



BOARD OF REGENTS
SUMMARY OF ITEM FOR ACTION,
INFORMATION, OR DISCUSSION

TOPIC: University of Maryland, College Park: Master of Science in Business Analytics

COMMITTEE: Education Policy and Student Life

DATE OF COMMITTEE MEETING: March 8, 2016

SUMMARY: The large amount of data that exists or has the potential to exist in organizations will only continue to grow with the advent of new methods of capturing data and ever-increasing storage capacity. Modern management professionals and business data analysts increasingly need significant mathematical, statistical, and technical knowledge to understand and manage data available to business and other organizational enterprises. According to McKinsey & Company, an international business consulting firm, there is a national shortage of professionals skilled in “big data” analytical skills: “The United States alone faces a shortage of 140,000 to 190,000 people with analytical expertise and 1.5 million managers and analysts with the skills to understand and make decisions based on the analysis of big data.” (McKinsey & Company. *Big Data: The next frontier for competition*)

This proposed program will develop mathematical and statistical skills such as quantitative modeling, operations management, data mining and simulation, and will develop technical skills required to manage network and infrastructure requirements. These computational and technical skills will provide a strong foundation for a broad array of careers in business and organizational analysis, including but not limited to the following: healthcare analytics, fraud detection, transportation analytics, operational analytics, management analytics, and procurement analytics.

While there is overlap with the Data Analytics program offered by the University of Maryland University College, however, according to MHEC’s enrollment information, in 2014 UMUC’s program enrolled 193 students. According to state projections, management analysts will provide 6,705 new positions in the state by 2022. Other business-oriented analytical professions are also expected to gain positions by 2022: statisticians (+1,567), budget analysts (+1,097), financial analysts (+1,993), logisticians (+1,677), and market research analysts (+3,082). (Maryland Department of Labor, Licensing and Regulation. *Maryland Occupational Projections-2012-2022*) The management analyst profession nationwide is also projected to grow much faster than average (an additional 103,400 positions by 2024), according to the US Bureau of Labor Statistics. (United States Department of Labor. *Occupational Outlook Handbook*)

ALTERNATIVE(S): The Regents may not approve the program or may request further information.

FISCAL IMPACT: No additional funding is necessary.

CHANCELLOR’S RECOMMENDATION: That the Committee on Education Policy and Student Life recommend that the Board of Regents approve the proposal from the University of Maryland, College Park to offer a Master of Science in Business Analytics.

COMMITTEE RECOMMENDATION:

DATE: March 8, 2016

BOARD ACTION:

DATE:

SUBMITTED BY: Joann Boughman

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A. Centrality to the University's Mission and Planning Priorities;

As the flagship campus of the University System of Maryland, and the original 1862 land-grant institution in the State, the University of Maryland, College Park (UMD) has a mission to provide excellent teaching, research, and service to nourish a climate of intellectual growth and provide outstanding instruction in a broad range of academic disciplines and interdisciplinary fields. UMD has as a primary goal to provide knowledge-based programs and services that are responsive to the needs of the citizens across the state and throughout the nation. In response to this call, the Robert H. Smith School of Business proposes to offer a new Master of Science program in Business Analytics. Students in this program will develop significant mathematical, statistical, and computational capabilities needed to understand, manage, and use large amounts of data for optimal business and organizational decision-making. The Master of Science in Business Analytics will serve UMD's institutional priority of having graduate programs of the highest quality, as this new program will train a new generation of business analysts who are knowledgeable and skilled in the analysis of large amounts of data and its application to a variety of organizational functions and environments.

B. Adequacy of Curriculum Design and Delivery

The proposed program will require 30 credits composed of required courses, electives, and a capstone project. Required courses include the following: BUSI630 Data, Models, and Decisions (3 Credits); BUDT732 Decision Analytics (3 Credits); BUDT733 Data Analytics (3 Credits); and BUDT 704 Database Management Systems (3 Credits) (see Appendix A for a list of courses). The elective courses (15 credits) will be offered in a manner that will allow students to focus in one particular area or take a set of courses that will allow them to broaden their knowledge. The capstone course will require students to apply the modeling and optimization knowledge and skills they have learned in the program to real world operational data.

Educational Objectives

The proposed program has the following educational objectives:

1. Provide students with comprehensive training in foundations and methodology of quantitative managerial analysis;
2. Provide students with comprehensive training in data analysis and data-based managerial decision making;
3. Provide students with an in-depth training on methods and tools of contemporary data analytics and big data;
4. Provide students with a strong background in spreadsheet-based modeling and optimization fundamentals and techniques;
5. Provide students with a good understanding of modern computational data analysis techniques such as data mining, Monte Carlo and discrete event simulation, and network analytics;
6. Provide students with strong hands-on training in data handling and data base management;
7. Provide for mastery of the contemporary software used for managerial quantitative and data analysis including web-based software and tools.

Student Learning Outcomes:

1. Students will demonstrate a clear understanding of the fundamental concepts of Statistics, Data Analysis, Quantitative Modeling, Simulation, and Optimization.
2. Students will demonstrate proficiency in the practical tools and techniques of modern Business Analytics.
3. Students will demonstrate written and oral communication skills through class participation and group presentations.
4. Students will demonstrate their ability to work effectively with other members of a team in the preparation of a group project.
5. Students will demonstrate a deeper understanding of one or more areas of Business Analytics, related to their chosen career path or specialized plan of study.

See Section L of this proposal for the program assessment plan.

C. Critical and Compelling Statewide Need;

As the Maryland State Plan for Postsecondary Education states, “In order to maintain and improve quality and effectiveness, institutions and their leaders must have the flexibility and resilience to address the changing needs of the State and its citizens.”¹ The large amount of data that exists or has the potential to exist in organizations will only continue to grow with the advent of new methods of capturing data and ever-increasing storage capacity. Modern management professionals and business data analysts increasingly need significant mathematical, statistical, and technical knowledge to understand and manage data available to business and other organizational enterprises. According to McKinsey & Company, an international business consulting firm, there is a national shortage of professionals skilled in “big data” analytical skills: “The United States alone faces a shortage of 140,000 to 190,000 people with analytical expertise and 1.5 million managers and analysts with the skills to understand and make decisions based on the analysis of big data.”²

This program will develop mathematical and statistical skills such as quantitative modeling, operations management, data mining and simulation, and will develop technical skills required to manage network and infrastructure requirements. These computational and technical skills will provide a strong foundation for a broad array of careers in business and organizational analysis, including but not limited to the following: healthcare analytics, fraud detection, transportation analytics, operational analytics, management analytics, and procurement analytics.

D. Market Supply and Demand;

This program will benefit students who are interested in becoming an analytics professional. According to the Maryland State Department of Labor, Licensing, and Regulation, the long term projections for these professions are promising. According to state projections, management analysts will provide 6,705 new positions in the state by 2022. Other business-oriented analytical professions are also expected to gain positions

¹ Maryland Higher Education Commission. *Maryland Ready: 2013-2017 Maryland State Plan for Postsecondary Education*. (P. 18). Retrieved from

http://www.mhec.state.md.us/higherEd/2004Plan/2013%20Maryland%20State%20Plan/MHECStatePlan_2014.pdf

² McKinsey & Company. *Big Data: The next frontier for competition*. Retrieved from

http://www.mckinsey.com/features/big_data

by 2022: statisticians (+1,567), budget analysts (+1,097), financial analysts (+1,993), logisticians (+1,677), and market research analysts (+3,082).³ The management analyst profession nationwide is also projected to grow much faster than average (an additional 103,400 positions by 2024), according to the US Bureau of Labor Statistics.⁴ As we see more specific fields branching into analytics, such as health care analytics, cybersecurity risk analysis, human resources analytics, criminal justice, and emergency and disaster response, the demand for this versatile field could be even larger. The program anticipates a yearly cohort of 40 students per year. Consequently, we anticipate the demand for graduates in this field will continue to exceed the number of graduates that UMD will supply.

E. Reasonableness of Program Duplication, if any;

Searching MHEC's website for other Master programs yields only two business analytics programs. First, University of Maryland University College (UMUC) offers an online Data Analytics program. UMUC's program description does indicate overlap in content with UMD's proposed program: "The Master of Science (MS) in Data Analytics is designed to meet the rising need for highly skilled professionals who can transform the growing amount of data confronting all organizations into usable information for use by their decision makers."⁵ According to MHEC's enrollment information, in 2014 UMUC's program enrolled 193 students.⁶ We believe that UMUC's program will not meet the demand that is projected for management analysts (see Section D above). Furthermore, our program will be the only option for students who are interested in a face-to-face educational experience. The other program with analytics in its title in a business context is UMD's own Marketing Analytics program. The Marketing Analytics program is different than the proposed program because Marketing Analytics focuses on marketing content. Marketing Analytics specializes in preparing students for careers in marketing.

F. Relevance to Historically Black Institutions;

We do not believe the proposed program will impact Historically Black Institutions (HBI's). No such programs currently exist at any of Maryland's HBI's. As we have stated, even after UMD's program is in operation, the demand for graduates in this area will continue to exceed the number of graduates that will be available should a Maryland HBI wish to offer a similar program. UMD's Robert H. Smith School of Business is already a nationally-recognized leader in business graduate programs and offers a number of master-level programs in business, including a Master of Business Administration, a Master of Finance, and Master of Science programs in Business in Business and Management, Accounting, Marketing Analytics, Supply Chain Management, and Information Systems. Accordingly, we do not believe that an additional program offered by the Smith School would impact on the uniqueness or institutional identity of any Maryland HBI.

G. Distance Education Program;

This program will not be a distance-education program.

H. Adequacy of Faculty Resources;

Faculty will be drawn from the Robert H. Smith School of Business. Biographies of the faculty expected to be teaching in the program are included in Appendix B.

³ Maryland Department of Labor, Licensing and Regulation. *Maryland Occupational Projections-2012-2022*. Retrieved from: <http://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml>.

⁴ United States Department of Labor. *Occupational Outlook Handbook*. Retrieved from: <http://www.bls.gov/ooh/business-and-financial/management-analysts.htm>.

⁵ University of Maryland University College. *Master of Science in Data Analytics*. Retrieved from: <http://www.umuc.edu/academic-programs/masters-degrees/data-analytics.cfm>.

⁶ Maryland Higher Education Commission. *Maryland Higher Education Trend Data and Program Inventory*. Retrieved from: http://data.mhec.state.md.us/mac_Trend.asp#trend.

I. Adequacy of Library Resources;

The University of Maryland Libraries has conducted an assessment of library resources required for this program. The assessment concluded that the University Libraries are able to meet, with its current resources, the curricular and research needs of the program.

J. Adequacy of Physical Facilities, Infrastructure, and Instructional Resources;

Delivery of this program will require some additional classroom utilization in existing buildings. Classes will be folded into our regular scheduling process. Some coursework requires a computer lab and computational resources, but these are available within the current capabilities of the campus.

K. Adequacy of financial resources;

See the resources and expenditures tables. Program expenditures will be accommodated by tuition revenue and with modest reallocation of the instructional budget of the Robert H. Smith School of Business.

L. Adequacy of Program evaluation;

The program learning outcomes will be assessed using the following framework:

Learning Outcome 1: Students will demonstrate a clear understanding of the fundamental concepts of Statistics, Data Analysis, Quantitative Modeling, Simulation, and Optimization.

Measure: Students will be required to pass a set of classes in each of these areas.

Criterion: At least 90% of students will receive a rating of "Satisfactory" or better from the Academic Director, who will review their performance in the core classes. The Academic Director will meet with students rated below "Satisfactory" to help improve their performance or determine their continued participation in the program. In addition, students must maintain a 3.0 GPA to remain in good academic standing. Failure to maintain a 3.0 jeopardizes continued enrollment in the program.

Assessment: Every Year, starting in the 2017-2018 academic year.

Learning Outcome 2: Students will demonstrate proficiency in the practical tools and techniques of modern Business Analytics.

Measure: Students must take and succeed in classes that teach the practical techniques of Business Analytics and their implementation with contemporary software applications.

Criterion: At least 90% of students will receive a rating of "Satisfactory" or better from the course instructor.

Assessment: Every Year, starting in the 2017-2018 academic year.

Learning Outcome 3: Students will demonstrate written and oral communication skills through class participation and group presentations.

Measure: All students must take the required courses that will include oral class participation and written case assignments to test these skills.

Criterion: At least 90% of students will receive a rating of "Satisfactory" or better from the course instructor.

Assessment: Every Year, starting in the 2017-2018 academic year.

Learning Outcome 4: Students will demonstrate their ability to work effectively with other members of a team in the preparation of a group project.

Measure: Students must prepare group projects as part of a class.

Criterion: At least 90% of students will receive a rating of "Satisfactory" or better from the course instructor.

Assessment: Every Year, starting in the 2017-2018 academic year.

Learning Outcome 5: Students will demonstrate a deeper understanding of one or more areas of Business Analytics, related to their chosen career path or specialized plan of study

Measure: Students will be required to pass elective classes related to their educational plan.

Criterion: At least 90% of students will receive a rating of “Satisfactory” or better from the Academic Director, who will review their performance in the core classes.

Assessment: Every Year, starting in the 2017-2018 academic year.

Formal program review is carried out according to the University of Maryland’s policy for Periodic Review of Academic Units, which includes a review of the academic programs offered by, and the research and administration of, the academic unit (<http://www.president.umd.edu/policies/2014-i-600a.html>). Program Review is also monitored following the guidelines of the campus-wide cycle of Learning Outcomes Assessment (<https://www.irpa.umd.edu/Assessment/LOA.html>). Faculty within the department are reviewed according to the University’s Policy on Periodic Evaluation of Faculty Performance (<http://www.president.umd.edu/policies/2014-ii-120a.html>). Since 2005, the University has used an online course evaluation instrument that standardizes course evaluations across campus. The course evaluation has standard, university-wide questions and also allows for supplemental, specialized questions from the academic unit offering the course.

M. Consistency with Minority Student Achievement goals;

The Robert H. Smith School of Business community is multifaceted at every level – students, staff and faculty represent a diverse blend of backgrounds, nationalities, ethnicities and experiences. About a dozen Smith School and student clubs are focused on bringing members together who have similar interests in gender, nationality, religion, and sexual orientation.

Current efforts include a wide range of recruiting efforts, including visits to academic program fairs, use of social media, visits to U.S. colleges and universities, presentations at professional conferences, and participation in Graduate Business Education events targeted for populations typically underrepresented in graduate business programs, particularly U.S. minorities and women. Future efforts will include targeted recruiting towards military families and veterans, highlighting of alumni and current graduate students who reflect a more diverse population. The School also engages in recruiting and outreach events across the globe to generate a diverse student body.

N. Relationship to Low Productivity Programs;

N/A

Estimated Resources and Expenditures

Resources Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	None	None	None	None	None
2. Tuition/Fee Revenue	\$1,384,200	\$1,384,200	\$1,845,600	\$1,956,069	\$2,069,760
a. FT Students	30	30	40	41	42
b. Credit Hour Rate⁷	\$1,538	\$1,538	\$1,538	\$1,539	\$1,540
c. Annual Credit Hours	30	30	30	31	32
d. Annual Tuition/Fee Rate	\$46,140	\$46,140	\$46,140	\$47,709	\$49,280
3. Grants, Contracts, & Other					
4. Other Sources					
TOTAL (Add 1 - 4)	\$1,384,200	\$1,384,200	\$1,845,600	\$1,956,069	\$2,069,760
Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Total Faculty (b+c)	\$496,800	\$511,704	\$595,801	\$682,420	\$771,639
a. #FTE	2	2	2	3	4
b. Total Salary	\$414,000	\$426,420	\$496,501	\$568,684	\$643,032
c. Total Benefits	\$82,800	\$85,284	\$99,300	\$113,737	\$128,606
2. Total Administrative (b+c)	\$116,415	\$119,908	\$123,505	\$127,210	\$131,026
a. #FTE	1	1	1	2	3
b. Total Salary	\$97,013	\$99,923	\$102,921	\$106,008	\$109,189
c. Total Benefits	\$19,403	\$19,985	\$20,584	\$21,202	\$21,838
3. Total Support Staff (b+c)	\$192,590	\$198,368	\$204,319	\$210,449	\$216,762
a. #FTE	3	3	3	4	5
b. Total Salary	\$160,492	\$165,307	\$170,266	\$175,374	\$180,635
c. Total Benefits	\$32,098	\$33,061	\$34,053	\$35,075	\$36,127
4. New or Renovated Space	\$0	\$0	\$0	\$0	\$0
5. Student Services	\$20,000	\$40,000	\$60,000	\$60,000	\$60,000
6. Marketing	\$50,000	\$75,000	\$75,000	\$75,000	\$75,000
7. Recruiting & Admissions	\$50,000	\$75,000	\$75,000	\$75,000	\$75,000
8. Career Services	\$50,000	\$75,000	\$100,000	\$100,000	\$100,000
9. Student Aid	\$50,000	\$100,000	\$100,000	\$100,000	\$100,000
10. Other Expenses	\$0	\$0	\$0	\$0	\$0
TOTAL (Add 1 - 10)	\$1,025,806	\$1,194,980	\$1,333,625	\$1,430,079	\$1,529,427

⁷ Assumes the FY16 Board of Regents approved in-state rate or \$1538 per credit-hour for the RHS School of Business.

Appendix A

Master of Science in Business Analytics

Course Descriptions

BUSI 630 Data, Models, and Decisions (3): Introduces students to analytical techniques that establish the optimality of managerial decisions via empirical (“data models”) and logical (“decisions”) means. The course may be viewed as consisting of two integrated parts. In the first part, various methods of analyzing data, including regression analysis are studied. The second part covers models for making optimal decisions in situations characterized by either an absence of uncertainty or where the uncertainty arises from non-competitive sources.

BUDT 732 Decision Analytics (3): This course explores basic analytical principles that can guide a manager in making complex decisions. It focuses on two advanced analytics techniques: optimization, dealing with design and operating decisions for complex systems, and simulation, dealing with the analysis of operating decisions of complex systems in an uncertain environment. The course provides students with a collection of optimization and simulation modeling and solution tools that can be useful in a variety of industries and functions. The main topics covered are linear, integer, and nonlinear optimization applications in a wide variety of industry segments, and Monte-Carlo Simulation and risk assessment. Application-oriented cases are used for developing modeling and analytical skills, and to simulate decision-making in a real-world environment.

BUDT 733 Data Analytics (3): Increasingly, governments and businesses are collecting more and more data. Examples include the Internet, point-of-sale devices, medical databases, search engines, and social networks. The increased data availability coupled with cheap computing power provides us with an unprecedented opportunity to use sophisticated data-driven mathematical models to achieve many important goals and/or gain a competitive edge. This course gives an overview of the data-mining process, from data collection, through data modeling and analytical algorithms, to data-driven decision making. The focus is on introducing data-mining algorithms such as logistic regression, classification trees and clustering, and their application to real-world data, as well as introducing some of the more recent developments in the field such as ensemble methods.

BUDT 704 Database Management Systems (3): Provides fundamental concepts and skills necessary for designing, building, and managing business applications which incorporate database management systems as their foundation. Topics covered include the fundamentals of database management (DBMS) technology, alternative methods for modeling organizational data, the application of delivering data through Web-based and other graphical interfaces. Non-majors should review their registration eligibility in the statement preceding the BUDT courses.

Elective and Capstone Project Courses

The elective courses will be offered in a manner that will allow students to focus in one particular area (for a depth of knowledge), to take a set of courses that will allow them to broaden their knowledge, or a combination of both. While many of the sections being offered will be new, we will also give students flexibility in taking courses within other relevant programs. These will be approved by the academic director of the program on a case by case basis as necessary. The initial set of electives that are being planned will include the following.

BUDT 758K Computer Simulation for Business Applications (3): This course covers the basic techniques for computer simulation modeling and analysis of discrete-event systems. Course emphasis is on conceptualizing abstract models of real-world systems (for example, inventory and queuing systems), implementing simulations in special purpose software, planning simulation studies, and analyzing simulation output. Some mathematical theory will be covered.

BUDT 706 Social Media and Online Analytics (3): Over the past years, social computing technologies such as online communities, blogs, wikis, and social networking systems have become important tools for individuals to seek information, socialize with others, get support, collaborate on work, and express themselves. Increasingly, businesses

are trying to leverage web 2.0 by using social computing technologies to communicate with customers, employees, and other business partners or to build new business models. This course will review concepts and principles related to web 2.0 and examine issues and strategies associated with business use of social computing technologies.

BUDT 758X Big Data: Strategy, Management and Applications (3): Digitization is occurring in every aspect of business and our daily lives, generating a huge amount of data. Big data represents unprecedented opportunities for companies to generate insights to improve products and services and contribute to the bottom line. At the same time, much of the big data is unstructured, in real time and only loosely connected. It defies the traditional ways of managing databases. This creates challenges even to tech-savvy companies on how to leverage the big data to gain competitive advantage. This course provides cutting edge knowledge about various aspects of big data, including: how to identify strategic values of big data, major types of big data, methods to capture and store big data, analytical tools for big data, and pitfalls to avoid in formulating a big data strategy. In the end of the course, students will have a comprehensive understanding of important business issues related to big data, and be able to successfully design and implement big data strategy.

BUDT 758X Price Optimization and Revenue Management (3): Revenue (or yield) management (RM) first emerged in the post-deregulation US airline industry, and hit the jackpot in the mid 90's with American Airlines RM scoring \$1 billion annual incremental revenues. The business strategy reformed the entire transportation and tourism industry, as well as telecommunications, broadcasting, ticketing, healthcare, fashion, manufacturing etc. Recently RM evolved to a new dimension with internet companies practicing dynamic and targeted pricing or auctions for products, services or advertisement slots. This course that specializes on dynamic price optimization and revenue management is meant to provide students with the right bundle of tools and principles, drawn from several disciplines in order to maximize profits. The RM solution integrates pricing with sales and inventory management strategies. The first part of the course addresses pricing issues such as pricing under various constraints, non-linear pricing, markdown pricing. The second part of the course provides tools and methods for combined pricing and capacity management decisions from an operational perspective.

BUDT 758F Google Online Challenge Analytics (3): This course is a hands-on learning-by-doing course. Students will design, develop, and implement sponsored search strategies for real-world clients are part of the Google Online Challenge. Students will work in teams of 4 or 5, spend real advertising dollars to run a sponsored-search advertising campaign for their client. In conjunction with the client, students will also develop digital and social media strategies that complement and support their sponsored search advertising campaigns on Google. The teams will also learn to use analytical tools to analyze the performance of their campaigns and provide guidelines to the client for future campaigns. This “real-time, real-business, real-money” challenge provides a valuable opportunity for students to gain a first-hand experience with online advertising and benefit from the immediate campaign performance feedback. At the end of this course, a student should feel comfortable developing and implementing digital strategies and executing online campaigns for firms. They should know all the key terminology and theories of the field and have a good idea of how things work below the surface.

BUDT 758X Healthcare Analytics (3): This class will focus on some of the key aspects of conducting analysis and applying the results in the health care system. The course will a) discuss the business of health care, payment systems and insurance b) discuss health care data, privacy and HIPAA, and c) explore successful implementations of analytics in healthcare settings. Various applications of healthcare analytics will be discussed, focusing on costs, operations, quality, equity, and access.

BUDT 758X Operations Analytics (3): This course explores analytical methods, tools and strategies that can enable firms to achieve effective and sustainable operations. The course covers a mix of qualitative and quantitative problems and issues confronting operations managers. The first part of the course focuses on analytics that measure the performances of business operations, explaining how to measure key process parameters like capacity and lead time and analyze the impact of variability on business processes. The second part of the course focuses on analytics that improve the performances of business operations, examining analytics in quality management as well as recent

moves toward lean operations. The course also includes a module on inventory analytics with applications in pricing and revenue management. Throughout the course various operations analytics applied to real operational challenges are illustrated. The aim is to provide both tactical knowledge and high-level insights of operations analytics needed by general managers and management consultants. It is also demonstrated how companies can use operational principles from to significantly enhance their competitiveness.

BUDT 758X Capstone Project in Operations Analytics (3): This course gives students an opportunity to apply the knowledge and skills they learned in the program on real world operational data through quantitative analysis with use of statistical models and the application of modeling and optimization techniques. Students form teams of 4-5 members and pursue an operational improvement project under the supervision of the instructor. The project groups are expected to suggest operational and business improvements and solutions based on analytical techniques and methods for the case they are analyzing.

Appendix B

Master of Science in Business Analytics

Faculty Credentials

Ritu Agarwal, Professor & Area Chair, Decision, Operations & Information Technologies, Robert H. Smith School of Business. Distinguished Scholar-Teacher; B.A., University of Delhi, 1982; M.B.A., Indian Institute of Management, Calcutta, 1984; Ph.D., Syracuse University, 1988; M.S., 1988. Teaching/research focus: Management of Information Systems, Health Care Information Systems. Courses: To be determined.

Pamela K. Armstrong, Clinical Associate Professor of Management Science, Robert H. Smith School of Business. B.S., Systems Engineering, University of Arizona. M.S., Industrial Engineering & Operations Research, University of California, Berkeley; Ph.D., Operations and Information Management, The Wharton School, University of Pennsylvania; Teaching/research focus: Service operations, quality, and performance management. Courses: BUDT 732 Decision Analytics (3), BUDT 758X Operations Analytics (3).

Michael O. Ball, Professor, Senior Associate Dean & Dean's Chair in Management Science, Robert H. Smith School of Business. B.E.S., Johns Hopkins University, 1972; M.S.E., 1972; Ph.D., Cornell University, 1977. Teaching/research focus: Network optimization and integer programming particularly as applied to problems in transportation systems and supply chain management. Courses: BUDT 758X Pricing Optimization and Revenue Management (3).

Sean Barnes, Assistant Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.S., Georgia Institute of Technology, 2006; M.S., 2007; Ph.D., University of Maryland-College Park, 2012. Teaching/research focus: Modeling, simulation, and complex systems. Courses: BUDT 630 Data, Models, and Decisions (3), BUDT 758K Computer Simulation for Business Applications (3), BUDT 758X Healthcare Analytics (3).

Margret Bjarnadottir, Assistant Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.S., University of Iceland, 2001; Ph.D., Massachusetts Institute of Technology, 2008. Teaching/research focus: Operations research methods using large scale data. Courses: BUDT 733 Data Analytics (3), BUDT 758X Healthcare Analytics (3).

Zhi-Long Chen, Professor & Area Chair, Decision, Operations & Information Technologies, Robert H. Smith School of Business. Ph.D., Princeton University, 1997. Teaching/research focus: optimization, logistics, scheduling, supply chain management, and operations management. Courses: BUDT 758X Operations Analytics (3), BUDT 758X Capstone Project in Operations Analytics (3).

Wedad J. Elmaghraby, Associate Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.A., Cornell University, 1992; B.S., 1992; M.S., University of California-Berkeley, 1995; Ph.D., 1998. Teaching/research focus: Design of competitive procurement auctions in business-to-business markets and pricing in markets where buyers behave strategically. Courses: BUDT 758X Operations Analytics (3).

Gordon Gao, Associate Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.Econ., Tsinghua University/Qinghua University, 1998; B.E., 1998; M.B.A., 2000; Ph.D., University of Pennsylvania, 2005. Teaching/research focus: IT's impact on Health care and innovation, and transparency in service quality. Courses: BUDT 758X Big Data: Strategy, Management, and Applications (3).

Bruce Golden, Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. Affiliate Professor, Civil & Environmental Engineering; Distinguished Scholar-Teacher; B.A., University of Pennsylvania, 1972; S.M., Massachusetts Institute of Technology, 1974; Ph.D., 1976. Teaching/research focus: Heuristic search, combinatorial optimization, networks, and applied operations research; Healthcare Operations. Courses: BUDT 758X Healthcare Analytics (3).

Il-Horn Hann, Associate Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.S., Technical University Darmstadt, 1994; Ph.D., University of Pennsylvania, 2000. Teaching/research

focus: Price competition in electronic markets, Pricing in Name-Your-Own-Price markets, online privacy, open-source software. Courses: BUDT 706 Social Media and Web Analytics (3), BUDT 758F Google Online Challenge Analytics (3)

Shawn Mankad, Assistant Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.S., Carnegie-Mellon University, 2008; M.A., University of Michigan-Ann Arbor, 2012; Ph.D., 2013. Teaching/research focus: Visualization and pattern extraction within vast quantities of data with applications in network analysis, and financial and health care analytics. Courses: BUDT 733 Data Analytics (3), BUDT 758K Computer Simulation for Business Applications (3).

Sunil Mithas, Professor, Decision, Operations & Information Technologies, Robert H. Smith School of Business. B.E., University of Roorkee, 1990; M.B.A., India, 1997; Ph.D., University of Michigan-Ann Arbor, 2005. Teaching/research focus: Strategies for managing innovation and excellence for corporate transformation, focusing on the role of technology and other intangibles, such as customer satisfaction, human capital, and organizational capabilities. Course: BUDT 706 Social Media and Web Analytics (3).

Kislaya Prasad, Director, Center for International Business Education and Research, and Research Professor, Robert H. Smith School of Business. Ph.D., Syracuse University. Teaching/research focus: Computability and complexity of individual decisions and economic equilibrium, innovation and diffusion of technology, and social influences on economic behavior. Courses: BUDT 630 Data, Models, and Decisions (3), BUDT 733 Data Analytics (3)

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