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NEW JERSEY CITY UNIVERSITY

[Form Approved by Senate on 04/12/10]

New Jersey City University

REQUEST FOR ACADEMIC PROGRAM APPROVAL

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UNIVERSITY SENATE

Program Title: Master of Science in Business Analytics and Data Science

Type of Program: Graduate: x | Certificate: | Interdisciplinary: | Undergraduate major: | Undergraduate minor:

Total Credit/Semester Hours: 39 credits

Requirements for Admission: Bachelor's degree; GPA >3.0; standardized test scores; letters of recommendation; writing sample; resume / CV

Department(s)/Academic Unit(s) of Origin: Finance

1. *Proposer (Faculty Member(s)/ Officer Initiating Program):* J.D. Jayaraman, A. Bossie, M. Griffin, E. Lee, K. Li

APPROVAL RECOMMENDED: SIGN IN SEQUENCE (Collaborating Departments/Units Use Right-Hand Column)

2/4/2016
2. Chair, Department Curriculum Committee Date

Chair, Department Curriculum Committee Date

2/4/2016
3. Chair, Department/Academic Unit Date

Chair, Department/Academic Unit Date

3/1/2016
4. Chair, College Curriculum & Instruction Cmte. Date

Chair, College Curriculum & Instruction Cmte. Date

3/21/2016
5. Chair, Senate Plan. Dev. & Budget Cmte. Date

3/24/2016
6. Dean, host College Date

3/28/16
7. Vice President for Academic Affairs Date

8. Chair, Senate Curriculum & Instruction Cmte. Date
or *Chair, Senate Graduate Studies Committee*

9. President, NJCU Senate Date

10. Vice President for Academic Affairs Date
(Upon sending to Presidents, Consultant & Trustees)

11. Vice President for Academic Affairs Date
(Upon sending PA to AIC & Council of Presidents)

12. Vice President for Academic Affairs Date
(Upon return of PA from AIC & Council of Presidents)

Earliest start date for program (VPAA)*
**Note: First-year and required courses must be fully approved by this date.*

FOR NOTIFICATION PURPOSES:

Proposer _____ Date _____

Chair _____ Date _____

Chair _____ Date _____

Dean _____ Date _____

Dean _____ Date _____

Dean _____ Date _____

Dean Grad. Studies _____ Date _____

Registrar _____ Date _____

See "Procedures for the Creation of Undergraduate Major and Graduate Programs"

M.S. in Business Analytics and Data Science

Program Announcement Narrative

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I. PROGRAM OBJECTIVES

As the head of Gartner Research, Peter Sondergaard said, "Information is the oil of the 21st century and analytics is the combustion engine." This quote succinctly captures the importance of data and data analytics in the 21st century. The amount of data produced every day is exploding. The Executive Chairman of Google, Eric Schmidt's quote "There were 5 Exabytes of information created between the dawn of civilization through 2003, but that much information is now created every 2 days." captures this meteoric rise in data generation in eye-popping fashion. Big Data and Data Analytics is transforming the world that we live in. Thus it is imperative that academic institutions prepare students for the data revolution.

The Master of Science in Business Analytics and Data Science program will prepare students with the skills needed to gather, store, analyze and interpret large amounts of data in order to make business decisions. The program is designed to cater to the burgeoning need for analytics and data science professionals in various industries such as finance, marketing, retail and accounting.

The business analytics and data science master's program at NJCU reflects the university's commitment to empower a diverse, underserved population and be an institution of higher education nimble in its response to dynamic 21st Century opportunities and challenges. The program also underscores the resolve of the NJCU School of Business to be a data-driven institution.

The program will be fully geared towards practice. Students learning experiences will be grounded in real world contexts. Students will learn skills and use software tools that are currently popular in the industry, to find solutions to data analysis problems that are commonly encountered in practice. Graduates of the program will be thoroughly prepared to take on the role of a data scientist in the industry.

The program will also prepare students to take the Certified Analytics Professional (CAP) certification.

II. EVALUATION AND LEARNING OUTCOMES ASSESSMENT PLAN

Overview

Program faculty and other stakeholders will assess the program on an on-going basis on the following components:

1. Definition of learning outcomes and alignment of the curriculum.
2. Design of assessment tools.
3. Collection and analysis of assessment data.
4. Dissemination of results.
5. Continuous improvement of the curricula, instruction and the assessment process.

All of the proposed coursework supports the seven university-wide learning goals (UWLG).

1. Students will demonstrate effective writing skills.
2. Students will demonstrate effective oral communication skills.
3. Students will demonstrate effective quantitative literacy skills.
4. Students will demonstrate the ability to think critically to evaluate and solve problems.
5. Students will demonstrate effective information and technology literacy skills.
6. Students will practice responsible citizenship in a culturally complex world.
7. Students will demonstrate knowledge of their disciplinary or interdisciplinary fields.

Students enrolled in the M.S program in Business Analytics will advance the knowledge and skills learned in the undergraduate setting, learn new skills and expand upon each of these seven university-wide learning goals through appropriate coursework.

Learning Outcomes

The specific learning outcomes for the Master's program in Business Analytics and Data Science are:

- LO1: Effectively gather, store and cleanse large amounts of data from a diverse array of sources ranging from real-time financial market data to social media data.
- LO2: Apply statistical analysis and machine learning techniques to identify patterns in the data and build predictive models.
- LO3: Effectively communicate the findings of the data analysis using visualization techniques
- LO4: Ability to think of creative ways of combining and using large and diverse datasets with predictive analytics to make business decisions and effectively disseminate results.

Assessment

The specific learning outcomes of the program will be assessed using a variety of direct assessment methods such as projects integrated with the class curriculum.

Learning Outcome	Measure
LO1: Effectively gather, store and cleanse large amounts of data from a diverse array of sources ranging from real-time financial market data to social media data.	• Class project in core course BADS 607 Data Collection, Data Warehousing and Data Cleansing • Thesis/Capstone project in Data Science
LO2: Apply statistical analysis and machine learning techniques to identify patterns in the data and build predictive models.	• Class project in core courses BADS 611 Introduction to Machine Learning, BADS 609 Applied Regression, and BADS 613 Experimental Design • Thesis/Capstone project in Data Science
LO3: Effectively communicate the findings of the data analysis using visualization techniques	• Class project in core course BADS 615 Data Visualization and Communication
LO4: Ability to think of creative ways of combining and using large and diverse datasets and predictive analytics to make business decisions and effectively disseminate results.	• Thesis/Capstone project in Data Science

Indirect measures of the program outcomes include surveys of students, alumni, and employers who hire the graduates of the proposed program. Retention rate, job placement, salary levels, and career progression will also be utilized as measurements of the long-term effectiveness and impact of the proposed program.

Further, the assessment of this program will be integrated with the overall assessment plan of the School of Business.

III. RELATIONSHIP OF PROGRAM TO NJCU STRATEGIC PLAN

NJCU School of Business's proposed Business Analytics and Data Science program is well aligned with the university strategic plan, Transforming Lives (New Jersey City University, 2013). As evidenced by the high demand and lucrative salaries, the master's degree will transform the lives of the candidates who successfully complete the program. The NJCU strategic plan includes the following over-arching goals: (1) Enhance Academic Excellence; (2) Achieve Student Success: Academic, Personal, and Social; (3) Enhance Resources and the University's Capacity to Achieve Vision; and (4) Strengthen NJCU Identity, Brand, Reputation, and Connections with the Community.

The master's program in business analytics and data science will be one of the most quantitative programs at NJCU and will attract students with high critical thinking and quantitative abilities, thereby enhancing academic excellence at the university. Students will be

mentored by strong faculty with years of experience working in the industry, and strong theoretical and research background, thus ensuring student success. The School of Business will also pursue student internship opportunities at various firms, thus dramatically increasing student's job prospects. The program will enhance NJCU's instructional resources through the use of innovative and state of the art teaching tools such as the Trading Simulation lab and the Data Science lab at the School of Business. Finally, the master's program in business analytics and data science will certainly strengthen NJCU's identity, brand, reputation, and connections with the external community. The program will be one of the most quantitative programs in the university, producing quality graduates who will go on to make significant contributions to the business community, adding to the academic reputation of the university.

IV. NEED

The business world is rapidly transforming into a data driven one. There is a deluge of valuable data being generated in every facet of business, rightfully earning the moniker "Big Data". Analyzing this avalanche of data has become paramount in making business decisions. It is becoming more and more apparent that those who have the skills to analyze big data will be the most sought after in the 21st century.

Employment Opportunities

A recent study by McKinsey Global Institute (Manyika, Chui, Brown, Bughin, Dobbs, & Roxburgh, 2011) projects about 500,000 jobs requiring data analysis skills by 2018, with a shortage of about 190,000 jobs representing a gap of 50% to 60% between supply and demand. Data analysis jobs are also lucrative with average salaries in the six figures. A recent analysis by WANTED Analytics (King & Richards, 2014) cited in Forbes magazine, puts the median annual salary for data science professionals at $104,850 and finds that demand has almost doubled in the past year. A recent MIT Sloan School of Management survey (Ransbothm, Kiron, & Prentice, 2015) reports that four in ten companies surveyed reported that the lack of professionals with data analytics skills as a key challenge. According to a new research survey (Boulton, 2015) of 430 senior executives conducted by the consulting firm A.T Kearny, two thirds mentioned the inability to hire personnel with data analysis skills, due to lack of supply. The survey also found that data analysis positions are expected to increase by 33% in the next five years. A survey by Dell, Inc. (Dell Survey, 2014) shows that midmarket companies are aggressively embracing big data projects (96% of companies surveyed). To cap it all, the Data Scientist job has been dubbed the "sexiest" job in the 21st century by a Harvard Business Review article (Davenport & Patil, 2012).

Thus, the above mentioned surveys provide ample evidence that the demand far outstrips supply for data science professionals.

Market Demand

The strong demand and high salaries for data science professionals has led to strong demand for academic programs that prepare students for the profession. Many of the top universities across the nation have started masters and certificate programs in Data Science in the past two years and have seen strong enrollment in these programs.

Several universities in New Jersey, such as Stevens Institute of Technology have also started data science certificate or masters programs just in the last year. New York City and New Jersey being the hub of the financial services industry, generate strong demand for professionals with data analytics skills. The Exchange Place location in New Jersey, where the NJCU School of Business is located, is home to many financial firms such as DTCC and ICAP and many information technology headquarters of large firms such as Toronto Dominion. This makes NJCU School of Business uniquely positioned to serve the demand for data science professionals from the large number of businesses in this area.

Thus, market demand for higher education programs in data science is strong (Lipman, B. 2014) and the NJCU School of Business is well positioned, both from a locational and resources standpoint, to offer a high quality, cost effective master's program in Business Analytics and Data Science.

Relationship of Program to NJCU Strategic Plan

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The master's program in business analytics and data science will be one of the most quantitative programs at NJCU and will attract students with high critical thinking and quantitative abilities, thereby enhancing academic excellence at the university. Students will be mentored by strong faculty with years of experience working in the industry, and strong theoretical and research background, thus ensuring student success. The School of Business will also pursue student internship opportunities at various firms, thus dramatically increasing student's job prospects. The program will enhance NJCU's instructional resources through the use of innovative and state of the art teaching tools such as the Trading Simulation lab and the Data Science lab at the School of Business. Finally, the master's program in business analytics and data science will certainly strengthen NJCU's identity, brand, reputation, and connections

with the external community. The program will be one of the most quantitative programs in the university, producing quality graduates who will go on to make significant contributions to the business community, adding to the academic reputation of the university.

Comparison to Other Masters Programs

The following universities in New Jersey offer graduate programs in data science

University	Degree	Department
Stevens Institute of Technology	MS in Business Intelligence and Analytics	School of Business
Rutgers University	MBA with Analytics and Information Management concentration Professional Science Masters, Analytics and Data Science concentration	School of Business
St Peters University	MS in Data Science	Data Science
Thomas Edison State College	MBA in Data Analytics	School of Business

Only four universities in New Jersey offer graduate programs in business analytics and data science. Of these four only two offer a Master of Science degree, while the other are MBA programs with a concentration in data science. Thus, there are only two master's programs solely focused on data science.

The NJCU School of Business's MS in Business Analytics and Data Science program will be a rigorous practice oriented program focused on providing a strong foundation in the techniques and tools employed in the field of data science, while providing the opportunity for the students to acquire further specialization, by means of electives, in four fields – finance, marketing, management and accounting. Thus, the NJCU program will be highly competitive with the other programs and will be among the most cost effective, high quality programs not only in New Jersey but also in the tri state area.

V. STUDENTS

The curriculum for the MS in Business Analytics and Data Science will require the completion of 39 credits and is designed to be completed either with part-time or full time study. The goal of the program will be to recruit fifteen students in the first year of the program and ramp up to over sixty students in the program in year five.

Candidates will be recruited from diverse educational and career backgrounds. The program plans to recruit candidates from the tristate area, nationwide, and internationally. Recruitment efforts will be particularly concentrated in the Exchange Place locality to take

advantage of the rich pool of IT professionals working at the businesses in the area, who will be a good fit for this program.

A marketing plan for the program that involves online, print, and radio advertisements, open houses, and direct outreach to potential candidates will be put together to drive recruitment.

Estimated Student Enrollment

At least fifteen students are expected to enroll in the first year of the program. Enrollment is expected to reach over sixty students by year five.

Academic Year	New Students	Continuing Students*	TOTAL
Year 1	15	0	15
Year 2	20	14	34
Year 3	25	18	43
Year 4	30	23	53
Year 5	35	27	62

*Assuming approximately 10% attrition rate per year

Revenue: Tuition and Fees

The revenue from tuition and fees, based on projected student enrollment is detailed below:

Academic Year	No of Students enrolled	Tuition and Fees*
Year 1	15	$207,805
Year 2	34	$443,318
Year 3	43	$560,085
Year 4	53	$688,727
Year 5	62	$805,494

* Tuition / Fees are $659.70 / per credit. It is anticipated that students will register for 21 credits in the first year and 18 credits in the second year; this is reflected in the revenue.

Expenses

The projected expenses for the program are detailed below:

Expense	Year 1	Year 2	Year 3	Year 4	Year 5
Faculty*		$110,495	$113,810	$227,720	$234,550
Faculty Summer Pay**	$9,000	$9,000	$9,000	$9,000	$9,000
Program Coordinator release time**	$9,000	$9,000	$9,000	$9,000	$9,000
Marketing***	$20,000	$15,000	$15,000	$10,000	$10,000
Graduate Assistant****		$4000	$8000	$12000	$16000
Software	$10,000	$10,000	$10,000	$10,000	$10,000
Library	$5000	$5000	$5000	$5000	$5000
Total	$53,000	$162,495	$169,810	$282,720	$293,550

* Salaries reflect base plus 34.75% benefits and a 3% yearly increase
** Assumes rate of $1500/credit.
***Reflects higher initial cost to start up the program
****Assumes one graduate assistant at $4000 per year

Summary

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	$207,805	$443,318	$560,085	$688,727	$805,494
Expense	$53,000	$162,495	$169,810	$282,720	$293,550
Net	$154,805	$280,823	$390,275	$406,007	$511,944

IV. PROGRAM RESOURCES

Additional Resources:

Faculty Resources

No additional faculty needs are anticipated for the first year of the program. One full time faculty will be hired in year 2 and year 4 of the program, subject to the program meeting student enrollment projections.

Technology Resources

The following are the software required for the program:

Software	Cost
Python (including SciPy, NumPy)	Open Source (free)
R	Open Source (free)
Apache Spark	Open Source (free)
Apache Hadoop	Open Source (free)
MongoDB	Open Source (free)
Google TensorFlow	Open Source (free)
SAS	$8,840 Annual fee for 25 licenses
SPSS	University currently has adequate licenses
LINGO	$470/License

The above mentioned software needs to be installed on all the machines in the Data Science lab and the Trading lab at the School of Business. Information Technology (IT) resources will be needed to install and maintain the above software.

Library Resources

The Guarini library at NJCU has extensive resources to aid student learning and research. The library subscribes to 150 online databases and has a physical collection of over 300,000 volumes and an e-book collection of over 150,000 volumes.

The program coordinator for the MS in Business Analytics and Data Science will work with the Guarini library to continue to add additional books and journals in support of the curriculum and research needs of the students and faculty.

Facilities Resources

The new NJCU School of Business location at Exchange Place provides a world class facility for students and faculty. Its proximity to New York City and Wall Street will be a huge plus in attracting students for the program. The current classroom and office space available at the School of Business will be adequate for the new program.

Degree Requirements:

Admissions

The following are the requirements for all applicants to the MS in Business Analytics and Data Science program:

- Bachelor's degree

All applicants must have an earned bachelor's degree with a major in fields such as mathematics, statistics, engineering, computer science, finance, economics, marketing, management and accounting. Official transcripts are required from each institution in which bachelor's and master's level credits were earned. Applicants with credentials from outside the United States must have their transcripts evaluated by a member organization of the National Association of Credential Evaluation Services.

- Grade Point Average

Applicants must have a minimum grade point average of 3.00 out of 4, in a nationally accredited Bachelor's Program.

- Standardized Test Scores or Scores

Applicants must provide evidence of having taken the Verbal, Quantitative and Analytical Writing tests of the Graduate Record Examination (GRE) or the Graduate Management Admissions Test (GMAT) within the last five years. They must have achieved minimum GRE scores of 150 out of 170 on the verbal reasoning and 155 out of 170 on the quantitative reasoning sections of the test, or a minimum GMAT score of 580, with analytical writing scores of 4.0 or higher out of 6.0. International students must have earned a minimum score of 70 on the Test of English as a Foreign Language (TOEFL). GRE/GMAT scores can be exempt on a case by case basis, based on GPA and work experience.

- Letters of recommendation

Three letters of recommendation should be submitted, based on academic or professional experience.

- Writing sample

A personal Statement of Purpose, of between 1000 and 2000 words, should describe the applicant's reasons for applying to the program and ways in which his or her experience, skills, and goals are aligned with the program.

- Resume Curriculum Vitae

A current resume / curriculum vitae that outlines the applicant's educational background, employment history, professional activities, and other activities that provide support for the Statement of Purpose.

Program Curriculum

The Master of Science in Business Analytics and Data Sciences will require the completion of 39 credits (9 core courses and 4 electives). The electives allows students to specialize in four areas – Finance/Economics, Management, Marketing and Accounting – depending upon their interests. A description of the core courses and the electives are provided in Appendix A. The curriculum is designed to be pursued on a full time or part time basis and should take two to two and a half years to complete.

Course Schedule

A suggested plan of study for a full time student is shown below:

Year	Term	Course #	Course Title	# of Credits
Year 1	Fall	BADS 601	Introduction to Data Science	3
	Fall	BADS 603	Statistical and Mathematical Methods for Data Science	3
	Fall	BADS 605	Programming for Data Science	3
	Spring	BADS 607	Data Collection, Data Warehousing and Data Cleansing	3
	Spring	BADS 609	Applied Regression and Time Series Analysis	3
	Spring	BADS 611	Introduction to Machine Learning	3
	Summer	BADS 613	Experimental Design	3
			Total Year 1	21

Year 2	Fall	BADS 615	Data Visualization and Communication	3
	Fall		Elective 1	3
	Fall		Elective 2	3
	Spring		Elective 3	3
	Spring		Elective 4	3
	Spring	BADS 617	Thesis / Capstone Project in Data Science	3
			Total Year 2	18

APPENDIX A. Course Descriptions

Core Courses

BADS 601 Introduction to Data Science

This course will introduce students to the fundamentals of data science. Students will learn to identify, classify and frame data science problems and get an introduction the various tools available for data analysis.

BADS 603 Statistical and Mathematical Methods for Data Science

This course will introduce students to the statistical and mathematical methods needed in the practice of data science. Students will learn the basics of statistics, probability, linear algebra and optimization techniques relevant to data science.

BADS 605 Programming for Data Science

Students will be introduced to the R programming language and the Python programming language, which are the two widely used programming languages in the field of data science.

BADS 607 Data Collection, Data Warehousing and Data Cleansing

Real world data is large and imperfect. Students will learn how to effectively store and access large amounts of data and clean/normalize the data to get it ready for meaningful analysis. Open source software such as Apache Spark and Hadoop will be introduced.

BADS 609 Applied Regression and Time Series Analysis

Students will learn univariate and multivariate regression analysis and various time series analysis techniques needed to model and make meaningful inferences from data.

BADS 611 Introduction to Machine Learning

This course will provide a broad introduction to the different aspects of machine learning. Through practical examples, students will learn techniques for recognizing patterns in data.

BADS 613 Experimental Design

This course will provide students with a thorough understanding of Experimental design and to help students develop the skills necessary to efficiently and effectively design and analyze experiments. Common techniques used in Experimental Design such as Fixed Effects model, Random Effects model, Mixture experiment, Factorial Design, and Latin Square will be

discussed in depth. Students will also be exposed to techniques such as Blocking and Confounding, Response Surface Methods and Designs, Nested and Split-Plot Design, as well as Repeated Measures. This course will prepare students for all the data analysis jobs.

BADS 615 Data Visualization and Communication

Effective visualization of data and proper communication of the results of your data analysis is as important as modeling and performing the analysis. This course will provide students with techniques and state-of-the art practice in data visualization and communication. The course will explore rationalization of using a particular chart and or table and illustrations of patterns and connections to the data and verbal information. The course will also explore a wide range of techniques from simple descriptive charts and maps to multidimensional analysis using dashboards. The course will help students develop creative questions and recommendations to improve business processes and better decision making.

BADS 617 Thesis / Capstone Project in Data Science

In this culminating thesis/project students will choose a data analysis problem from any field that they are interested in and will solve the problem using the techniques learned in the program.

Electives

Finance/Economics Electives

FINC XXX Big Data in Capital Markets

Capital markets generate enormous amounts of real-time data. Algorithms that exploit the big data to provide trading signals are extremely valuable and lucrative. Students will learn about high frequency trading and the challenges of analyzing huge amounts of data in real-time. Algorithms and data storage and retrieval techniques commonly used on Wall Street will be studied.

FINC XXX Financial Systems

Financial systems are the centerpiece of well-oiled financial markets and are extremely complex. Students will learn the basics of financial systems design. Different types of systems, from risk management systems to algorithmic trading systems and their nuances will be discussed.

FINC XXX Risk Management

This course will give students an overview of financial risk management. Students will get a broad understanding of market risk, credit risk and operational risk and how data science techniques are applied in the field of risk management.

FINC 625 Financial Modeling

This course will cover standard financial models in the areas of corporate finance, portfolio management and valuation of options and other securities. Various techniques such as Monte Carlo simulation and optimization will be covered. Implementation of these models in Excel or R will be covered.

Management Electives

MGMT XXX Supply Chain Analytics

This course will provide students with a thorough understanding of supply chain analytics such as location decision, inventory control, quality assurance (QA), quality function deployment (QFD), supplier selection, and multi-criteria decision making. Supply Chain Analytics is one of the crucial business areas using business intelligence applications and dealing with Big Data. Students will be exposed to aforementioned critical and effective techniques used in supply chain management. Students will also be exposed to data-driven decision making processes and data handling including processes of gathering, storing, manipulating, analyzing, and visualizing data within and intra organizations. This course will prepare students for the supply chain analytics and supply chain management areas of the supply chain professional certifications and data analysts.

MGMT XXX Optimization and Decision Modeling

This course will introduce optimization modeling including linear, integer, non-linear models for optimization. The course will use graphical analysis, simplex methods, and branch-and-bound and other methods. The course further investigates queuing theory, simulation, and transportation and inventory models. Additional topics include critical path methods and project evaluation and review technique (CPM-PERT) and decision tree as well as multi-criteria decision making techniques such as data envelope analysis (DEA) and analytic hierarchy process (AHP). Students will use state-of-the-art software for optimization with big data. Students will develop decision models and conduct sensitivity analysis to apply results and implications to business decision making. The course will prepare students for certified analytics professionals.

MGMT XXX Strategic Human Resource Management

Strategic human resource management will be explored in this course, examining employees as "investments," identifying trends that affect human resources management practices, describing what strategic HR is (particularly in contrast to more traditional approaches to HR), and look at how both the design of work systems and relevant employment laws influence the practice of managing people in organizations. The course will further examine strategic issues related to staffing, training, performance management, compensation, labor relations, employee separation, and managing a global workforce. Within the scope of the course, students will practice reading for comprehension, purposeful writing for academic papers, and oral expression of clear concepts and the application of theory. Readings will be assigned for

each week's class. We will hold class discussion, role playing and in-class debates regarding topical ethical issues. Everyone will be engaged in researching, writing, and presenting one or more academic paper. There will be significant emphasis on the refinement of the broad skills necessary for successful management in a firm. To that end, we will focus on reading for comprehension, computer literacy, writing, oral communication, presentation, and critical thinking.

MGMT XXX Project Management and Analytics

This course will provide students with a thorough understanding of project management with analytics. For successful project management, students will integrate data analytics and principle and theory of project management in line with practical case studies. The students will have opportunities to use skill sets such as probability distribution, analytic hierarchy process and analytic network process, lean six-sigma, and simulation modeling for project management. The students will have a realistic group project using data analytics and real public and private datasets considering time, budget, and resource constraints during the course. This course will prepare students for the project management professionals and certified analytics professional.

Marketing Electives

MKTG XXX Digital Marketing

Digital marketing is a field where data analysis techniques are widely used. This course will give an overview of data science techniques in the field of digital marketing.

MKTG XXX Big Data in the Retail Industry

The retail industry produces large amounts of data on customer buying patterns etc. The retail industry is at the fore front of big data analytics currently. This course will cover the big data techniques used in the retail industry to make decisions.

MKTG XXX Customer Relationship Management

The transactions that customers generated with the company as well as the company's communications with the customer created large amounts of data. This course will cover the current techniques such as CLV, BG/BB model that are used to deal with the customer data.

MKTG XXX Advanced Probability Models and Bayesian Analysis in Marketing

This course will provide students with the advanced probability models as well as the Bayesian data analysis that are applied to deal with different kinds of research problem in marketing.

Accounting Electives

ACCT XXX Big Data and Accounting

This course will introduce students to the application of big data techniques in the field of accounting.

ACCT XXX Auditing and Data Analytics
This course will give students a good understanding of using data analysis in the field of public auditing and internal auditing.

ACCT XXX Big Data Ethics and Governance
This course will explore the ethics behind the use of Big Data. Issues around privacy and confidentiality of data and transparency of data will be discussed. Governance issues around big data will also be addressed.

ACCT XXX Forensic Accounting and Big Data Analytics
Students will learn about the use of Big Data techniques in the field of forensic accounting, to detect white collar crime and fraud.

APPENDIX B.

References

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