


COVER SHEET


INDIVIDUAL AREA MAJOR PROPOSAL


DATE: 4/5/16

TITLE OF PROPOSED MAJOR: Data Science

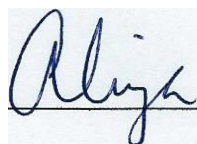
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4/04/2016

# Data Science Area Major Proposal

– 4/5/16

## *Introduction*

Throughout my life, I've been able to pinpoint two prominent academic interests: sports and mathematical analysis (one, if you consider the fact that I didn't know sports qualified as an academic interest until I discovered Rice's Department of Sport Management). For this reason, my professional interests are perfectly defined by the emerging field of Sport Analytics. All forms of quantitative data analysis used to draw conclusions about unanswered questions in sports – the creation of advanced statistics to better analyze a player's value, the use of tracking devices to measure players' movement

and energy exertion, even models created to attempt to predict the results of tournaments such as the NCAA Men's Basketball tournament – fit into the Sport Analytics category.

When I got to Rice, I sought to tailor my academic curriculum to my professional interests. Sport Management was self-explanatory; I was completely convinced by the program's ability to place students in rewarding, relevant internships as well as the business-like component of the major. However, I decided I'd want a second major to complement my Sport Management degree and help develop the analytic skillset I'd need down the road, and the choice also seemed like an easy one. Daryl Morey, General Manager of the Houston Rockets, majored in Computer Science as an undergraduate at Northwestern. Monte McNair, Vice President of Basketball Operations with the Rockets, was a Computer Science major at Princeton. Devin Pleuler, Manager of Analytics for Toronto FC, graduated with a Computer Science degree from Wentworth Institute of Technology. I decided to major in it as well.

However, beginning early in the Fall semester of my sophomore year, I began to realize that Computer Science would not satisfy my academic interests. There were Computer Science classes I knew I'd have to take that concerned topics I wasn't interested in (like COMP 412, Compiler Construction) or didn't seem to directly correlate with my intended professional responsibilities (like COMP 421, Operating Systems and Concurrent Programming), coupled with the fact that I'd have to take these classes at the expense of several courses that seemed much more relevant and useful to my expected academic experiences. I struggled with the idea of finishing the major and began exploring other possibilities for the first time since first declaring it.

It wasn't until early in the Spring 2016 semester that a close friend of mine, Justin Onwenu, announced that his Area Major proposal had been approved; I had not heard of the process until then, but immediately I was intrigued. I had the interest in Statistics as well during my time at Rice and was intending on minoring in it, but the idea of creating an Area Major that perfectly spanned Computer Science and Statistics quickly became ideal. I did some research and it didn't take long to determine exactly what I'd be pursuing: a Data Science Area Major.

### ***Current Situation – Why It's Necessary***

I aspire to be an NBA General Manager, and I've aspired to since I was in high school. I want to be the person in command of an NBA team's personnel; player trades, signings, draft selections, contract negotiations, and staffing. I came to Rice knowing I wanted to work in NBA Basketball Operations, and in the nearly two years since I first stepped foot on campus as a student, nothing has changed; in fact, my desire to be one of 30 NBA personnel decision-makers has only increased.

Although confident in my work ethic and passion, I am privileged enough to be in a position to realize that desire is not enough. My current role as Basketball Operations Intern with the Houston Rockets has shown me that skills are necessary in order to make a valuable impact in an NBA front office – true analytical skills.

I want to continue the analytics revolution currently taking the league and entire sport industry by storm. I want to be able to develop algorithms and models to predict the success of a team, player, or basketball strategy. I want to be able to design and implement database systems to harbor player and team information. I want to expand my ability to think critically, analytically, and most importantly creatively; the skill of developing self-inspired ideas, especially in a competitive, million-dollar industry like Sport Analytics, is absolutely essential.

The more and more I have learned about detailed responsibilities of high-ranking members of NBA Front Offices through the incredible opportunity of interning in the Houston Rockets Basketball Operations Department, the more and more I have desired to tailor my academic curriculum to prepare me directly for these responsibilities I hope to one day assume.

As a result, my objectives for the Data Science Area Major are as follows:

1. Generally. Create a valuable, all-encompassing academic curriculum that develops the analysis, database proficiency, and critical thinking skills necessary to successfully evaluate ALL forms of data in ALL fields.
2. Personally. Supplement my Sport Management degree optimize my undergraduate experience to develop abilities I have learned to be essential to my intended professional responsibilities: statistical analysis, programming expertise, and operations research.
3. Impactfully. Provide a potential catalyst for Rice's development of a world-class Data Science program, by bridging Mathematics, Computer Science, and Statistics while maintaining flexibility for specialization in several different avenues of Data Science (Sport Analytics, in my case).

I traveled to Boston, Massachusetts earlier this year for the MIT Sloan Sports Analytics Conference on March 11<sup>th</sup> and 12<sup>th</sup>, 2016. Attending the conference, co-founded in 2007 by Daryl Morey and Jessica Gelman, had been a goal of mine since I was in high school and was my first opportunity to experience the world of Sport Analytics first-hand. Because of the secretive, competitive nature of the industry, many panels were vague and general; however, through private conversations with industry professionals and a few panels where practical uses of Data Science and analytics in sports were showcased, my interest in Data Science as a supplement to Sport Analytics was cemented. My intentions to pursue this proposal, self-define my academic curriculum, and carve my own path were affirmed when, during a question and answer session, Morey said, "Everyone always asks me what path they need to take to [be an NBA General Manager], and I always tell them, 'That's not a useful question. They're all different. You have to assess your situations, passions, and skillsets, and differentiate yourself in your own way.'" I have taken his quote to heart in the pursuit of my Data Science Area Major.

### ***Helpful Individuals***

In a process like proposing an Area Major, advice and input from individuals experienced and knowledgeable about all aspects of the intended output are invaluable. Thankfully, I have been exposed to many of these immeasurably helpful individuals:

- Dr. Susan McIntosh, Chair of Rice University's Committee on Undergraduate Curriculum
  - Dr. McIntosh was appreciative of my intent to create an Area Major and recognized my knowledge of the rigorous nature of the proposal process. She gave very helpful suggestions of things to include in the proposal and what arguments to make for best chance of approval, and referred me to a few relevant professors and websites.
- Monte McNair, Vice President of Basketball Operations, and Fan-Hal Koung, Basketball Operations Analyst, for the Houston Rockets
  - Monte and Fan-Hal are Computer Science graduates from Princeton and Stanford, respectively. I consulted both of them about the Computer Science courses offered at Rice that would be most relevant to their everyday work, which is centered around databases and analytical evaluation procedures – exactly what I want to do. Their feedback and recommendations were invaluable in using Computer Science courses to structure my curriculum.
- Travis Stockbridge, Basketball Operations Scout for the Houston Rockets
  - Travis graduated from Rice in December 2015 with degrees in Sport Management and Statistics. He has worked in Basketball Operations with the Rockets since the Spring Semester of 2013 and is familiar with practical skills and techniques used by everyone in the department. I consulted Travis about the Statistics courses he took in his time here that he finds to be most useful for the forms of data analysis used in NBA Basketball Operations, and many of the Statistics classes included in my proposal were highly recommended by Travis.
- Dr. Rudy Guerra, Professor of Statistics at Rice University
  - Dr. Guerra is the undergraduate advisor in the Statistics Department. He not only pointed me in the right direction and provided several alternative options in case the Data Science Area Major is not approved, agreed to review my proposal and aid in the creation of the curriculum. He also provided extremely helpful insights into the state of Data Science talks at Rice and a few suggestions to enhance my chances of approval.
- Dr. Andrew Schaefer, Professor of Computational and Applied Mathematics at Rice University
  - Dr. Schaefer was very excited by the idea of including his Operations Research course in the Data Science Area Major curriculum. He agreed to review the proposal, pass the idea onto his colleagues, and advise on the process as a whole. His recommendations were vital in the inclusion of the CAAM courses in my proposal.
- Dr. James Disch, Associate Professor in Department of Sport Management at Rice University
  - Dr. Disch approved the inclusion of SMGT 490 as my Capstone Experience in the Data Science curriculum and believes the proposal itself is a valuable route to take in order to best prepare myself to pursue my professional interests.
- Aliya Bhimani, Director of Academic Advising at Rice University's Office of Academic Advising
  - Aliya was instrumental in recommending next steps and guiding me through the nuts and bolts of an Area Major proposal. She reviewed the curriculum and compared it favorably to previous Area Majors in terms of selection and number of required courses, and thankfully informed me that an Area Major "cannot be used to form a double major;" thus I have sculpted Data Science to be dichotomous with Sport Management.

### ***Curriculum – 68-74 Credit Hours***

- \* Denotes a course for which credit has already been received before Fall 2016
- ^ Denotes a course to be taken in Fall 2016
- ~ Denotes a course included in my Four Year Plan
- All classes in the Data Science Area Major curriculum do NOT contribute to my Sport Management Degree – with the exception of a few that could count for electives, but I already have my Sport Management electives taken care of by my Business minor.

#### [CORE] Prerequisites – 26 Credit Hours

These prerequisites establish essential skills necessary to succeed in the core courses of the curriculum:

1. Single-Variable Calculus
2. Critical Thinking
3. Programming Proficiency
4. Basic understanding of Computer Engineering and Computer Systems

Course Identifier	Course Name	Prerequisites	Credit Hours	Notes
MATH 101*	Single Variable Calculus I	None	3	May substitute MATH 111/112 or take after MATH 111
MATH 102*	Single Variable Calculus II	None	3	
ELEC 220*	Fundamentals of Computer Engineering	None	4	
COMP 140*	Computational Thinking	None	4	May substitute COMP 130 or COMP 160
COMP 182*	Algorithmic Thinking	COMP 130 or COMP 140 or COMP 160	4	
COMP 215*	Introduction to Program Design	COMP 182	4	
COMP 321*	Introduction to Computer Systems	ELEC 220 and COMP 215	4	

[CORE & BREADTH] Core Courses – 29 Credit Hours

These core courses to the curriculum introduce the principal methods of Data Science in the scope of four different fields:

1. Mathematics – Analysis of differential equations, linear algebra, and/or multivariable calculus
2. Computer Science – Introductory techniques of Data Science and exposure to database systems
3. Statistics – Probability, Regression, Data Mining, Statistical Learning, and Statistical Computing
4. Computational and Applied Mathematics – Operations Research and Optimization

Course Identifier	Course Name	Prerequisites	Credit Hours	Notes
MATH 211*	Ordinary Differential Equations and Linear Algebra	None	3	May substitute MATH 212
MATH 355*	Linear Algebra	None	3	May substitute MATH 354 or CAAM 335
COMP 330^	Tools and Models for Data Science	(MATH 211 OR MATH 221) and COMP 215	3	
COMP 430~	Introduction to Database Systems	COMP 182 and COMP 215	4	
STAT 310*	Probability and Statistics	MATH 102	3	Cross-Listed with ECON 307; May substitute STAT 312
STAT 405^	Statistical Computing and Graphics	STAT 305 or STAT 312 or STAT 310 or ECON 307 or ECON 382 or STAT 385*	3	
STAT 410^	Linear Regression	STAT 310 or STAT 312 or ECON 307 or ECON 382	4	
STAT 444~	Data Mining and Statistical Learning	STAT 410 and (CAAM 210 or COMP 140 or STAT 405) or STAT 411	3	
CAAM 378~	Intro to Operations Research and Optimization	None	3	

[DEPTH] Advanced Technical Electives (Choose 3, At Least 2 Departments) – 9-12 Credit Hours

The Advanced Technical Electives are designed to further introduce Data Science methods and projects through courses in Computer Science, Statistics, and Computational and Applied Mathematics – topics and techniques covered may include Object-Oriented Programming, Machine Learning, Statistical Optimization, and different forms of Data Analysis. **All classes cannot be taken from one department.**

Course Identifier	Course Name	Prerequisites	Credit Hours
COMP 310	Advanced Object-Oriented Programming and Design	COMP 215	4
COMP 314	Applied Algorithms and Data Structures	COMP 182 and COMP 215	4
COMP 440	Artificial Intelligence	COMP 310 and (STAT 310 or ECON 307 or ECON 382 or STAT 312 or STAT 331 or ELEC 331 or ELEC 303) and (MATH 354 or MATH 355 or CAAM 335)	4
COMP 441	Large-Scale Machine Learning	COMP 440 or ELEC 440	3
COMP 540~	Statistical Machine Learning	(STAT 331 or STAT 310) and (MATH 355 or CAAM 335)	4
STAT 411~	Advanced Statistical Methods	(STAT 310 or STAT 312 or ECON 307 or ECON 382) and STAT 410	3
STAT 422~	Bayesian Data Analysis	STAT 410	3
STAT 541	Multivariate Analysis	STAT 410 or STAT 615	3
CAAM 440	Applied Matrix Analysis	None	3

[BREADTH] Advanced Theoretical Elective (Choose 1) – 3 Credit Hours

An Advanced Theoretical Elective is essential in developing further critical thinking capabilities by solidifying a further understanding of discrete mathematics, algorithms, automata and formal languages, probability, advanced statistical techniques, or linear programming – all based on preference.

Course Identifier	Course Name	Prerequisites	Credit Hours
COMP 382	Reasoning About Algorithms	COMP 182	3
COMP 481	Automata, Formal Languages, and Computability	None	3
STAT 418	Probability	None	3
STAT 419	Statistical Inference	(MATH 354 or MATH 355 or CAAM 335) and STAT 418	3
CAAM 471~	Linear and Integer Programming	None	3

[DEPTH] Specialization Capstones/Seminars (Choose 1) – 1-4 Credit Hours

The purpose of these courses is to provide the student an opportunity to apply the skills accumulated through the traversal of the Data Science major to a practical issue, preferably in their field of study of interest. For all of these courses, the student is to coordinate a Data Science-related problem with the course professor or department advisor.

Course Identifier	Course Name	Prerequisites	Credit Hours	Notes
COMP 490	Computer Science Projects	None	1-4	
STAT 450	Senior Capstone Project	None	1-3	
CAAM 498	Research Themes in the Mathematical Sciences	None	1-3	Cross-Listed: MATH 498 and STAT 498
SMGT 490~	Seminar in Sports Analytics	SMGT 430 and COMP 140 and STAT 385 and STAT 405	3	



### ***Peer Institutions' Data Science Programs (Curriculums Attached to End of Proposal)***

Data Science is an emerging field of study and work in our society today, and its impact and potential value are massive. The New York Times substantiated the field's potential, saying, "This hot new field promises to revolutionize industries from business to government, health care to academia." An October 2012 Harvard Business Review article claims the 'Data Scientist' to be the "Sexiest Job of the 21<sup>st</sup> Century." In fact, in an article published on February 25 of this year, it was revealed that Data Scientist had the best overall score in Glassdoor's most recent employment analysis ("...allows employees to anonymously rate their jobs and their employers, awarding scores for how well they are paid, treated, and helped to advance in their careers.").

As a result, institutions around the country and world are rapidly creating their own Data Science programs in efforts to breed the next crop of forward-thinkers and difference-makers. The levels of the programs range from Bachelors to Doctorate with Certificates and Masters in between, and the names of the programs can sound something like "Computational and Data Sciences" or "Big Data Analytics," but the essences of these programs are all very similar: equip students with the ability to code, think critically, and statistically analyze all forms of data. *The full list of Data Science programs can be found at the link provided in the Appendix.* I decided to model my curriculum after a set of similar programs at the following peer universities: California Polytechnic State University, the University of Michigan, Ohio State University, and Drake University. It is worth noting that each of these institutions have both a Computer Science and Statistics undergraduate major in addition to their Data Science (or similarly named) program except Ohio State and Drake; Ohio State offers a Computer Science major and Statistics minor, while Drake only offers a Computer Science major.

Each of the following analyses of these peer institutions' programs includes a short description of the program from its website, as well as a few notable characteristics of the program that relate to my Data Science Area Major.

#### California Polytechnic State University: Cross Disciplinary Studies Minor in Data Science

"Through an inter-college collaboration, the Computer Science and Statistics departments offer a cross-disciplinary minor in Data Science -- a rapidly evolving discipline that uses elements of statistics and computer science to gather, organize, summarize, and communicate information from a variety of data sources and data types. Job opportunities for data scientists are growing as the availability of data becomes ever abundant via the internet, consumer transactions, sensor arrays, medical records, embedded biometrics, bioinformatics, etc.

The CDSM provides an opportunity for both statistics and computer science students to complement their major training with foundational skills for data science. Statistics majors will acquire essential programming, database, distributed computing, and data mining skills from the Computer Science Department while computer science majors will acquire essential probability, regression modelling, statistical programming, and multivariate analysis skills from the Statistics Department."

- Although limited to an undergraduate minor, it is both rigorous (80 credit units) and balanced in its inclusion of Mathematics, Computer Science, and Statistics courses.
- There is a separate Data Science (DATA) Department at the university that contributes two classes and Capstones to the minor, but the Data Science material is mirrored by COMP 330, COMP 540, and STAT 444.

- Mathematics courses are required up to the level of Linear Algebra.
- Computer Science courses reach Distributed Computing and Knowledge Discovery, which are similar to topics covered in Rice courses: cloud computing and data mining, respectively.
- Statistics courses reach probability, regression, and computational applications.
- The minor allows for two Technical Electives in Computer Science, Statistics, or Data Science.

#### University of Michigan, Ann Arbor: Undergraduate Program in Data Science

“The program draws on our expertise in Computer Science, Statistics, and Mathematics, complementing them with exposure to application domains to provide a multidisciplinary degree to develop future generations of data scientists. To provide exposure to application domains and to broader issues in data science, the data science program will include technical electives from LSA, Engineering, School of Information, and other U-M schools and colleges.

The undergraduate program in Data Science will provide sufficient background in mathematics (linear algebra and advanced calculus) and build a strong foundation in data science, covering data structures, algorithms, database management, and machine learning (courses in Computer Science) and data collection, data mining, modeling, and inference (Statistics). The Data Science program is designed to produce students with a deeper and broad intellectual understanding of both statistical and computing principles when working with big data, with those principles being applicable to a variety of domains.”

- Michigan’s Data Science program is a robust undergraduate major that closely resembles my Area Major curriculum. Unlike Cal Poly, the major is entirely interdisciplinary; all core courses are drawn from Computer Science (EECS), Mathematics, and Statistics departments.
- Prerequisites to the major’s core requirements are Calculus, Linear Algebra, and Introductory Programming.
- There is a Computing and Discrete Mathematics requirement, mirrored by Rice’s COMP 182.
- The last two core requirement categories are Machine Learning/Data Mining and Database requirements.
- The major requires Advanced Technical Electives in Data Science (in fields more specific than the Data Analysis courses offered at Rice such as Bioinformatics and Biostatistics but also including Computer Science and Statistics) and a Capstone Experience.

#### The Ohio State University, Columbus: Undergraduate Data Analytics Major

“Data analytics applies fundamental scientific principles to the analysis of large, complex data sets. This rapidly growing field needs practitioners with expertise that cuts across core disciplines of computer science, mathematics and statistics, AND highly developed critical thinking, problem-solving and communication skills.

Data analytics is a uniquely interdisciplinary major with academic partnerships rarely found in other majors. Data analytics majors receive a Bachelor of Science (BS) degree from the College of Arts and Sciences through curricular partnerships with the College of Engineering, the College of Medicine and the Fisher College of Business.

The major is jointly administered by the Department of Computer Science and Engineering and the Department of Statistics.”

- Ohio State's Data Analytics major is very similar to my Data Science Area Major curriculum. The major is jointly administered by Computer Science and Statistics, has prerequisites to its core courses, does not have its own independent Data Science department, and draws classes from Mathematics, Computer Science, and Statistics.
- Mathematics core requirements reach Linear Algebra.
- Computer Science core requirements include Computer Systems introduction (mirrored by COMP 321 at Rice), Database introduction, advanced Database Management Systems, and Data Mining.
- Statistics requirements include modeling, Bayesian Analysis (STAT 422), and Statistical Learning (STAT 444).
- The major offers 3 specializations: Biomedical Informatics, Business Analytics, and Computational Analytics. My Data Science Area Major does not include these exact specializations, but attempts to allow students to apply their skills to fields of interest through several degrees of freedom in a Capstone Experience.

#### Drake University: Data Analytics Major

"Drake's Data Analytics program will prepare students to be stewards of how we, as a global community, use data in newer and richer ways.

Students will gain skills as they navigate the program and beyond, building strengths in communication, ethics, algorithmic analysis of data, identification of data quality, manipulation, and application of statistical models for analyzing data in order to identify trends and relationships, make predictions, and support data-driven decision making.

In line with Drake's mission, the major is structured with an interdisciplinary core curriculum that emphasizes both the liberal arts and professional skills development. Students in the major will gain exposure to ethical concerns in the discipline, critical thinking, and communication skills necessary to interact with clients and end users of big data analyses. This curriculum embraces the commitment to developing global citizens prepared with the competencies needed for the rapidly changing century ahead.

Drake's new program will allow students to apply principles of data analytics to topics they find personally fulfilling: biology, marketing, actuarial science, computer science, economics, finance, and, as the program develops, additional fields as well."

- Core requirements are introductory courses to the various fields of Data Science: coding, machine learning, cloud computing and database systems, computational statistics, probability, modeling and data mining, and case study-applications to Big Data.
- The program is defined by its specialties. Students can specialize in Actuarial, Bioinformatics, Computational, Electronic Commerce, Economics, Finance, Marketing, or Mathematics disciplines of Data Science – these specializations involve between nine and sixteen additional credit hours plus a capstone and/or internship requirement.
- Drake's Data Analytics program's emphasis on specialization mirrors my intended undergraduate experience at Rice. In essence, though not offered in Drake's program, my Data Science Area Major is designed to serve as a Sport Analytics specialization.

### ***Undesirability of Alternative Options at Rice***

Rice's selection of academic majors, minors, and other programs is admirably diverse and comprehensive. However, through the exploration and analysis of Rice's possible curriculum tracks that involve computational and statistical data analysis, I believe my Data Science Area Major is first, sufficiently distinct and unique from these possible tracks to be necessary to my goals for my undergraduate experience; and second, an efficient and effective consolidation of material that satisfies my goals without excessively deviating from my academic interests.

- Why Not the newly-approved Sport Management Concentration in Analytics?

The Analytics concentration of the Sport Management degree at Rice is a welcome sight for a student like me, but it is simply not sufficient in depth. The concentration has appropriate breadth (includes classes from MATH, STAT, and COMP including its prerequisites), but these classes represent only the basic concepts of Data Science as it pertains to Sport Analytics. Instead of completing this concentration, I find it more useful, relevant and rewarding to complete the previous Sport Management curriculum and supplement it with the Data Science Area Major instead of the Sport Analytics concentration.

- Why Not Computer Science with a Statistics Minor?

The academic track described above is the one I have been on course to finish for several semesters now. However, there are two vital shortcomings of this track: first, the Computer Science major requires lower-level, hardware-related courses (Programming Languages, Compiler Construction, and Operating Systems) that would hinder my ability to take more Data-Science related courses (Applied Algorithms, Artificial Intelligence, and Machine Learning); and second, the eight Statistics courses I would be completing instead of the six required for the Statistics minor motivates the consolidation into a Data Science major. Completing the Computer Science major with a Statistics minor would sacrifice courses I know to be absolutely essential to my professional goals at the expense of core requirements I am not interested in and are not relevant to these goals.

- Why Not Statistics With Computer Science Courses Alongside Them?

Because there is not a Computer Science minor, this is the most reasonable alternative option to my current track. However, the Statistics department is not geared towards modern Data Science. Many of the courses required for the major are taught more classically, dealing with number and probability theory instead of practical, 'big data,' database problems that define Data Science. Classes are not taught in the breadth of programming languages desired. The department simply has not transitioned into a (big) data-friendly program; I desire an undergraduate curriculum with a more evident emphasis from the appropriate department on programming and algorithms as manners of analyzing data.

- Why Not Electrical Engineering Specialization in Data Science?

I was not aware of this Specialization until recently, but the Electrical Engineering Specialization in Data Science is far from the curriculum described in my Data Science Area Major. The specialization itself includes Signal Processing and has required courses such as Learning from Sensor Data and Introduction to Neuroengineering that are irrelevant to my professional goals and do not relate to the analytic skillset I hope to acquire from my undergraduate academics.

### ***Future Impacts***

I strongly believe that the most important, valuable characteristic of developing skillsets is the ability to select and develop the ones that will be relevant to an industry *in the future*, not right now. Data Science embodies this mantra perfectly. Besides its public perception as a 'sexy job' and the seemingly insane demand for 'Data Scientists' in all fields these days, Data Science is also the most desirable academic trail to follow in order to develop the adequate supplementary skillset required in Sport Analytics.

On September 21, 2015, Rice University announced \$150 million in strategic research initiatives. \$43 million of this investment was allocated towards establishing "a world-class program in data sciences;" however, if this \$43 million becomes a Data Science major somewhere down the road, I might not still be at Rice. However, the initiative provides a valuable argument for my Data Science Area Major: my proposal can be a catalyst. My curriculum can be a model for future academic planners to consider when crafting an official Data Science major for Rice. The professors that aided me in proposing my Area Major can serve as advisors to undergraduates looking to major in Data Science in coming years. I myself could provide valuable feedback and input towards the process of creating a world-class program. Quite simply, the possible impact of a successful Data Science Area Major proposal in the scope of benefitting Rice as a whole is tremendous, and I want the opportunity to make a lasting academic impact on this institution.

To conclude, I believe the most powerful arguments for my Data Science Area Major are:

1. My desire to augment the business and communication skills acquired by the Sport Management degree with analytical skills and abilities that directly compare to those of Data Scientists in any industry today
2. My knowledge of exactly what skills and responsibilities I intend to have in the future, and the consultation with the professionals that hold these skills and responsibilities right now in order to form a curriculum perfectly geared towards my goals
3. The budding Data Science program at Rice, as evidenced by a newly-minted Electrical and Computer Engineering Specialization in Data Science as well as preliminary talks in October 2014 regarding a Data Science Minor attended by professors such as Dr. Guerra, Dr. Jermaine, Dr. Keith Cooper, and Dr. Devika Subramanian
4. My Area Major's potential to be a resource for future students interested in Data Science or a catalyst for the creation of the major itself, feeding my desire to contribute to Rice lastingly

I hope I have been able to define the motivations behind my Area Major proposal and the potential benefits it could provide for myself and Rice University. A Data Science Area Major is most achievable under my current academic situation at Rice and most suitable to the skillsets I want to develop through my undergraduate academic experiences. I hope you favorably consider my proposal. Thank you.

### ***Appendix***

<http://datascience.community/colleges>

<http://news.rice.edu/2015/09/21/rice-announces-150-million-in-strategic-research-initiatives-2/>

# 2015-2017 Catalog

## Cross Disciplinary Studies Minor in Data Science

<a href="#">CSC/CPE 101</a>	Fundamentals of Computer Science I	4
<a href="#">CSC/CPE 102</a>	Fundamentals of Computer Science II	4
<a href="#">CSC/CPE 103</a>	Fundamentals of Computer Science III	4
<a href="#">CSC 348</a>	Discrete Structures	4
or <a href="#">MATH 248</a>	Methods of Proof in Mathematics	
<a href="#">CSC/CPE 349</a>	Design and Analysis of Algorithms	4
<a href="#">CSC/CPE 365</a>	Introduction to Database Systems	4
<a href="#">CSC/CPE 369</a>	Introduction to Distributed Computing	4
<a href="#">CSC/CPE 466</a>	Knowledge Discovery from Data	4
<a href="#">DATA 301</a>	Introduction to Data Science	4
<a href="#">DATA 401</a>	Data Science	4
<a href="#">DATA 451</a>	Data Science Capstone I	2
<a href="#">DATA 452</a>	Data Science Capstone II	2
<a href="#">MATH 143</a>	Calculus III	4
<a href="#">MATH 206</a>	Linear Algebra I	4
or <a href="#">MATH 244</a>	Linear Analysis I	
<a href="#">STAT 302</a>	Statistics II	4
or <a href="#">STAT 312</a>	Statistical Methods for Engineers	
<a href="#">STAT 305</a>	Introduction to Probability and Simulation	4
<a href="#">STAT 324</a>	Applied Regression Analysis	4
<a href="#">STAT 331</a>	Statistical Computing with R	4
<a href="#">STAT 419</a>	Applied Multivariate Statistics	4
Technical Electives (CSC/STAT/DATA)		8
Total units		80

## Prerequisites to the Major (each with minimum grade of C or higher)

- *Calculus*: MATH 115, 116, and 215 (each completed with a minimum grade of C or higher)
- *Linear Algebra*: MATH 214 or 217 (completed with a minimum grade of C or higher)
- *Introductory Programming*: One of EECS 183, ENGR 101, or ENGR 151

## Requirements for the Major

A minimum of 42 credits is required (each with minimum grade of C or higher), distributed as follows.

### I. Core:

#### 1. *Computing and Discrete Mathematics*

- EECS 203 Discrete Mathematics (preferred)  
or  
MATH 465 Introduction to Combinatorics
- EECS 280 Programming and Elementary Data Structures.

#### 2. *Computing and Statistics*

- EECS 281 Data Structures and Algorithms.
- STATS 412 Introduction to Probability and Statistics.
- STATS 413

#### 3. *Machine learning and data mining* (minimum 4 credits):

- EECS 445 Machine Learning  
or  
▪ STATS 415 Data Mining

#### 4. *Data management and applications* (minimum 4 credits):

- EECS 484 Database Management Systems  
or  
▪ EECS 485 Web Database and Information Systems

#### 5. *Data Sciences Applied to a Domain* (minimum 4 credits): A student must take at least one 400-level or higher course in which data science techniques are applied to a domain area.

- 400+ courses in Statistics and CSE on analytics in healthcare human behavioral analytics, financial analytics
- 400+ level courses in bioinformatics (specify: is this bioinformatics courses in any SUBJECT or courses in BIOINF)

### II. **Capstone Experience.** One course of at least 4 credits approved as satisfying the Data Science Capstone Experience requirement. STATS 485 and the proposed Data Science-oriented CSE courses that also meet the Major Design Experience (MDE) requirements as playing this role.

If a student takes a required course that can also be used to provide capstone experience, the student must either not double count the credits or make up any overlapping credits by taking advanced elective courses.

### III. **Advanced Technical Electives in Data Science:** At least 8 credits of advanced technical electives (at the 300-level or higher) that build on the foundation provided by the core courses and includes courses in data collection methods, scientific visualization, algorithms, security and privacy, mathematical modeling in biology, biostatistics, and optimization techniques. These courses must be selected from the following list of courses, or other courses by exception selected with advisor approval prior to taking the course.

- BIOINF 463 / BIOPHYS 463 / MATH 463 Mathematical Modeling in Biology
- BIOINF 527 Introduction to Bioinformatics & Computational Biology
- BIOINF 545 / STATS 545 / BIOSTAT 646 High Throughput Molecular Genomic and Epigenomic Data Analysis
- BIOINF 547 / MATH 547 / STATS 547 Probabilistic Modeling in Bioinformatics
- BIOPHYS 463 / BIOINF 463 / MATH 463 Mathematical Modeling in Biology
- BIOSTAT 449 / STATS 449 Topics in Biostatistics
- BIOSTAT 646 / BIOINF 545 / STATS 545 High Throughput Molecular Genomic and Epigenomic Data Analysis
- EECS 388 Introduction to Computer Security
- EECS 442 Computer Vision
- EECS 467 Autonomous Robotics
- EECS 477 Introduction to Algorithms
- EECS 484 Database Management Systems
- EECS 485 Web Database and Information Systems

- EECS 492 Introduction to Artificial Intelligence
- EECS 498 Special Topics (approved sections only. By default, EECS 498 sections will not count towards the Data Science advanced technical electives)
- EECS 4xx Data Science and Healthcare
- EECS 4xx Data Science and Human Behavior and Emotion Analytics
- EECS 545 Machine Learning
- EECS 549 / SI 650 Information Retrieval
- IOE 310 Introduction to Optimization Methods
- MATH 463 / BIOINF 463 / BIOPHYS 463 Mathematical Modeling in Biology
- MATH 547 / STATS 547 / BIOINF 547 Probabilistic Modeling in Bioinformatics
- MATH 548 / STATS 548 Computations in Probabilistic Modeling in Bioinformatics
- SI 639 Web Archiving
- SI 649 Information Visualization
- SI 650 / EECS 549 Information Retrieval
- STATS 403 Introduction to Quantitative Research Methods
- STATS 406 Introduction to Statistical Computing
- STATS 414 Special Topics in Statistics, section titled "Introduction to Bayesian Data Analysis"
- STATS 426 Introduction to Theoretical Statistics
- STATS 449 / BIOSTAT 449 Topics in Biostatistics
- STATS 470 Introduction to Design of Experiments
- STATS 480 Survey Sampling Techniques
- STATS 508 Statistical Analysis of Financial Data
- STATS 531 Analysis of Time Series
- STATS 545 / BIOINF 545 / BIOSTAT 646 High Throughput Molecular Genomic and Epigenomic Data Analysis
- STATS 547 / MATH 547 / BIOINF 547 Probabilistic Modeling in Bioinformatics
- STATS 548 / MATH 548 Computations in Probabilistic Modeling in Bioinformatics

## Dual Majors with Computer Science

For a dual major with Computer Science, the student will need to take an additional 14 credits in pertinent technical subjects, with advisor approval in both Computer Science and Data Science, beyond satisfying the requirements for each of the majors.

## Honors Plan

Students are responsible for finding a faculty mentor whose research area aligns with the student's interest and who is willing to supervise their project. Statistics and CSE will designate a Capstone Thesis course that can be used to satisfy both the Data Science Honors requirement in LSA and the Capstone Experience requirement.

- Complete a research project under the direction of a faculty mentor in Computer Science or Statistics (and an optional a co-advisor from any department) by registering for a Capstone Thesis course in EECS or STATS. (The Capstone Thesis course, if completed successfully, will also count toward the Capstone Experience requirement, irrespective of whether the Honors designation is awarded.)
- Write an original thesis report on the research project and make a public presentation of the work. Satisfy the advisor and a second reader that the thesis report and the public presentation are worthy of the Honors designation.
- 3.5 GPA in the major and pre-major courses
- 3.4 overall U-M GPA (at the time of graduation)

## Data Science (Fall 2015-Summer 2016)

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# Data Analytics Core Curriculum

The core focuses on principles that are fundamental to all areas of data analytics and consists of courses taken by all majors. In these courses, students investigate the computational, mathematical and statistical foundations of data analytics, and develop critical thinking and communication skills.

## Core Educational Objectives

A student graduating with a Bachelor of Science degree with a major in Data Analytics will demonstrate:

- an understanding of and ability to apply computer science principles relating to data representation, retrieval, programming, and the analysis of big data.
- an understanding of and ability to apply statistical methods, models and concepts to data analysis, and to draw conclusions supported by data.
- critical thinking skills associated with problem identification, problem solving and decision making.
- the ability to apply knowledge gained from one area to problems and data in another.
- the ability to communicate findings and their implications, and to apply them effectively in organizational settings.

## Mathematical Pre-requisites

The mathematical pre-requisites for the Data Analytics major are:

- [Math 1151](#): Calculus I
- [Math 1152](#): Calculus II

As noted on the [General Education \(GE\) advising page](#), Math 1151 and 1152 also satisfy GE requirements.

## CSE Pre-requisites

- [CSE 1223](#) or equivalent

## Core Requirements

All students in the Data Analytics major must complete the following 51 credit hours worth of core requirements.

- [CSE 2221](#): Software I, Software Components
- [CSE 2231](#): Software II, Software Development and Design

- [CSE 2321](#): Foundations I, Discrete Structures
- Choose **one** of the following
  - [CSE 2421](#): Systems I: Introduction to Low-Level Programming and Computer Organization
  - [CSE 3430](#): Overview of Computer Systems for Non-Majors
- [Math 2568](#): Linear Algebra
- [CSE 3241](#): Introduction to Database Systems
- [Stat 3201](#): Introduction to Probability for Data Analytics
- [Stat 3202](#): Introduction to Statistical Inference for Data Analytics
- [Stat 3301](#): Statistical Modeling for Discovery I
- [Stat 3302](#): Statistical Modeling for Discovery II
- [Stat 3303](#): Bayesian Analysis and Statistical Decision Making
- [ISE 3230](#): Systems Modeling and Optimization for Analytics
- [Stat 4620](#): Introduction to Statistical Learning
- Choose **one** of the following
  - [CSE 5242](#): Advanced Database Management Systems
  - CSE 5xxx\*: Advanced Databases and Cloud Computing
- [CSE 5243](#): Introduction to Data Mining
- Visualization: choose **one** of the following
  - [CSE 5544](#): Introduction to Scientific Visualization
  - [ISE 5760](#): Visual Analytics and Sensemaking

\* These courses are currently under development and will be available soon.

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# Biomedical Informatics Specialization

## Specialization Educational Objectives

In addition to the [core objectives](#), a student graduating with a Bachelor of Science degree with a major in Data Analytics with a specialization in Biomedical Informatics will demonstrate:

- an understanding of the core sub-disciplines of biomedical informatics that play a role in the design, implementation, and management of clinical, research, and translational information systems.
- an understanding of the contributing theoretical frameworks that are conventionally used to inform the design and use of biological and medical information systems, and integrative data discovery and analysis tools.
- critical evaluation skills that allow for the analysis of system design and or utilization of biomedical information systems and data.

## Specialization Requirements

All students specializing in Biomedical Informatics must complete the following specialization requirements.

- [MolGen 5660](#): Integrated Molecular and Cellular Biology for Non-Biologists
- [BMI 5710](#): Introduction to Biomedical Informatics
- [BMI 5720](#): Introduction to Imaging Informatics
- [BMI 5730](#): Introduction to Bioinformatics
- [BMI 5740](#): Introduction to Research Informatics
- CSE 5xxx\*/Stat 5xxx\*: Capstone in Data Analytics

\*The Computer Science and Engineering/Statistics Capstone course is currently under development. A course number will be provided as soon as it is available.

Students specializing in Biomedical Informatics should also take the following courses:

- Choose **one** of the following:
  - [Chemistry 1110](#): Elementary Chemistry
  - [Chemistry 1210](#): General Chemistry I
- [Biology 1113](#): Biological Sciences: Energy Transfer and Development
- [Biology 1114](#): Biological Sciences: Form, Function, Diversity, and Ecology

These courses will satisfy the pre-requisite requirements for the required course MolGen 5660 and, as noted on the [GE advising page](#), can be simultaneously used to fulfill the GE requirements in the Natural Science category.

## Four-year Sample Advising Plan

Take a look at a [suggested four-year sample advising plan](#) [pdf]. This should be used as a guide only. Semester offerings are subject to change.

[pdf] - Some links on this page are to Adobe .pdf files. If you need these files in a more accessible format, please contact [data-analytics@osu.edu](mailto:data-analytics@osu.edu)

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# Business Analytics Specialization

## Specialization Educational Objectives

In addition to the [core objectives](#), a student graduating with a Bachelor of Science degree with a major in Data Analytics with a specialization in Business Analytics:

- will demonstrate an understanding of how research and data analytics are done in business.
- will demonstrate proficiency at designing and implementing analyses to carry out a firm's business objectives.
- can identify and assess ethical issues surrounding business decisions.

## Specialization Requirements

All students specializing in Business Analytics must complete the following specialization requirements:

### Required General Education Courses

- [Economics 2001.01](#) (or .02 or .03): Principles of Microeconomics
- [Economics 2002.01](#) (or .02 or .03): Principles of Macroeconomics

As noted on the [GE advising page](#), Econ 2001.01 and 2002.01 can be used to fulfill the GE requirements in the Social Sciences category.

### Business Industry Cluster

- [BUSADM 3630.05](#): Introduction to Business Analytics: Defining and Applying "Big Data"
- [BUSADM 3632.05](#): Design and Development of Business Analytics Solutions

A pre-requisite for enrolling in BUSADM 3630.05 and 3632.05 is enrollment in the [Business Industry Cluster Program](#). Please be aware that the [eligibility requirements](#) for enrolling in the program include a **cumulative GPA of at least 3.0**.

The required courses BUSADM 3630.05 and 3632.05 serve as the capstone experience for the Business Analytics specialization. These courses represent a contiguous two semester program in the [Business Analytics Cluster](#) that will introduce the students to Business Analytics (Fall) and then allow them to work in small teams on projects provided by the class sponsors (Spring). The Fall semester will utilize Faculty from the Fisher College of Business combined with external speakers/presenters from our sponsoring companies. Current sponsoring companies for this two semester program include JP Morgan Chase, Scotts Miracle Gro, Lane Bryant, Saama, and Cardinal Health. Sponsors are continually added to the program, and as a result each session will vary in

speaker content and student projects. Students will work on two separate sponsor projects in the spring, and will be expected to present to representatives from the sponsor(s).

## Business Electives

In addition to the courses listed above, students in the Business Analytics specialization must take an **additional 9 credit hours** of coursework from the electives listed below. Courses are grouped to show possible focus areas but students may select any combination of courses (having met appropriate pre-requisites) to meet the 9 credit hours requirement.

### Electives: Finance Focus

- [BUSFIN 3120](#): Foundations of Finance (3 cr hrs)
- [BUSFIN 3220](#): Business Finance (3 cr hrs)
- [BUSFIN 3222](#): Foundations of Investments (3 cr hrs)
- [BUSFIN 3250](#): Foundations of International Finance (3 cr hrs)
- [BUSFIN 4201](#): Financial Data (1.5 cr hrs)

### Electives: Accounting and Management Information Systems Focus

- [ACCTMIS 2000](#): Foundations of Accounting (3 cr hrs)
- [ACCTMIS 3600](#): Introduction to Accounting Information Systems (3 cr hrs)
- [ACCTMIS 4210](#): Topics in Financial Accounting (3 cr hrs)
- [ACCTMIS 4310](#): Topics in Management Accounting (3 cr hrs)
- [ACCTMIS 4650](#): Decision Support and Expert Systems (3 cr hrs)
- [ACCTMIS 5000](#): Accounting and Cost Analysis (3 cr hrs)

### Electives: Customer Insights Focus

- [BUSML 3150](#): Foundations of Marketing (3 cr hrs)
- [BUSML 3250](#): Principles of Marketing (3 cr hrs)
- [BUSML 4202](#): Marketing Research (3 cr hrs)
- [BUSML 4210](#): Advanced Market Research (1.5 cr hrs)
- [BUSML 4211](#): Market Analysis, Development & Forecasting (1.5 cr hrs)
- [BUSML 4212](#): Customer Relationship Management (1.5 cr hrs)

### Electives: Operations & Logistics Focus

- [BUSMGT 3230](#): Introduction to Operations Management: Improving Competitiveness in Organizations (3 cr hrs)
- [BUSMGT 4250](#): Six Sigma Principles (3 cr hrs)
- [BUSMGT 4251](#): Six Sigma Projects (3 cr hrs)
- [BUSML 3380](#): Logistics Management (1.5 cr hrs)
- [BUSML 4382](#): Logistics Analytics (3 cr hrs)
- [BUSML 4386](#): Logistics Technology and Application (1.5 cr hrs)

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# Computational Analytics Specialization

The focus of the specialization in Computational (Data) Analytics is to allow students to further explore and specialize in the areas of large-scale data analytics and architectures from theory to practice with more of a computational focus. This ranges from Machine Learning, Text and Linguistic Analytics, Graph Analytics, Visual Analytics to Map Reduce, noSQL Databases, Analytics in Cybersecurity, High Performance Computing and Cloud Computing.

## Specialization Educational Objectives

In addition to the [core objectives](#), a student graduating with a Bachelor of Science degree with a major in Data Analytics with a specialization in Computational Analytics will demonstrate:

- an understanding of the principles governing an advanced computational focus area (Cyber-security, Machine Intelligence, Systems/Theory, Linguistics and Text analytics).
- an advanced understanding of and the ability to use analytic techniques in one or more focus areas.

## Specialization Requirements

Students in the Computational Analytics specialization must take **14 credit hours** of coursework from the electives listed below. Courses are grouped to show possible focus areas but students may select any combination of courses (having met appropriate pre-requisites) to meet the 14 credit hours requirement.

- [Ling 2000\\*](#): Introduction to Language in the Humanities (3 cr hrs)

\*As noted on the [GE advising page](#), students choosing the Linguistics and Text Analytics focus should take Linguistics 2000 - Introduction to Language in the Humanities. This course is a pre-req for the Ling 4x00 courses and may also be used to satisfy the GE requirement in the Culture and Ideas category.

## Electives: Cyber-security Focus

- [CSE 3461](#): Computer Networking and Internet Technologies (3 cr hrs)
- [CSE 4471](#): Information Security (3 cr hrs)
- Choose **one** of the following:
  - [CSE 5472](#): Information Security Projects (3 cr hrs)
  - [CSE 5473](#): Network Security (3 cr hrs)
- CSE 59xx\*/Stat 5xxx\*: Capstone in Data Analytics (4 cr hrs)

## Electives: Machine Intelligence Focus

- [CSE 2331](#): Foundations II: Data Structures and Algorithms (3 cr hrs)
- [CSE 3521](#): Survey of Artificial Intelligence I: Basic Techniques (3 cr hrs)
- Choose **two** of the following courses:
  - [CSE 5245](#): Introduction to Network Science (3 cr hrs)
  - [CSE 5523](#): Machine Learning and Statistical Pattern Recognition (3 cr hrs)
  - [CSE 5524](#): Computer Vision for Human-Computer Interaction (3 cr hrs)
  - [CSE 5526](#): Introduction to Neural Networks (3 cr hrs)
- CSE 59xx\*\*/Stat 5xxx\*\*: Capstone in Data Analytics (4 cr hrs)

## Electives: Core (Systems or Theory) Focus

- Choose **one** of the following:
  - [CSE 2331](#): Foundations II: Data Structures and Algorithms (3 cr hrs)
  - [CSE 2431](#): Systems II: Introduction to Operating Systems (3 cr hrs)
- [CSE 3901](#), [3902](#), [3903](#): CSE Junior Project Choice (4 cr hrs)
- Choose **one** of the following courses:
  - [CSE 5245](#): Introduction to Network Science (3 cr hrs)
  - [CSE 5361](#): Numerical Methods (3 cr hrs)
  - [CSE 5441](#): Introduction to Parallel Computing (3 cr hrs)
- CSE 5901, 5902, 5903: CSE Senior Capstone Choice (4 cr hrs)

## Electives: Linguistics and Text Analytics Focus

- [Ling 5801](#): Computational Linguistics I (3 cr hrs)
- [Ling 5802](#): Computational Linguistics II (3 cr hrs)
- [CSE 5525](#): Foundations of Speech and Language Processing (3 cr hrs)
- Choose **one** of the following:
  - [Ling 4100](#): Phonetics (3 cr hrs)
  - [Ling 4200](#): Syntax (3 cr hrs)
  - [Ling 4300](#): Phonology (3 cr hrs)
  - [Ling 4400](#): Linguistic Meaning (3 cr hrs)
- CSE 59xx\*\*/Ling 5xxx\*\*: Capstone in Data Analytics (4 cr hrs)

\*\*The Computer Science and Engineering/Statistics Capstone course and the Computer Science and Engineering and Linguistics capstone course are currently under development. Course numbers will be provided as soon as they are available.

## Four-year Sample Advising Plan

Take a look at a [suggested four-year sample advising plan](#) [pdf]. This plan was developed for a student interested in the cyber-security focus area and should be used as a guide only. Semester offerings are subject to change.

[pdf] - Some links on this page are to .pdf files. If you need these files in a more accessible format, please contact [data-analytics@osu.edu](mailto:data-analytics@osu.edu).



[Specialities \(/analytics/majorandminor/#d.en.260462\)](#)

[Data Analytics Minor \(/analytics/majorandminor/#d.en.260556\)](#)

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## The Major Core

A 30-credit major core gives students breadth of knowledge and a strong foundation in data analytics.

- [CS 065 \(/analytics/courses/#d.en.260635\)](#): Introduction to Computer Science I
- [CS 066 \(/analytics/courses/#d.en.260635\)](#): Introduction to Computer Science II
- [CS 083 \(/analytics/courses/#d.en.260635\)](#): Computer Ethics
- [CS 167 \(/analytics/courses/#d.en.260635\)](#): Machine Learning
- [CS 178 \(/analytics/courses/#d.en.260635\)](#): Cloud Computing and Database Systems
- [STAT 040 \(/analytics/courses/#d.en.260638\)](#): R and SAS
- [STAT/MATH 130 \(/analytics/courses/#d.en.260637\)](#): Probability for Analytics or [ACTS/MATH 131 \(/analytics/courses/#d.en.260638\)](#): Introduction to Probability I

Students taking the Actuarial Science specialty need to take ACTS/MATH 131 since it is a prerequisite for courses in the Actuarial Science specialty

- STAT 170: Statistical Modeling and Data Analysis II
- STAT 172: Generalized Linear Models and Data Mining
- STAT/CS 190: Case Studies in Data Analytics and Big Data

Course Rotation

Offered every fall and spring: ACTS/MATH 131, STAT 170, CS 065 & 66, STAT 40

Offered every fall: CS 83 & 167

Offered every spring: STAT 172, CS 178, STAT/CS 190

Note: STAT/MATH 130 will be offered once a year but exactly when is still TBA.

## The Specialties

To complete the course of study, each Data Analytics student will choose at least one specialty area through which foundational data analytics principles are applied. Each specialty includes a capstone course and recommended internship experience. The following specialties will be available to students beginning in Fall 2015; options may expand as the program grows.

### **Actuarial (/analytics/courses/#d.en.260707)**

12 credit hours plus capstone and recommended internship

- ACTS 120 and 120L: Theory of Interest and Lab
- ACTS 121: Introduction to Derivatives
- ACTS 132 and Lab: Introduction to Probability II and Lab
- ACTS 145: Derivatives Mathematics
- Math 100: Calculus III
- Capstone according to policies in CBPA/ACTS
- Internship according to policies in CBPA/ACTS(recommended)

### **Bioinformatics**

**(/analytics/courses/#d.en.260708)** 16 credit hours plus recommended internship

- BIO 012: General Biology + Lab
- BIO 105: Introduction to Genetics or BIO 165: Cell Biology

- BIO 116: Bioinformatics
- BIO 186: Molecular Biology
- BIO 198: Internship or similar course (1-12 credit hours) - recommended
- BIO 199: Capstone

**Computational (/analytics/courses/#d.en.260709)**

13 credit hours plus recommended internship

- Pick four courses among:
  - CS 137: Data Structures and Algorithms
  - CS 143: Artificial Intelligence
  - CS 147: Graphics
  - CS 160: Operating Systems
  - CS 165: Numerical Methods
  - CS 188: Software Engineering
  - Appropriate topics courses in computer science, informational systems, mathematics and in other disciplines (by permission of the instructor)
- CS 191: Capstone
- CS 140: Internship or similar course (recommended)

**Electronic Commerce (/analytics/courses/#d.en.260710)**

9 credit hours plus capstone and recommended internship

- Pick three among the following:
  - IS 074: Advanced IT Applications for Business
  - IS 145: Website Technology

- IS 160: Database Management
- IS 194: Electronic Commerce
- Another electronic commerce-related business course
- Capstone according to policies in CBPA
- Internship according to policies in CBPA(recommended)

**Economics (/analytics/courses/#d.en.260711)**

15 credit hours plus capstone and recommended internship

- ECON 001: Principles of Macroeconomics
- ECON 002: Principles of Microeconomics
- ECON 107: Econometrics
- ECON 173: Intermediate Microeconomic Analysis
- ECON 174: Intermediate Macroeconomic Analysis
- Capstone according to policies in CBPA/ECON
- Internship according to policies in CBPA(recommended)

**Finance (/analytics/courses/#d.en.260712)**

12 credit hours plus capstone and recommended internship

- FIN 101: Corporate Finance
- FIN 102: Advanced Corporate Finance
- FIN 121: Introduction to Derivatives
- FIN 193: Portfolio Analysis
- Capstone according to policies in CBPA/FIN

- Internship according to policies in CBPA(recommended)

**Marketing (/analytics/courses/#d.en.260714)**

12 credit hours plus capstone and recommended internship

- MKTG 101: Marketing Principles
- MKTG 113: Marketing Research
- Two of the following three:
  - MKTG 109: Marketing and the Internet
  - MKTG 111: Direct and Interactive Marketing
  - MTKG 130: Field Applications in Marketing
- Capstone according to policies in CBPA/MKTG
- Internship according to policies in CBPA(recommended)

**Mathematics (/analytics/courses/#d.en.260715)**

13 credit hours plus recommended internship

- Pick three among the following:
  - MATH 125: Mathematical Modeling
  - MATH 127: Game Theory
  - CS/MATH 165: Numerical Methods
  - MATH 176: Advanced Linear Algebra
- MATH 120: Differential Equations
- MATH 191: Capstone
- MATH 140: Internship or similar course (recommended)



<b>Student Name:</b>	<b>Student ID Number:</b>
<b>Major(s): Sport Management; Proposed Data Science Area Major</b>	<b>Major Advisor(s): Dr. Clark Haptonstall; Dr. Rudy Guerra, Dr. Andrew Schaefer, and Dr. James Disch</b>
<b>Minor(s): Business</b>	<b>Minor Advisor(s): Dr. Rick Schell</b>
<b>Has your major(s) advisor(s) approved this academic plan? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</b>	<b>Date of Major Advisor Approval: 4/4/16</b>
<b>In the following plan, I have 94-100 hours of upper-level credit and 173 TOTAL hours</b>	

- Permission from Dr. John Hutchinson, Dean of Undergraduates, ([ugdean@rice.edu](mailto:ugdean@rice.edu)) is required to enroll in fewer than 12 hours
- The Office of Academic Advising approves registration for course loads greater than 20 hours: <http://oaa.rice.edu> for details
- You will not be permitted to register for the Fall Semester of your junior year unless you have declared a major. Students should declare a major no later than their second semester sophomore year (See Major Declaration Form).

AP/IB/Transfer Credits Earned														
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
CEVE 100				3										
COMP 110	D3			3										
ECON 112				3										
ENGL 121				3										
HIST 105				4										
POLI 110				3										
PSYC 101	D2			3										
STAT 280	D3	SMGT		4										
Total AP/IB/Transfer Hours														26

YEAR 1														
Fall 2014					Spring 2015					Summer 2015				
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
COMP 140	D3	DSCI		4	COMP 182		DSCI		4					
FWIS 155	D1			3	ECON 201	D2	SMGT	BUSI	3					
LEAD 313				2	ELEC 220	D3	DSCI		4					
MATH 101	D3	DSCI		3	MATH 102	D3	DSCI		3					
SMGT 260	D2	SMGT		3	SMGT 276		SMGT		3					
					SMGT 362		SMGT		3					
Total Semester Hours				15	Total Semester Hours				20	Total Semester Hours				
Co-Curricular Pursuits: Rice Rally Club, Intramural Sports, Houston Rockets SportVU Operator, Rice Men's Club Volleyball, HACER					Co-Curricular Pursuits: Rice Rally Club, Intramural Sports, Rice Sport Business Society (RSBS), SportVU Operator, Club Volleyball, NCAA Final Four Research					Co-Curricular Pursuits: Houston Rockets Draft Preparation Internship				

YEAR 2														
Fall 2015					Spring 2016					Summer 2016				
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
BUSI 296	D2	SMGT	BUSI	3	BUSI 305	D2	SMGT	BUSI	3					
COMP 215		DSCI		4	CAAM 335	D3	DSCI		3					
MATH 211	D3	DSCI		3	COMP 321		DSCI		4					
RELI 157	D1			3	HUMA 201		SMGT		3					
SMGT 350		SMGT		3	SMGT 364		SMGT		3					
STAT 310	D3	DSCI		3	SMGT 376		SMGT		3					
Total Semester Hours				19	Total Semester Hours				19	Total Semester Hours				
Co-Curricular Pursuits: Rice Rally Club, SportVU Operator, Houston Rockets Basketball Operations Internship, Rice Women's Basketball Scout Team, RSBS					Co-Curricular Pursuits: Rice Rally Club, SportVU Operator, Basketball Operations Internship, Women's Scout Team, RSBS					Co-Curricular Pursuits: Draft Preparation Internship, STATS LLC Software Developer Internship				

YEAR 3														
Fall 2016					Spring 2017					Summer 2017				
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
BUSI 310	D2	SMGT	BUSI	3	BUSI 380	D2	SMGT	BUSI	3					
COMP 330		DSCI		3	COMP 430		DSCI		4					
LEAD 321		SMGT		3	COMP 540		DSCI		4					
SMGT 430		SMGT		3	SMGT 360		SMGT		3					
STAT 405	D3	DSCI		3	STAT 411		DSCI		3					
STAT 410		DSCI		4										
Total Semester Hours				19	Total Semester Hours				18	Total Semester Hours				
Co-Curricular Pursuits: Rice Rally Club, Basketball Operations Internship, Women's Scout Team, RSBS					Co-Curricular Pursuits: Rice Rally Club, Basketball Operations Internship, Women's Scout Team, RSBS					Co-Curricular Pursuits: Draft Preparation Internship, NBA Summer League Tour				

YEAR 4														
Fall 2017					Spring 2018					Summer 2018				
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
BUSI 343	D2	SMGT	BUSI	3	BUSI 390	D2	SMGT	BUSI	3					
CAAM 378		DSCI		3	LPAP 1--				1					
COMP 382		DSCI		3	SMGT 466		SMGT		3					
SMGT 366		SMGT		3	SMGT 477		SMGT		3					
STAT 422		DSCI		3	SMGT 490		DSCI		3					
STAT 444		DSCI		3		D1			3					
						D1			3					
Total Semester Hours				18	Total Semester Hours				19	Total Semester Hours				
Co-Curricular Pursuits: Rice Rally Club, Basketball Operations Internship, Women's Scout Team, RSBS					Co-Curricular Pursuits: Rice Rally Club, Basketball Operations Internship, Women's Scout Team, RSBS					Co-Curricular Pursuits: Full-Time Employment in an NBA Organization's Basketball Operations Department				



YEAR 5 (N/A)														
Fall ____					Spring ____					Summer ____				
Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours	Course	D1/D2/D3	Major	Minor	Hours
Total Semester Hours					Total Semester Hours					Total Semester Hours				
Co-Curricular Pursuits:					Co-Curricular Pursuits:					Co-Curricular Pursuits:				

### Graduation Requirements

(See relevant *General Announcements* for details.)

Mark an X if your plan accounts for the following requirements (if appropriate):

- ☒ Be registered at Rice full time for at least four full fall and/or spring semesters
- ☒ Complete the requirements of at least one major degree program
- ☒ Complete at least 120 semester hours (some degrees programs require more)
- ☒ Complete at least 60 semester hours at Rice
- ☒ Complete at least 48 hours of 300+ level courses (there are also rules on the amount completed at Rice)
- ☒ Complete more than half of the upper-level courses in degree work **at Rice**
- ☒ Complete more than half of the upper-level courses in their major work **at Rice** (certain departments may specify a higher proportion)
- ☒ Complete all Rice courses satisfying degree requirements with a cumulative GPA of 1.67 or higher and cumulative GPA in major of 2.0 or higher
- ☒ Take the English Composition Examination and satisfy the Writing Communication Requirement, First Year Writing Intensive Seminar (FWIS)
- ☒ Satisfy the Lifetime Physical Activity Program (LPAP) requirement
- ☒ Complete courses to satisfy the distribution requirements
- ☐ Dual **degree** (not double major) consideration: 30 hours beyond the first degree