last year, and 511 seeking candidates with good 'written communication' skills.

### Most Commonly Requested Skills Employers Seek in Doctoral-Level Data Science Professionals

*March 2017-February 2018; Nationwide Data[4]*

n=14,071 unique job postings

**Hard Skills**

| Skill | Value |
|---|---|
| Machine Learning | 8,720 |
| Statistics | 8,246 |
| Big Data | 6,060 |
| Algorithms | 5,991 |
| Apache Hadoop | 5,525 |
| NLP* | 4,234 |
| Predictive Modelling | 4,013 |
| Java | 3,911 |
| Data Mining | 3,583 |
| Predictive Analytics | 3,316 |
| Econometrics | 3,140 |
| SAS | 2,606 |
| Text Mining | 2,524 |
| Mathematical Optimization | 2,493 |
| Operations Research | 2,434 |
| Python | 2,322 |
| SQL | 2,194 |
| C++ | 2,112 |
| C | 2,042 |
| R | 1,781 |

**Soft/Common Skills**

| Skill | Value |
|---|---|
| Mathematics | 7,063 |
| Computer Sciences | 6,625 |
| Research | 4,817 |
| Data Analysis | 4,123 |
| Management | 4,008 |
| Physics | 3,955 |
| Operations | 2,731 |
| Innovation | 2,599 |
| Communications | 1,886 |
| Leadership | 1,644 |
| Presentations | 1,351 |
| Problem Solving | 1,066 |
| Mentorship | 840 |
| Architecture | 807 |
| Infrastructure | 781 |
| Decision Making | 740 |
| Financial Services | 551 |
| Creativity | 526 |
| Information Technology | 515 |
| Written Communication | 511 |

■ Programming language          *Natural language processing

■ Software

4) Emsi Analyst™

eab.com

Doctoral-level data science professionals list 'Python' as a skill in their professional profiles most often. Programming languages 'SQL' and 'R' also rank among the top 10 skills listed in relevant professional profiles. However, professional profiles feature common skills 'data analysis' and 'research' more than any programming language or other skill except 'Python.'

A significant number of doctoral-level data science professionals list 'management' as a skill in their professional profiles: 'management' appears in 42 percent of analyzed profiles (i.e., 1,221 of 2,930 profiles). This frequency indicates doctoral-level data science professionals often choose to emphasize 'management' skills in their professional profiles. Administrators at the **University of North Carolina-Charlotte** should include leadership and management training in the PhD program to appeal to students hoping to gain or hone leadership and management skills.
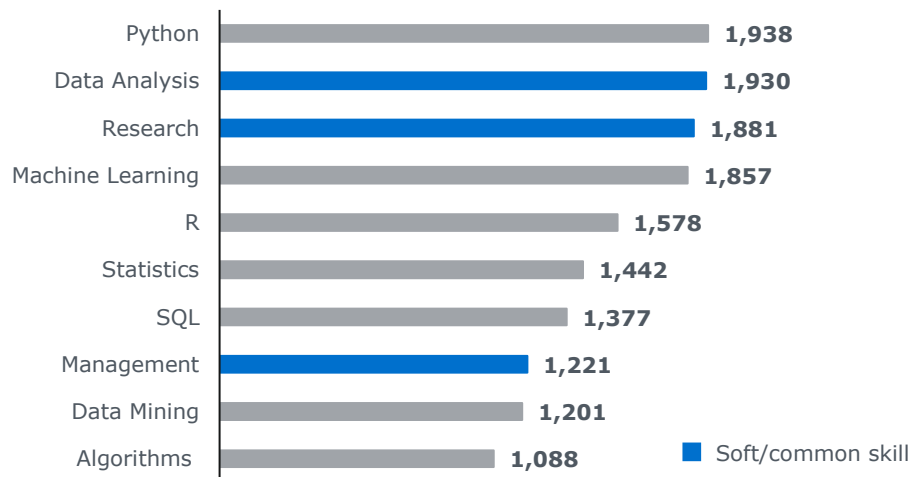
**How Data Science Professionals Describe their Work**

Data on this page comes from an analysis of professional profiles via Emsi's Alumni Insight™ tool. The tool consists of 110 million worker profiles representing a significant portion of the US working population. The profiles are derived from publicly-available professional and social media profiles, as well as CareerBuilder's proprietary resume database. The data is used to illuminate what's happening in today's workforce by showing the connections between people, education, and work.

**Most Commonly Listed Skills in Professional Profiles of Doctoral-Level Data Science Professionals**

*2016-2018; Nationwide Data; Hard and Soft Skills[5]*

n=2,930 professional profiles

| Skill | Value |
|---|---|
| Python | 1,938 |
| Data Analysis | 1,930 |
| Research | 1,881 |
| Machine Learning | 1,857 |
| R | 1,578 |
| Statistics | 1,442 |
| SQL | 1,377 |
| Management | 1,221 |
| Data Mining | 1,201 |
| Algorithms | 1,088 |

■ Soft/common skill

# Common Job Titles

## Employers Seek Data Science Professionals for Software Engineering and Research and Development Roles
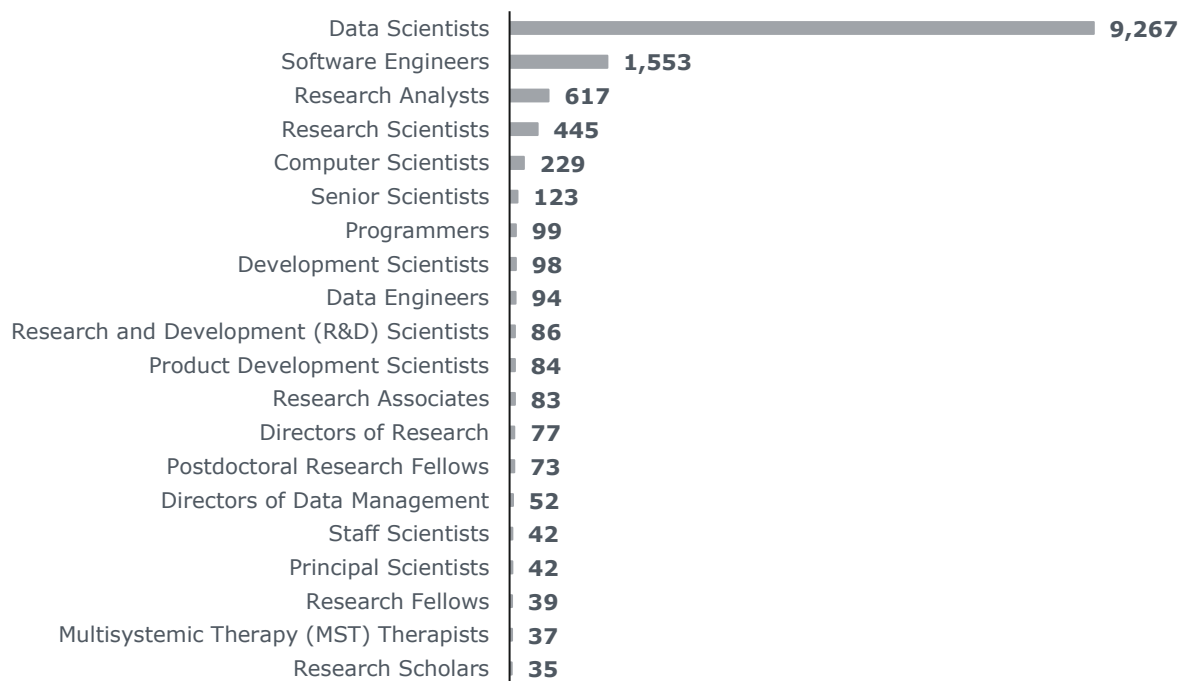
As expected, employers use the title 'data scientist' most often in job postings for doctoral-level data science professionals. Nationwide employers posted 9,267 'data scientist' jobs for doctoral-level data science professionals in the last 12 months, more than five times as many postings as appear with any other title. In addition to 'data scientist' roles, employers also often post jobs with research and engineering titles such as 'research analyst,' 'research scientist,' and 'data engineer.' In the last 12 months, employers posted 1,553 'software engineer' jobs seeking doctoral-level data science professionals, making it the second-most commonly posted job title.

The presence of director-level roles like 'director of research' and 'director of data management' among the most commonly posted job titles suggests administrators should include leadership training in the PhD program curriculum to prepare graduates for high-level management and leadership positions.

### Most Commonly Posted Job Titles for Doctoral-Level Data Science Professionals

*March 2017-February 2018; Nationwide Data[6]*

n=14,071 unique job postings

| Job Title | Count |
|---|---|
| Data Scientists | 9,267 |
| Software Engineers | 1,553 |
| Research Analysts | 617 |
| Research Scientists | 445 |
| Computer Scientists | 229 |
| Senior Scientists | 123 |
| Programmers | 99 |
| Development Scientists | 98 |
| Data Engineers | 94 |
| Research and Development (R&D) Scientists | 86 |
| Product Development Scientists | 84 |
| Research Associates | 83 |
| Directors of Research | 77 |
| Postdoctoral Research Fellows | 73 |
| Directors of Data Management | 52 |
| Staff Scientists | 42 |
| Principal Scientists | 42 |
| Research Fellows | 39 |
| Multisystemic Therapy (MST) Therapists | 37 |
| Research Scholars | 35 |

6) Emsi Analyst™

eab.com

# High-Demand Employers

## In the Past Year, Anthem Inc, Amazon, and Oracle Posted the Most Jobs for Doctoral-Level Data Science Professionals Nationwide

As expected, large technology companies like Amazon, Apple, Oracle, and Microsoft demonstrate significant demand for doctoral-level data science professionals. However, health insurance company Anthem Inc posted the most jobs for doctoral-level data science professionals in the last 12 months. Anthem Inc posted 2,610 relevant jobs, more than double the number of job postings from any other employer nationwide. Aetna Inc is the only other health care company to appear on the list of the top 20 employers with highest demand.
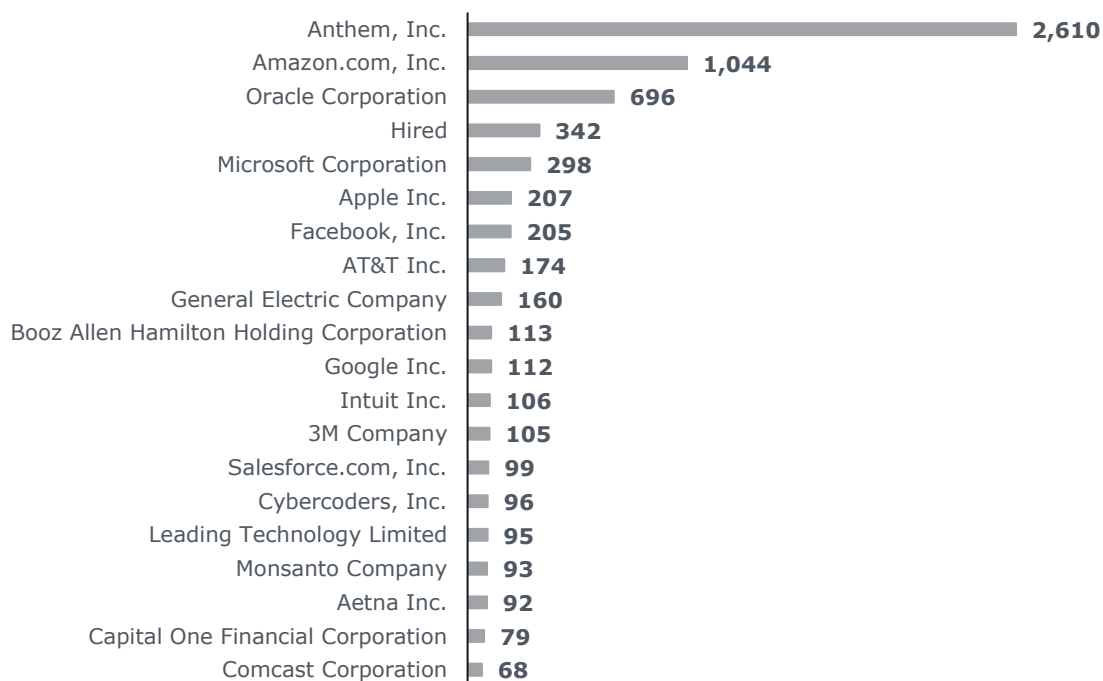
In addition to technology and health care companies, the following types of employers also demonstrate significant demand for doctoral-level data science professionals in the last year:

- Telecommunications companies AT&T Inc and the Comcast Corporation,

- Agriculture firm the Monsanto Company,

- Management consulting firm Booz Allen Hamilton, and

- Capital One Financial Corporation.

### Employers with the Highest Demand for Doctoral-Level Data Science Professionals

*March 2017-February 2018; Nationwide Data[7]*

n=14,071 unique job postings

| Employer | Postings |
|---|---|
| Anthem, Inc. | 2,610 |
| Amazon.com, Inc. | 1,044 |
| Oracle Corporation | 696 |
| Hired | 342 |
| Microsoft Corporation | 298 |
| Apple Inc. | 207 |
| Facebook, Inc. | 205 |
| AT&T Inc. | 174 |
| General Electric Company | 160 |
| Booz Allen Hamilton Holding Corporation | 113 |
| Google Inc. | 112 |
| Intuit Inc. | 106 |
| 3M Company | 105 |
| Salesforce.com, Inc. | 99 |
| Cybercoders, Inc. | 96 |
| Leading Technology Limited | 95 |
| Monsanto Company | 93 |
| Aetna Inc. | 92 |
| Capital One Financial Corporation | 79 |
| Comcast Corporation | 68 |

# 4) Degree Completion Trends

## Rising Degree Completions in Programs Related to Data Science Indicate Growing Student Interest

The National Center for Education Statistics' Classification of Instructional Programs (CIP) does not include a code for data science programs. To best estimate the total number of degrees completed nationally in data science-related programs, previous EAB research recommends analyzing degree completions for the following CIP codes: computer science, statistics, and management information systems and services.

In the last five years of available data, nationwide institutions report an 18 percent increase in doctoral-level degree completions related to data science (i.e., reported completions rose from 1,193 in 2012 to 1,409 in 2016). Of the programs related to data science, institutions report the highest completions in computer science.

Total completions rose steadily before peaking in 2015. From 2015 to 2016, total degree completions in doctoral-level programs related to data science decreased from 1,417 to 1,409.

### Trends in Degree Completions for Data Science-Related Programs

*National Data, Doctoral Level[8]*



- ■ Computer Science (CIP Code 11.0701)
- ■ Statistics (CIP Code 27.05)*
- ■ Management Information Systems, General (CIP Code 51.1201)
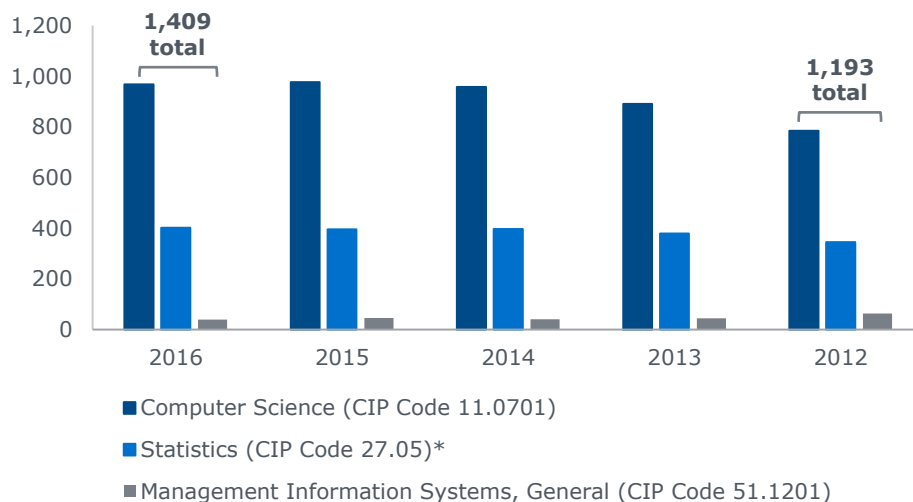
*This category includes the following CIP codes:
- 27.0501 – Statistics, General
- 27.0502 – Mathematical Statistics and Probability
- 27.0503 – Mathematics and Statistics
- 27.0599 – Statistics, Other

8) National Center for Education Statistics

# [EXTERNAL] Support for PhD in Data Science

1 message

**Baker, Aditi (Data Science)** <Aditi.Baker@thehartford.com>                    Mon, Nov 7, 2022 at 12:56 PM
To: Doug Hague <dhague@uncc.edu>

Dear Doug

As a supporter of the UNC Charlotte School of Data Science and its predecessor (the Data Science Initiative), we are very happy to see that the School is proposing to add a PhD to their degree options. We are supportive of this proposal as we see a large need for more doctoral level talent especially in fields like NLP, computer vision and graph learning.

Sincerely,

Aditi Baker

**ADITI BAKER, FCAS**
VP – Head of Data Science Enablement
Commercial Lines Data Science

The Hartford
Remote – New York

aditi.baker@thehartford.com

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Business Insurance
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# Letter of Support for UNC Charlotte PhD

# in Data Science

To:      Dr. Douglas Hague, Executive Director of the UNC Charlotte School of Data Science
From:    Madlen Ivanova
Subject: Support for PhD in Data Science
Date:    November 7, 2022

As a longtime supporter of the UNC Charlotte School of Data Science and its predecessor (the Data Science Initiative, we are very happy to see that the School is proposing to add a PhD to their degree options. We are supportive of this proposal as we see a large need for more doctoral level talent in our organization as well as in the larger industry.

Sincerely,

*Madlen*
*Ivanova*
_____

Madlen Ivanova

Principal data scientist at Lowe's Companies Inc.

October 28th, 2022

Dr. Douglas Hague
Executive Director and Professor of Practice
The University of North Carolina at Charlotte
School of Data Science
9201 University City Blvd.
Charlotte, NC 28223

Dear Dr. Douglas Hauge:

Please accept this letter of support for the proposed PhD degree program within the School of Data Science at The University of North Carolina at Charlotte. Premier, Inc. is a Charlotte based company representing over 4,400 U.S. hospitals and health systems and over 225,000 alternative provider organizations. To support the analytics needs of our member hospitals, Premier employs over 100 Data Scientists, Statisticians, Applied Researchers, and Data Analysts. Many of these positions require an advanced technical degree at the MS or PhD level. We are supportive of the PhD program being considered at UNC Charlotte and the educational and technical benefits that it would offer our employees in our pursuit of our mission to reduce cost and improve quality of the care in the U.S. Health System.
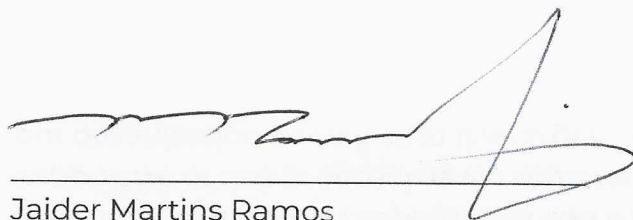
With best regards,

Michael Korvink, MA
Principal Data Scientist
ITS Data Science
Premier, Inc. (PINC)
13034 Ballantyne Corporate Place
Charlotte, NC, 28277
USA
michael_korvink@premierinc.com
Phone: (704) 771-4601

**To:** Dr. Douglas Hague, Executive Director of the UNC Charlotte School of Data Science

**From:** Jaider Martins Ramos

**Subject:** Support for PhD in Data Science

**Date:** November 2, 2022

As a supporter of the UNC Charlotte School of Data Science, we are very happy to see that the School is proposing to add a PhD to their degree options. We are supportive of this proposal as we see a large need for more doctoral level talent in our organization as well as in the larger industry.

Sincerely,

Jaider Martins Ramos
Managing Director for Americas
QINTESS