Master of Science with a major in Data Science
University of Delaware
Program Policy Statement
Approved May, 2023

A. Sample Elective Courses
B. Sample Courses of Study

Part I. Program History

A. Purpose

A campus-wide Data Science Working Group (DSWG) was formed in 2016 to foster data science research on the University of Delaware campus. The DSWG organized several meetings and events over the course of 2017, and produced a white paper in autumn 2017. Those events, in no small part, inspired this degree program. The examples presented in the events made it clear that successful data science programs involve collaboration across multiple disciplines: generally this means statistics, computer and information sciences, and mathematics together with domain or application areas.

Data science is one of the fastest growing sectors in the US. According to "The QUANT CRUNCH How the demand for data science skills is disrupting the job market", there were more than 2,350,000 job listings for Data Science and Analytics (CSA) in 2015; and the demand for DSA jobs is projected to grow by 15% over the following five years, which translates to additional 364,000 new job postings. From "Investing in America's data science and analytics talent: The case for action," a BHEF/PWC report (pwc.com/us/dsa-skills), there were 58,151 ads for data science and analytics jobs in the Philadelphia-Camden-Wilmington area in 2015 alone. In that year, there were a similar number in Seattle, and around 70,000 in each of the Boston, Dallas and Atlanta. In the larger metro areas of New York, Chicago, Los Angeles, San Francisco, and Washington DC combined to have postings of about 750,000 such positions. It may be that this is at the upper end for estimates for jobs, but there is little doubt that these staggering numbers of positions are difficult for organizations to fill.

According to the global management consulting firm McKinsey, data-driven technologies will bring an additional $300 billion of value to the U.S. health care sector alone, and by 2020, 1.5 million more "data-savvy managers" will be needed to capitalize on the potential of data, "big" and otherwise. (Manyika, J. et al., 2011, "Big data: The next frontier for innovation, competition, and productivity." McKinsey Global Institute, http://www.mckinsey.com).

The importance of data science was recognized in the "Final Report from the National Science Foundation Computer and Information Science and Engineering Advisory Committee Data Science Working Group" (https://www.nsf.gov/cise/ac-data-science-report). Their recommendations include the creation of data science centers; to support the design and development of data science pedagogy and curricula; and to invest in both national and institutional infrastructure to support emerging Data Science research and education programs.

The MS in Data Science is as a professional masters with a flexible set of core requirements in statistics, mathematics and computer and information sciences with a range of possible application areas. It provides a solid background in the methods behind data science so that

our graduates can go out into their fields and work well with data, and be better prepared for the next methods to come along to work with large and/or dynamic data sets.

The program will provide both the breadth of training, and the flexibility to apply them in different fields. The flexibility allows for training in different categories of positions in data science: data analysts (use mathematical, statistical and modeling techniques to solve problems), data engineers (design, build and maintain an organization's data and analytical infrastructure) and data scientists (create sophisticated analytical models to build new data sets and derive new insights from data).

Given the interdisciplinary nature of data science, the program exploits departmental and college cooperation. The main requirements of the program comprise courses from three departments (and colleges): the Department of Mathematical Sciences (DMS, in Arts and Science), the Department of Applied Economics and Statistics (AES, in Agriculture and Natural Resources) and the Department of Computer and Information Sciences (CIS, in Engineering). Two courses would be required from each department, with each having a small list from which to choose. The idea of this Master of Science in Data Science is to provide a foundation in these three areas, with electives in these areas or, where appropriate, electives from wide range of departments to give specific domain knowledge.

B. Current Status

The program began admitting students for Fall 2018, and is expected to be reviewed for permanent status in 2023. The degree program was initially housed in the Department of Mathematical Sciences, wherein physical files and administrative help were located. The program moved to the Graduate College beginning the Fall 2021 semester. Though this document governs the rules of the program, some current information such as events, elective courses offered, and so forth can be found on the program web page at www.msds.udel.edu.

C. Degree Offered

The degree awarded to those who complete this program will be a Master of Science with a major in Data Science (MSDS). The MSDS is awarded by the Graduate College. The degree is also offered in combination with a limited number of Bachelor degrees as a "4+1" program for students who are undergraduates at UD. In that case, the background subjects are covered in the undergraduate degree (either through required or elective courses), and six credits of the MSDS course work count toward the Bachelor degree as described below. There is also a separate dual degree program that combines the MSDS with the PhD program in either Mathematics or Applied Mathematics that is described elsewhere.

Part II. Admission

A. Admission Requirements

Applicants must submit all materials directly to the Graduate College using the online admission process before admission can be considered. Admission applications are available at: https://grad.udel.edu.

The program admission process is completed as follows: Completed applications consisting of the online application, undergraduate/graduate transcripts, three letters of recommendation, and the written statement of professional goals and values, are reviewed by the Executive Committee. A grade point average (GPA) of at least 3.00 is preferred. Applications are evaluated based on a combination of record of academic achievement, recommendations, and the applicant's statement of professional goals and values. The Admissions Committee will make admission decisions and assign accepted students to faculty advisors upon matriculation.

International applicants must submit official proof of English proficiency such as TOEFL or IELTS scores. The recommended minimum TOEFL score is 100 and/or IELTS of 6.5.

B. Educational Requirements for Admission

A Bachelor's degree from an accredited program is required for admission. A major in any of mathematics, applied mathematics, statistics, computer science or engineering, or a field of engineering is a good background for this program. The minimal educational requirements outside of the above STEM majors should include at least one semester of

- multivariable calculus equivalent to UD's MATH 243 or MATH 222,
- linear algebra equivalent to UD's MATH 349,
- statistics and/or probability equivalent to UD's MATH 350 or 450, or Math 205, or STAT 470 or STAT 471, and
- at least two semesters of computer programming (data structures equivalent to UD's CISC220 is desirable).

Additional recommended courses include

- ordinary differential equations (equivalent to UD's MATH 302 or MATH 351),
- a first numerical analysis or methods course (equivalent to UD's MATH 353 or MATH 426),
- an algorithms course (equivalent to UD's CISC 320),
- a logic and programming course (equivalent to UD's CISC 304),
- and both probability and statistics courses (equivalent to UD's MATH 350 and MATH 450, or STAT 470 and STAT 471).

The admissions committee makes a decision on the application for the MSDS degree. Since the program is interdisciplinary, the executive committee will consult with participating department(s) for advice on the application if needed. An advisor will be assigned to matriculated students, and the first semester courses shall be approved by the advisor and assistant director prior to the start of that semester.

Three letters of recommendation from individuals familiar with the candidate's academic and/or professional background and capabilities are required. Candidates must also submit a personal statement describing how their academic, professional and personal background has prepared them to be successful in the MSDS program, and explaining how the completion of the MSDS will contribute to their professional goals.

C. Admission requirements to the Combined 4+1 Bachelor and MSDS Degree

Students who wish to be admitted to the combined Bachelor/MSDS 4+1 program should submit an application during the junior year of academic study toward an undergraduate degree at the University of Delaware using the Graduate College on line admission application. Interested students should consult with an advisor from the MSDS program about the courses to be taken in order to complete the "Graduate Course Approval Form for 4+1 Admission Approval" that is to be submitted with the admission application. Applicants must submit the form with the on-line admission application when they select the Bachelor/MSDS 4+1 program. At a minimum, the applicant must have a cumulative GPA of 3.2 and a GPA of 3.4 in their undergraduate major. For the UD Bachelor degree, the applicant must have completed the educational requirements listed in Section II.B by the end of the fourth year of undergraduate study. Two letters of recommendation from University of Delaware faculty and academic transcripts must be submitted. The TOEFL exam is required for 4+1 program international student applicants as that was required when admitted to UD as an undergraduate student.

Applicants for the 4+1/MSDS degree program must complete the educational requirements during their undergraduate degree program and the completion of the undergraduate degree.

D. Application deadlines

The application deadline for Fall admission is March 1; the deadline for Spring admission is November 1. Earlier applications are encouraged because space may be limited.

E. Admission Status Categories

Students may be admitted into the program in one of two categories as follows.

1) Regular Admission: Regular status is offered to students who meet all of the established entrance requirements.

2) Conditional Admission: Applicants are admitted conditionally if all required official documents have not been received. These documents must be submitted to the Graduate College by the first day of classes. Fulfilling the conditions stated on an offer of conditional admission is critical. Failure to clear all stated conditions by the start of graduate coursework may result in revocation of admission to the graduate program.

F. University Statement

Admission to the MSDS graduate program is competitive. Those who meet the stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer appropriate strengths.

Part III. Academic Degree: Master of Science with a major in Data Science (MSDS)

A. Degree Requirements

A total of 33 credits is required for the degree. If the student lacks background knowledge for one or more courses, prerequisite courses may need to be taken that do not count toward the degree. Expected semester of course offering is given below (F = fall, S = spring, J = summer); these are subject to change.

1) Core Requirements: 18 credits (See explanation of how courses in the Core list may or may not be used toward elective requirements noted below):

At least six credits of core courses (2 courses) are required from the following list of courses in the area of PROBABILISTIC AND STATISTICAL FOUNDATIONS (each course is three credits):

- STAT611 Regression Analysis (F/S/J)
- STAT613 Applied Multivariate Methods (F)
- EDUC812 Regression and Structural Equation Modeling (S)
- EDUC874 Applied Multivariate Data Analysis (S)
- MATH630 Probability Theory and Applications (F)

At least three credits of core courses (1 course) are required from the following list of courses in the area of DATABASES AND DATA MINING FOUNDATIONS (each course is three credits):

- *CISC637 Database Systems (F/S)
- CISC683 Introduction to Data Mining (F)
- *STAT674 Applied Data Base Management (F/S/J)
- CPEG657 Search and Data Mining (S)
- EDUC875 Educational Data Mining (F)

At least three credits of core courses (1 course) are required from the following list of courses in the area of MACHINE LEARNING FOUNDATIONS (each course is three credits):

- CISC684 Introduction to Machine Learning (S)
- #ELEG815 Analytics I - Statistical Learning (F)
- #STAT617 Multivariate methods and Statistical Learning (F)
- #MATH637 Mathematical Techniques in Data Science (F/S)
- #SPPA 722 Machine Learning for Public Policy (S)
- #PHYS 661 Data Science for Physical Scientists (F, odd yrs)

At least three credits of core courses (1 course) are required from the following list of courses in the area of MATHEMATICAL AND COMPUTATIONAL FOUNDATIONS (each course is three credits):

- CISC 621 Algorithm Design and Analysis (F/S)
- **$**MATH 612 Computational Methods for Equation Solving and Function Min (F)
- **$**STAT 603 Statistical computing and optimization (convex optimization and algorithms) (S)

Three credits (1 course) is required from the following list of courses in the area of ETHICS:

- PHIL 655 Ethics in Data Science and Artificial Intelligence (F)

Explanations of how courses may be applied to the core requirements:
*****Only one of STAT 674 and CISC 637 may be taken for credit toward the degree.
Only two of these courses may be applied as required courses toward the degree.
$ Only one of MATH 612 and STAT 603 may be applied as required courses toward the degree.

2) <u>Electives</u>

Fifteen (15) credits of elective courses may come from a variety of courses on campus with relevant application or quantitative content. A list of example courses is given in Appendix A. The elective list is not meant to be exhaustive. The courses must be at the 600 level or above. A course from the core lists may be chosen as an elective provided that it has not already been used to satisfy the core course requirement. The electives taken by the student must be approved by the advisor and the Assistant Director of the MSDS prior to registration. The student's plan of study for the degree shall be approved, at the latest, by the advisor and by the Assistant Director prior to the beginning of the last semester.

3) <u>Non-thesis option</u>

33 credits of course work are required. Up to three credits of Special Problem (866) or Research (868) can be applied toward the credit total. These courses may come from departments on campus or from the MSDS program. These Special Problem or Research credits may come from experience on campus or in industry (e.g., internships). Special Problem or Research credits must be related to the degree and must be approved by the advisor and the executive committee. Valid scholarly output from such credits are presentations (oral or poster), papers, reports or similar that demonstrate related work in the field.

4) <u>Thesis option</u>

A minimum of six credits of 869 are required for the thesis option. The University requirements for master's theses shall apply to the thesis in this degree. The committee for the thesis shall include three members with at least one faculty member outside of the department of the advisor.

5) Bx/MSDS 4+1 program

The MSDS can be obtained in conjunction with a limited numbers of Bachelor degree programs as a 4+1 combination. Here the x in Bx can be A for Arts, S for Science or other letters for other degrees. At the time of writing, the Bachelor degrees available are as follows. Any of the Bachelor degrees from Mathematical Sciences(DMS) may be combined with the MSDS: BA in Mathematics or Mathematics Education; BS in Actuarial Sciences, Applied Mathematics, Mathematics and Economics, Mathematics Education, or Quantitative Biology; or honors versions of any of them, HBx. Similarly, any of the Bachelor degrees from CIS, Electrical and Computer Engineering (ECE), Mechanical Engineering (ME), or Physics and Astronomy (DPA) are available for combining with the MSDS as a 4+1 program. From CIS, these are: Computer Science (BA, BS); Information Systems (BS); and honors versions (HBx). From ECE, these are: Computer Engineering (BCpE); Electrical Engineering (BEE); and honors versions (HBx). From ME, these are: Bachelor of Mechanical Engineering (BME), and the honors version (HBME). From DPA, these are: BS, BA, HBS, HBA options in each of Physics or Astronomy, as well as BA and HBA in Physics Education. Up to six credits from the graduate course work may be applied to the Bachelor degree that come from the area of the undergraduate major. For example, mathematics courses may be applied to a major from DMS, computer science courses can be applied to a major from CIS, and electrical engineering courses may be applied to a major from ECE.

Students who wish to be admitted to the Bx/MSDS 4+1 program should submit an application during the junior year of academic study toward an undergraduate degree at the University of Delaware as described in section II.C.

6) Advisor and Program of Study

An advisor will be assigned prior to the start of the first semester of study for the MSDS. The first semester courses shall be approved by the advisor prior to the start of that semester. The student and the advisor will develop a program of study; the program of study submitted to the Assistant Directorfor approval prior to the end of the first semester of courses. For students accepted into the 4+1 program, an advisor for the MSDS will be assigned prior to the end of the second semester of the junior year of undergraduate study, and a program of study for the MSDS shall be approved before the end of that semester.

7) Changes to the Program of Study

Students may need to alter approved programs of study due to scheduling conflicts or the creation of new courses directly related to the student's goals. Students who wish to make minor changes to their program of study must obtain permission from their advisor. Major changes to the program of study, such as the substitution of one or more core courses, must be approved by the Program Director. All changes in a previously approved program of study must be approved by the Program Director.

8) Transfer credits

Up to six credits of approved courses completed at other universities may be transferred toward the degree, provided that the credits have not been applied to obtain a different degree. The transfer must be approved by the Executive committee, and if necessary, in consultation with the department that offers the (potentially) equivalent course.

9) Awarding the degree

The MS degree is awarded by the Dean of the Graduate College. The executive committee shall approve the program of study for the MSDS on the student's Application for Advanced Degree (available online).

B. Timetable and satisfactory progress toward the degree

1) Academic load and satisfactory progress

The MSDS program will follow the University of Delaware, Graduate College policy for determining students' failure to make satisfactory progress towards degree requirements and time limits for completion. Students may be enrolled on a full-time (9 credits per term) or part-time (fewer than 9 credits per term) basis.

2) Grade and GPA requirements

Students must pass all of the core courses with a minimum grade of B or better, and a grade point average (GPA) of 3.25 or better in the six core courses, to continue in the program. The student may repeat a core course in order to earn an acceptable grade for the degree. All graduate-numbered courses taken with graduate student classification at the University of Delaware are applied to the cumulative GPA. Credit hours and courses for which the grade is below B- do not count toward the degree even though the grade is applied to the overall GPA. Elective courses may not be repeated to apply to the degree.

3) Grievance procedures

Students concerned that they have received an unfair evaluation or have been graded inappropriately may file grievances in accordance with the student guide to University of Delaware policies. Students are encouraged to contact the program director prior to filing a grievance.

Part IV. Educational Goals and Assessment Plan

A. Educational Goals

1) Philosophy of the degree

The MS in Data Science at the University of Delaware aims to educate leaders in understanding and applying modern methods of data science to analyze problems of current interest in

industry, government and academia. We aim to give the student a solid background in selected areas and the freedom to select relevant domain area courses. The domain areas may come from all over campus, from technical fields of engineering, to social science and public policy, to the health sciences. The program is designed for flexibility. The following learning objectives aim to achieve these goals.

2) Educational Goals

1. Demonstrate a mastery of foundational knowledge in data science through the successful completion of a diverse range of coursework encompassing multiple areas of domain *and* technical expertise.
2. Develop and apply data science techniques in one or more domain areas of interest via course projects, examinations, and/or a master's thesis.
3. Communicate data science techniques and findings to expert and non-expert audiences in written, discussion, visual, and oral presentation formats.
4. Demonstrate a deep understanding of ethics in data science and related technical tools through in-depth discussion and study of current ethical issues in the field.
5. Gain experiential training—via on-campus projects or external internships—in workflow management, technical collaboration, and professional accountability in preparation for the expectations of the workplace.

B. Program Assessment

The program will follow the Academic Program Review (APR) schedule, policies and procedures, established by the Provost's office and Faculty Senate. Data will be provided by the Office of Institutional Research and Effectiveness, in conjunction with faculty/student interviews, measures of scholarly productivity and alumni. Meetings will be held at least semi-annually to discuss curricular changes, review data, identify actions to strengthen the program, and establish timelines and assignments for responsibilities. The program will continue consultation with the Center for Teaching and Assessment of Learning to periodically assess learning outcomes, assessment criteria, and benchmarks for success.

C. Student Progress

Assessment plan for students in the M.S. in Data Science				
Objectives	**Strategic Activities**	**Measures**	**Short-term Outcomes**	**Long-term Impact**
1. Train students in a mix of statistics, math and computer science	Recruit excellent applicants and matriculate students with strong credentials	Number and demographic data of student applicants and matriculated students.	Retention and time to degree statistics	Students gain employment in data-science related fields, in domain area jobs (e.g., energy, commerce, etc), or go on to more graduate school
	Course work covering the disciplines of probability, mathematics, statistics and computer programming and algorithms	Faculty evaluation of student progress in course work Surveys of graduate students in the program and post-graduation	Students are prepared for subsequent coursework that requires theoretical and practical knowledge	Graduates enjoy long term success in government, industrial, commercial or academic careers.
2. Provide training in data science techniques	Course work in regression, statistics, multivariate analysis, logistic regression, data management, machine learning, optimization, algorithms, data mining and other approved courses including electives from domain areas	Surveys of students focusing on their experiences in these classes Surveys of graduates to determine the utility of these classes to their career Faculty evaluation of student progress in course work	Course work for the M.S. in Data Science degree helped students secure initial employment Students and graduates report applying knowledge from courses to work settings	Graduates enjoy long term success in data science and domain area careers
3. Provide experiential training in projects or internships to prepare students for the	Case study approach in courses with real data and required analysis Research or Special Problem courses using projects from	Quality of the case study results in the courses. Faculty evaluation of quality and scope of the research project.	Case studies, Research and Special Problem courses force the student to apply the material in the class to real data.	Graduates enjoy long term success in their careers

expectations of the workplace	academic and non-academic sources A thesis option, when chosen, requires synthesis of the knowledge and methods studied.	Surveys of graduates to determine the utility of their course experience to their career	A thesis, is that option is chosen, forces the student to master an area of use to the field, and develops strong writing skills.	

Part V. Financial Aid

This is a professional master's program. There is no financial aid offered by the program for stipends or tuition.

Part VI. Appendices

A. Elective Courses

The design of this degree is flexible. Courses appropriate from the main departments, as well as a few others, are listed below as a sample. The list is not meant to be exhaustive. The electives taken by the student must be approved by the advisor and the Executive Committee of MSDS.

The list includes course number, title and in parentheses, typical semesters in which the course is offered (F=Fall, S=Spring, J=Summer). The typical semester of offering is subject to change.

1. Courses from the Department of Mathematical Sciences may come from the list of core courses, or from the following:
    - MATH 611 Introduction to Numerical Discretization (S)
    - MATH 620 Introduction to Mathematical Finance (S)
    - MATH 631 Introduction to Stochastic Processes (S)
2. Courses from the Department of Computer and Information Sciences may come from the list of core courses, or from the following:
    - CISC 612 Software Design (S)
    - CISC 636 Computational Biology and Bioinformatics (F/S)
    - CISC 642 Introduction to Computer Vision (F)
    - CISC 665 Introduction to Cybersecurity (S)(also CPEG 665, ELEG 665, MISY 665)
    - CISC 681 Artificial Intelligence (F/S)
    - CISC 841 Algorithms in Bioinformatics
    - CISC 689 Topics in Artificial Intelligence
    - CISC 882 Natural Language Processing (F)
    - CISC 889 Advanced Topics in Artificial Intelligence

3. Courses from the Department of Applied Economics and Statistics may come from the list of core courses, or from the following:
    - STAT 602 Mathematical Statistics (S)
    - STAT 612 Advanced Regression Techniques (S)
    - STAT 619 Time Series Analysis (S)
    - STAT 622 Statistical Network Theory (F)
    - STAT 656 Biostatistics (S)
    - STAT 675 Logistic Regression (S/F)
4. Courses from the Department of Electrical and Computer Engineering may come from the list of core courses, or from the following:
    - ELEG 630 Information Theory (S)
    - ELEG 667 Machine Learning Systems (F)
    - ELEG 817 Large Scale Machine Learning (F)
    - ELEG 845 Modern Machine Learning (S)
5. Courses from the Center for Bioinformatics and Computational Biology may come from the following:
    - BINF 644 Bioinformatics (F)
    - BINF 694 Systems Biology I (F/S)
    - BINF 695 Computational Systems Biology (F)
6. Courses from the School of Public Policy and Administration may come from the following:
    - SPPA 667 Principles of Urban Science (F, even yrs)
    - SPPA 689 Information Technology and Management of Public and Nonprofit Organizations (S)
    - SPPA 701 Public Policy (F/S)
    - SPPA 721 Data Science Tools for Evidence Based Policy (F, odd yrs)
7. Courses from the Department of Geography and Spatial Sciences may come from the following:
    - GEOG 670 Geographic Information Systems and Science (F)
    - GEOG 671 Advanced Geographic Information Systems (S)
    - GEOG 673 Select Technical Topics: GIS (F/S)
    - GEOG 681 Remote Sensing of Environment (F)
8. Courses from the College of Education and Human Development may come from the following:
    - EDUC 862 Randomized Field Trials in Education
    - EDUC 865 Educational Measurement Theory
    - EDUC 871 Advanced Structural Equation Modeling
    - EDUC 872 Advanced Educational Measurement
    - EDUC 873 Multilevel Modeling in Education (F)
9. Courses from the Department of Physics and Astronomy may come from the following:
    - PHYS 607 Mathematical and Computer Algebra Methods in Physics (F)
    - PHYS 616 Statistical Physics and Thermodynamics (F)
    - PHYS 660 Computational Physics (S)

- PHYS 664 Machine Learning for Time Series Analysis (S, even yrs)
- PHYS 667 Computer Vision for Physical Sciences (F, even yrs)

10. Courses from the Department of Mechanical Engineering may come from the following:
    - MEEG 621 Linear Systems (F)
    - MEEG 677 Introduction to State Estimation (S)
    - MEEG 877 Sensing and Estimation in Robotics (F)
    - MEEG 890 Nonlinear Programming (F)
11. Courses from the Department of Civil and Environmental Engineering may from the following:
    - CIEG 642 Advanced Data Analysis (W)
    - CIEG 652 Transportation Facilities Design (F)
    - CIEG 654 Urban Transportation Planning (F)
    - CIEG 655 Civil Infrastructure Systems (F)
12. Courses from the Department of Economics in Lerner College may come from the following:
    - ECON 803 Applied Econometrics I (F)
13. Courses from additional departments are likely to be added as they are requested by students or departments, and subsequently approved by the executive committee.

B. Sample courses of study

Some sample courses of study appear below. Some advanced classes may not be offered every year.

Sample Courses for Statistics Interests:

Fall 1	Spring 1	Summer 1	Fall 2
CISC621	MATH637	Project or	MATH612
STAT611	STAT674	Industry	CISC683
STAT613	STAT675 or STAT612	Experience (3 cr)	STAT675 or STAT622
PHIL655			

Sample Courses for Computer Science Interests (biomedical data analysis):

Fall 1	Spring 1	Fall 2	Spring 2
CISC621	CISC684	CISC637	CISC841
STAT601	STAT613	MATH630	CISC844

CISC683	MATH637	CISC636	CISC879
PHIL655			

Sample Courses for Big-data-applications Interests:

Fall 1	Spring 1	Fall 2
CISC621	CISC684	CISC683
MATH612	CISC637	STAT613
ELEG815	STAT611	CISC882
PHIL655		ELEG817

Sample Courses for Computer Science Interests (focus on text analytics):

Fall 1	Spring 1	Fall 2	Spring 2
CISC621	MATH637	CISC683	CISC684
PHIL655	CISC681	CISC882	CISC887
STAT611	STAT613	CISC642	Optional: CISC844
CISC637			

Sample Courses for Mathematics Interests:

Fall 1	Spring 1	Summer 1	Fall 2
CISC621	CISC637	Project or	MATH630
MATH612	MATH637	industry	STAT613
STAT611	STAT619	Experience (3 cr)	MATH620
PHIL655			CISC 684

Sample Courses for Various Domains :

Possibilities for applications tracks could include: Public Policy and Administration; the physical or life sciences; Education; Political Science; Engineering; and others.

Fall 1	Spring 1	Summer 1	Fall 2
CISC621	STAT675	Project or	CISC637
MATH612	MATH637	industry	UAPP668
STAT611	STAT613	experience (3 cr)	UAPP689 or CISC684

PHIL655			

Fall 1	Spring 1	Summer 1	Fall 2
CISC621	CISC637	Project or	CIEG652
MATH612	MATH637	industry	CIEG654
STAT611	STAT613	Experience (3 cr)	CIEG655
PHIL655			CISC684

Sample Courses for Education Interests:

Fall 1	Spring 1	Summer 1	Fall 2
EDUC875	EDUC812	Project or	EDUC 873
STAT613	CISC684	industry	EDUC 865
CISC621	STAT674	experience (3 cr)	SPPA 721
PHIL655			

Sample Courses for Geospatial Interests:

Fall 1	Spring 1	Summer 1	Fall 2
PHIL655	ELEG604	STAT674	CISC621
STAT611	GEOG671		PHYS661
GEOG670	STAT613		CISC642 or PHYS667 or SPPA721
	GEOG681		

Sample Courses for Social Science interests:

Fall 1	**Spring 1**	**Summer 1**	**Fall 2**
PHIL655	SPPA722	Project or	CISC621
EDUC875	STAT611	Industry	SPPA701
SPPA721 or SPPA667	EDUC812	Experience (3 credit)	EDUC862
	CISC665		

Sample course of study for Electrical and Computer Engineering interests (focus on machine learning):

Fall 1	**Spring 1**	**Summer 1**	**Fall 2**
MATH630	CPEG657	Project or	MATH612
ELEG6667	ELEG630	industry	ELEG817
ELEG815	ELEG845	experience (3 cr)	
STAT611			PHIL655

Sample courses for 4+1 Students:

Two courses may be applied to both the undergraduate degree and the MSDS. Two of them must be taken in the 4th year of undergraduate study; suppose those two are CISC 621 and MATH 637. It is very useful to take a third course prior to the +1 year; suppose this course is STAT 611. The following table applies for one year of subsequent graduate study for the non-thesis option.

Fall 1	**Spring 1**
CISC637	STAT613
MATH612	CISC849
PHIL655	STAT611
CISC683	CISC684