Georgia Institute of Technology
Institute Graduate Curriculum Committee
Minutes
February 6, 2014

Present: Ashuri (BC), Breedveld (ChBE), Cozzens (Vice Provost), Dickson (CHEM), Ferri (ECE), Flowers (ARCH), Foley (CoC-IC), Jagoda (AE), Jayarman (MSE), Macrakis (HTS), Neitzel (ME), Pikowsky (Registrar), Singhal (CoB), Storici (BIOL)

Visitors: Laros (Registrar), Merkousko (Registrar), Hodges (Registrar), Sokol (ISyE), Castro (BC), Stone (CRP), Tyson (Exec. Board Liaison), Sharp (Graduate Education), Slaughter (CoB), Chau (CoC-CSE), Verhaeghen (PSYC)

N**ote:** All action items in these minutes require approval by the Academic Senate. In some instances, items may require further approval by the Board of Regents or the University System of Georgia. If the Regents' approval is required, the change is not official until notification is received from the Board to that effect. Academic units should take no action on these items until USG and/or BOR approval is secured. In addition, units should take no action on any of the items below until these minutes have been approved by the Academic Senate or the Executive Board.

Academic Matters

1. A motion was made to approve a request from the School of City and Regional Planning for a new Certificate in Geographic Information Systems. The motion was seconded and approved.

   New Certificate - APPROVED

   Certificate in Geographic Information Systems

   The Certificate in Geographic Information Systems is intended to address the needs of two groups of students. First, Master of City and Regional Planning students have requested that specialized certification be offered in the area of geographic information systems, a skillset in high demand amongst a range of employers in the area of planning. Second, many non-MCRP graduate students drawn from around the Institute regularly enroll in one of several GIS courses offered by the School of City and Regional Planning, some of whom are expected to complete the Certificate in GIS outside of the MCRP program. The certificate will be structured around three sets of courses, including a foundational course in GIS, three skills related courses, and one policy context course.

   The Certificate in GIS requires four courses drawn from the following lists. All courses are existing courses:

   - Foundational Course (3 credit hours): CP 6521: Advanced GIS – course covers the fundamentals of the full suite of geographic information system

- functionality, including map projection systems, spatial measurement and analysis, automated data processing, and structured query language, among other applications. It should be noted that this course is titled "advanced" to distinguish it from an introductory course that is open to both graduate and undergraduate students. This course is intended to be the foundational course for graduate students and makes use of an introductory text for the graduate level. CP 6521 requires as a prerequisite the introductory course in GIS, CP 4510/6514, which is a required core course for all MCRP students. For students lacking this pre-requisite, 15 rather than 12 credit hours of coursework will be required for the certificate.

- Two skills courses drawn from the following list (6 credit hours):
    - CP 6531: Introduction to Remote Sensing – covers cartographic theory, multi-spectral data and the procedures by which information is enhanced and extracted from digital imagery and other remotely sensed data.
    - CP 6541: Environmental Analysis Using GIS – course structured to familiarize students with basic GIS functions most widely used in environmental applications and to acquaint students with the types and sources of GIS data needed to support environmental applications.
    - CP 6542: Transportation and GIS – course covers the basic principles of geographical information science for transportation and equips students with the state-of-the-practice computing technology for transportation planning in a GIS environment.
    - CP 6551: Socioeconomic GIS – course addresses human activity patterns overs pace and time within the context of general end values such as sustainability, economy, equity, and livability. In particular, the course includes GIS-based consideration of demographics (age, race, sex, ethnicity), economics (income and employment), and housing (both individual units and community characteristics).

- One policy context course drawn from the following list (3 credit hours):
    - CP 6112: Introduction to Land Use – course focuses on how land uses are arranged within urban areas and how land use drives the demand for transportation, environmental services, and economic development.
    - CP 6213: Urban Environmental Planning and Design – course explores the potential for ecology to provide a general theoretical framework for urban planning and introduces students to a range of spatial analysis and remote sensing techniques that may be used to develop and incorporate ecological criteria into the land use and development process.
    - CP 6311: Introduction to Transportation Planning – course introduces students to the theory and practice of transportation planning and examines the context in which such planning occurs. The course provides an overview of transportation systems, planning theory, history, current problems, decision making, financials, environmental impacts, and future policy initiatives.

- CP 6412: Local Economic Development Planning and Policy – This course provides an introduction to the context, theory, process and practice of local economic development planning, explicitly incorporating issues of sustainability.
- CP 6611: Principles of Real Estate Finance and Development – course prepares students to analyze real estate-based development proposals and projects for feasibility, credit-worthiness, and long-term viability.
- CP 6832: Introduction to Urban Design – course provides introduction to urban design ideas and design strategies and examines some of the widely accepted lessons of urban design, understand their origins and debate their applicability in the contemporary city.

- We anticipate that 20 to 30 students will complete the certificate annually over a three year period. This number is based on direct MCRP student responses gathered through a survey and assumes that 5 to 10 students from outside of the School will complete the certificate each year.

- We do not anticipate any additional costs, at least in the first several years of the certificate program, given current enrollments in courses required for the certificate.

- We do not anticipate the need for additional space or special facilities to support the certificate program.

- At present the University of Georgia offers an undergraduate GIS certificate program and Georgia State University offers a graduate GIS certificate program. We do not anticipate that the creation of a graduate GIS certificate program at Georgia Tech will have any impact on the Georgia State certificate program. Given that all of the required courses are already offered, we do not believe a collaborative arrangement with either existing program would be beneficial at this time.

- The total required credit hours for the GIS certificate program will be 12 hours, as outlined above in response to question #2. Certificate enrollment and award information will be administered by the School of City and Regional Planning academic advisor.

2. A motion was made to approve a request from the School of Building Construction for a new course. The motion was seconded and approved.

   New Course - APPROVED

   BC 6575: Real Estate Production Finance 3-0-3

   Note: The expected mode of presentation on the NCP was corrected to reflect Lecture 70% and Discussion 30%.

3. A motion was made to approve a request for a degree modification from the School of Psychology and to accept a clarification of degree requirements for the Master of Science in Psychology. The motion was seconded and approved.

Degree Modification - APPROVED

Doctor of Philosophy with a major in Psychology

Rationale for changing the approved program:

Three major changes:

- requiring three core courses instead of four, and adding new courses to the list of core classes
- changes in the requirements of individual areas
- deletion of the two courses falling under the previous rubric of professional requirements

These changes have three goals:

- Requiring three core courses instead of four and deletion of the two courses falling under the previous rubric of professional requirements reduces the course load for graduate students, thus freeing more time for research-based activities and potentially improving speed of graduation.
- Changes under (b) reflect changes in the respective fields.
- Adding new core courses offers students more flexibility in optimizing their own curriculum.

Reducing course load was a recommendation of the external APR review, as well as an internal review by the curriculum committee.

Changes in area-specific courses and adding new core classes were prompted both by the internal and external evaluations, as well as by reflection within areas on the changing state in the field, and the perception that psychology graduate programs elsewhere are likewise moving towards streamlined curricula that emphasize individualized programs of study and a stronger emphasis on an apprenticeship model.

Depending on the area, course load is reduced by 3-12 credit hours. Three fewer core hours are required.

Currently Approved vs. Proposed Program Curriculum

Graduate Student Course Checklist
Partial Requirements for the Degree

To be submitted to the Graduate Coordinator with the degree petition

Name _____ Program _____

General Psychology Core Requirements:
(At least ~~four~~ three) Note 1

__ Psyc 6011 Cognitive Grade __ Waiver__ Notes 2 & 3 & 4
__ Psyc 6012 Social Grade __ Waiver__
__ Psyc 6013 Biopsychology Grade __ Waiver__
__ Psyc 6014 Sensation/Perception Grade __ Waiver__ Note 3
__ Psyc 6015 Developmental Grade __ Waiver__
__ Psyc 6016 EAB Grade __ Waiver__
__ Psyc 6017 Human Abilities Grade __ Waiver__
__ Psyc 6021 Personality Theories Grade __ Waiver__
__ Psyc 6060 Psychology of Aging Grade __ Waiver__ Note 2
__ Psyc 6090 Cognitive Neuroscience Grade __ Waiver__
__ Psyc 7101 Engineering Psych I Grade __ Waiver__ Note 3
__ Psyc 7201 Industrial/org. Psychology Grade __ Waiver__ Note 5

Quantitative Core:

__ Psyc 6018 Research design (including RCR) Grade __ Waiver__
__ Psyc 6019 Stat I Grade __ Waiver__
__ Psyc 6020 Stat II Grade __ Waiver__

~~Professional Core (Ph.D. only):~~

~~__ Psyc 7701 Teaching Practicum Grade __ Waiver__ Note 7~~
~~__ Psyc 7700 Professional Problems Grade __ Waiver__~~

Minor (If in I/O program must be statistics) (Ph.D. only):

__ _____ Grade __
__ _____ Grade __
__ _____ Grade __

First-Year Project:

__ Psyc 7105 First year Research Project I Grade __ Waiver__
__ Psyc 7106 First year Research Project II Grade __ Waiver__

Area Requirements
CBS:

__ Psyc 6040 Topics in Cognition & Brain Science Grade __ Waiver __
~~__ Psyc 6060 Psychology of Aging Grade __ Waiver __~~
__ Psyc 8080 Seminar in Cognition & Brain Science Grade __ Waiver __
__ Psyc 8080 Seminar in Cognition & Brain Science Grade __ Waiver __

Cognitive Aging:

__ Psyc 6041 Topics in Cognitive Aging Grade __ Waiver __
__ Psyc 7020 Survey of Cognitive Aging Grade __ Waiver __
__ Psyc 8020 Seminar in Cognitive Aging Grade __ Waiver __
__ Psyc 8020 Seminar in Cognitive Aging Grade __ Waiver __

Engineering Psychology:

~~__ Psyc 7101 Engineering Psyc I Grade __ Waiver __ (MS & Ph.D.)~~
__ Psyc 7102 Engineering Psyc II Grade __ Waiver __ (MS & Ph.D.)
__ Psyc 7104 Skills or Psyc 8040 Grade __ Waiver __ (Ph.D.)
~~__ **Biomechanics Course _____ Grade __ Waiver __ (Ph.D.)**~~

__ Psyc 7701 Teaching Practicum Grade __ Waiver __ (Ph.D.)
__ Psyc 8040 _____Grade __ Instructor_____
~~__ **Psyc 8040** _____ **Grade __ Instructor**_____~~

Industrial/Organizational Psychology:

~~__ Psyc 7201 Industrial/organizational Psychology Grade __ Waiver __~~
__ Psyc 7202 Personnel Selection Grade __ Waiver __
__ Psyc 7203 Organizational Behavior Grade __ Waiver __
__ Psyc 7204 Training and Development Grade __ Waiver __
__ Psyc 7205 Teams Grade __ Waiver __
__ Psyc 8050 _____ Grade __

Quantitative Psychology – additional quantitative courses e.g., Multivariate Statistics, Psychometric Theory, Item Response Theory, Structural Equation Modeling, Multilevel Modeling, Longitudinal Modeling, Categorical Data Analysis, Multidimensional Scaling, …):

__ Course 1 _____ Grade __
__ Course 2 _____ Grade __
__ Course 3 _____ Grade __
__ Course 4 _____ Grade __
__ Course 5 _____ Grade __

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Note 1: Four core classes are required for the Engineering Psychology area
Note 2: Required for Cognitive Aging area.
Note 3: Required for Engineering Psychology area
Note 4: Required for CBS area
Note 5: Required for I/O area

CLARIFICATION OF DEGREE REQUIREMENTS - ACCEPTED

Master of Science in Psychology

Rationale for changing the approved program:

No actual change is requested – the proposal simply lists the requirements as currently codified in the School of Psychology's Graduate Handbook. These requirements never made it into the Catalog. The School notes that this version differs from the last version on record in the Registrar's office (*Minutes of the Graduate Curriculum Committee, February 19, 1998*). It is unclear to the current Graduate Coordinator and Chair why the newer version was apparently never submitted.

In the 1998 version Psyc 6011-6012-6013 are required (the requirements in the School's handbook specify two out of a longer list of core classes), and seminars (8900 or 01 or 02) are required that are no longer required; the Handbook's version also lists the first-year project as a requirement (7105/6) – these classes did not exist in 1998.

The MS degree is a fall-back degree: The School of Psychology does not offer a 'terminal Masters'. The criteria for a MS were never specified in the Catalog, and this proposal

serves to clarify what the degree requirements are, as currently codified in the School of Psychology's Graduate Handbook. (Note: After some discussion, it was determined that the term "fall-back" is not the accurate way to describe this MS degree. It is actually a degree that doctoral students receive "along the way" to completing the Ph.D.)

Current Program Curriculum:

Graduate Student Course Checklist
Requirements for the MSPSY Degree

To be submitted to the Graduate Coordinator with the degree petition

Name _____ Program _____

Students must complete and pass, with a grade of B or better, the required courses listed below, and a research thesis as partial fulfillment of the Master's Degree requirement.

General Psychology Core Requirements:
(At least two)

__	Psyc 6011 Cognitive	Grade __	Waiver__	Notes 1 & 2 & 3
__	Psyc 6012 Social	Grade __	Waiver__	
__	Psyc 6013 Biopsychology	Grade __	Waiver__	
__	Psyc 6014 Sensation/Perception	Grade __	Waiver__	Note 2
__	Psyc 6015 Developmental	Grade __	Waiver__	
__	Psyc 6016 EAB	Grade __	Waiver__	

__	Psyc 6017 Human Abilities	Grade __	Waiver__	
__	Psyc 6021 Personality Theories	Grade __	Waiver__	
__	Psyc 6060 Psychology of Aging	Grade __	Waiver__	Note 1
__	Psyc 6090 Cognitive Neuroscience	Grade __	Waiver__	
__	Psyc 7101 Engineering Psych I	Grade __	Waiver__	Note 2
__	Psyc 7201 Industrial/org. Psychology	Grade __	Waiver__	Note 4

Quantitative Core:

__	Psyc 6018 Research design (including RCR)	Grade __	Waiver__
__	Psyc 6019 Stat I	Grade __	Waiver__
__	Psyc 6020 Stat II	Grade __	Waiver__

First-Year Project:

__	Psyc 7105 First year Research Project I	Grade __	Waiver__
__	Psyc 7106 First year Research Project II	Grade __	Waiver__

Thesis hours:

__ Psyc 7000 Master's Thesis (9 hours minimum)

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Note 1: Required for Cognitive Aging area.

Note 2: Two out of these are required for Engineering Psychology area
Note 3: Required for CBS area
Note 4: Required for I/O area

4. A motion was made to approve a request from the College of Engineering, College of Computing, and Scheller College of Business for a new Master of Science degree in Analytics. The motion was seconded and approved.

New Degree - APPROVED

Master of Science in Analytics

Summary

Georgia Tech proposes to create a nationally elite interdisciplinary analytics degree program. Analytics is defined as "the scientific process of transforming data into insight for making better decisions," and sits at the intersection of big data/computing, statistics/operations research, and business. As databases grow rapidly and computing capacity and advanced statistical and operations research algorithms make data analysis ever more powerful, the perspective and skills of analytics are in high demand in a wide range of industries.

Georgia Tech's mission statement recognizes that "technological change is fundamental to the advancement of the human condition", and its strategic plan notes that "nationally and internationally, our task is to influence the ways in which problems are identified and solved, and the ways that students are prepared to evaluate, analyze, and resolve those problems." This proposal describes exactly such a degree: recognizing how technological advances are driving significant changes in the business world, Georgia Tech proposes to add a new Master's degree that exploits its nationally-recognized strengths in engineering, computing, and business by bringing the three disciplines together in the growing field of *analytics*.

Within the state of Georgia, there are currently no existing degree programs in analytics, and only one (at Georgia State University) has been formally proposed in the USG system. The Georgia Department of Economic Development explicitly lists education as a "strategic asset" and "competitive advantage" of Georgia in recruiting businesses to the state, and of the 17 "key industries" they list, most make significant use of analytics.

Students also appear to have caught on to the growth in analytics. Current and recent-past students in all three Georgia Tech units participating in the degree have been trying to take electives that will prepare them as much as possible for careers in analytics. However, the existing degree programs do not have sufficient coverage or flexibility, so these students are currently unable to adequately obtain all of the necessary analytics skills.

More broadly, the exponential growth in the number of analytics degree programs nationally, and the demand for professional certification experienced by INFORMS, corroborate the anecdotal evidence of both student and employer demand for the Master's degree in analytics. In fact, the September 2013 U.S. News Best Colleges issue listed two different facets of analytics among the top 7 in their "Discover 11 hot college majors that lead to jobs" article.

While the need for analytics education is easy to see, the number of existing degree programs is still somewhat small. The first professional analytics degree was developed in 2007 at North Carolina State University's Institute for Advanced Analytics. Six years later, they estimate that there are only 60-70 Master's degrees, tracks, or tracks in analytics offered in the United States, with just 23 of them being full-time Master's degree programs – and most of those have been established in the last two years as analytics has really taken off in the business world. A number of top universities (MIT, etc.) are said to be working to jump into the field, a situation that makes this proposal time-sensitive; there can be a significant advantage to moving quickly.

The bottom line is that analytics is an important and quickly-growing field, new enough that its need has clearly outpaced the supply of students and will do so for the foreseeable future.

Description of the program

Georgia Tech's interdisciplinary MS Analytics program is designed to both give graduates the computing, business, and statistics/operations research skills to identify, analyze, and solve analytics problems; and to integrate those skills in an interdisciplinary way that other, single-discipline-oriented analytics degrees might not. In addition to an integrated breadth of study covering the core areas of analytics, students will satisfy one of the specialized tracks to give them depth in an analytics area of specialization, either computational data analytics, analytical tools, or business analytics.

Courses available to the students either as core requirements or elective options include topics like forecasting, regression analysis, data mining, statistical learning, machine learning, computational data analytics, design of experiments, simulation, optimization, probabilistic models, data analytics, visualization, databases, text mining, algorithms, high performance computing, graph analytics, business intelligence, pricing analytics, revenue management, business process analysis, financial analysis, decision support, privacy and security, and risk analytics.

Goals/objectives of the program

The program will be a professional Master's degree that provides sufficient training for graduates to move directly into business, industry, and government positions where they can apply the practical knowledge and skills they have gained in analytics to immediately benefit their employers. Such a program would help provide for the growing needs of companies in Georgia, throughout the Southeast, and nationally.

Students earning the MS Analytics degree will be able to understand and integrate fundamental principles and advanced concepts across the core analytics disciplines of computing, statistics, operations research, and business (see Section 6a for details). These include identification and framing of problems; acquisition, management, and utilization of large and fast-moving streams of data; creation, solution, and analysis of mathematical models using appropriate methodology; and the integration of these interdisciplinary skills to enable graduates to successfully develop and execute analytics projects. Beyond these core skills, each track will provide additional depth to students in its specific area of analytics.

Location of the program

The program will be located at Georgia Tech's main campus in Atlanta.

Curriculum

The MS Analytics degree is designed to give graduates a core of computing, business, and statistics/operations research skills to identify, analyze, and solve analytics problems; to integrate those skills in an interdisciplinary way that other, single-discipline-oriented analytics degrees might not; and to provide depth in an analytics area of specialization. It is designed to be completed in a single year (fall, spring, and summer), with a total of 36 credit-hours required for each student.

The program is interdisciplinary between the Scheller College of Business (COB), the School of Computational Science and Engineering (CSE, within the College of Computing), and the Stewart School of Industrial and Systems Engineering (ISyE, within the College of Engineering). Each of the three units (COB, CSE, and ISyE) provides expertise in a different facet of analytics, with interdisciplinary coordination achieved by having faculty cooperate on the development and revision of course content, especially in core and required courses.

Students will be take core introductory coursework and other advanced required courses to give them integrated breadth in analytics, and then satisfy the requirements of a track that will provide depth of knowledge in an area of analytics, tailored to their specific interests and career goals. The available tracks are Analytical Tools (focusing on the statistical and operations research methodology in which ISyE is a specialist), Business Analytics (focusing on the application of analytics to business problems in which COB is a specialist), and Computational Data Analytics, i.e., "big data" (focusing on data and computational issues in analytics, in which COC is a specialist).

Core courses

Each unit will provide a core course that provides an introduction to its area of analytics while tying in to and coordinating with each of the other areas. Students will take these courses in their first semester, cohort-style (i.e., all Analytics students will take them

together). This will both give students the foundation needed to take their advanced coursework, and help them develop the integrated view of analytics that is needed in the workplace. The introductory courses include CSE 6040 Introduction to Computing for Data Analytics, ISyE 8803 Introduction to Analytical Methods, and MGT 8803 Introduction to Business for Analytics.

Required courses

Beyond the core introductory analytics courses, every student is required to take coursework in each facet of analytics. Like the core coursework, the required courses will include material that shows the integration of their primary subject with other elements of analytics, to help ensure the interdisciplinary nature of the degree. Some of these courses will be taken cohort-style, while others (e.g., a statistics course like regression analysis) may be taken with other students; in the latter case, an additional analytics teaching resource will be provided to serve the analytics students and help provide the integration with other areas of analytics.

Electives/Track Requirements

To obtain a deeper expertise in an area of analytics, every student is required to satisfy the requirements of one of the tracks: Analytical Tools, Business Analytics, or Computational Data Analytics. The track requirements include lists of related electives from which the students may choose, as well as restrictions or recommendations for appropriate courses to meet the statistics/OR requirement in a way that applies best to the student's choice of track.

With the help of academic advising from faculty and career advising from professionals (see Section 7), students will be able to tailor their selection electives and other track requirements to their own individual interests and career goals. This allows students even in the same track to specialize in ways that are significantly different.

Practicum

At the end of the MS Analytics program, in the summer semester, each student will complete a 6-credit-hour applied analytics practicum. For the practicum courses, teams of students will work with companies and organizations on a real analytics project to solve a real business problem, one project per team. Teams will consist of MS Analytics students from each track, to bring each of their specializations to bear in an integrated solution, and the teams will be advised by appropriately-selected faculty in each of the disciplines. In this way, the interdisciplinary learning will be emphasized in practice as well as in the classroom.

Specific Requirements for the MS Analytics Degree

In this section, we present the specific, detailed requirements for the MS Analytics degree. We first show the general requirements for all tracks, and then show how they

are specified for each available track within the MS Analytics degree. Example programs for each track are also shown.

The curriculum will periodically be reviewed with the assistance of the Analytics Industry Advisory Board (see Section 7 below). The Board will be made up of highly-placed practitioners and consumers of analytics in business, industry, government, etc. and will provide advice and feedback regarding the alignment of the curriculum with current practice and the needs of employers.

GENERAL REQUIREMENTS FOR MS ANALYTICS

The following set of requirements is the complete set of requirements for all MS Analytics students.

- 2 Statistics courses (6 hours)
- 1 Operations research course (3 hours)
- 1 Computing course (3 hours)
- 1 Business course (3 hours)
- 5 Elective/core courses (15 hours; includes 3 introductory analytics courses in computing, business, and statistics/OR areas, each of which may be waived depending on individual student backgrounds; most students are expected to need 2, leaving 3 remaining elective course slots)
- 6 hours of practicum, *or* an analytics internship (unpaid internship students can earn 6 credit hours, paid internship students will need 6 more elective hours)
- Each student's course choices must satisfy the requirements of at least one of the defined tracks (initially Analytical Tools, Business Analytics, and Computational Data Analytics).

TOTAL: 36 hours

	Fall semester	**Spring semester**	**Summer semester**
Recommended general program for tracks	1. Core/intro course 2. Core/intro course 3. Statistics course 4. Operations research course 5. Track elective	1. Statistics course 2. Business course 3. Computing course 4. Track elective 5. Track elective	1. Practicum I 2. Practicum II

For the purpose of these degree requirements, elective courses are sorted into the following Categories (see below for courses).

- (A) Applications of analytics
- (B) Business
- (C) Computing
- (O) Operations research
- (S) Statistics

INDIVIDUAL TRACK REQUIREMENTS

There are three tracks available to MS Analytics students. Each student must satisfy the requirements of either the Analytical Tools track, the Business Analytics track, or the Computational Data Analytics track. The tailoring of the general requirements to each track is shown below, along with two sample programs of study for each. The sample programs assume the likely situation that students enter the program with a background in one facet of analytics, and can substitute an additional elective for one of the core courses. Please see the beginning of Section 3 (above) for a longer description of each track.

Analytical Tools Track

The Analytical Tools track provides students with a greater understanding of the quantitative methodology of analytics: how to select, build, solve, and analyze models using methodology such as parametric and non-parametric statistics, regression, forecasting, data mining, machine learning, optimization, stochastics, and simulation. The general MS Analytics requirements are tailored to the Analytical Tools track in a way that provides students the opportunity to gain practical knowledge customized to their own individual interests within the field, as shown below:

- At least 2 electives other than introductory analytics courses must come from statistics/operations research courses (Categories S and O)
- At least 3 courses must be taken from statistics (Category S), *or* at least 3 courses must be taken from operations research (Category O)
- At least 1 course must be taken in each of deterministic OR (O1,O5) and stochastic OR (O2,O3,O4).
- Required business course is MGT 8803 Big Data Analytics in Business
- Required computing course is CSE 6242 Data and Visual Analytics

The following table shows two examples of potential programs for MS Analytics students pursuing the Analytical Tools track.

	Fall semester	**Spring semester**	**Summer semester**
Example program 1 for Analytical Tools Track	1. CSE 6040 Intro to Computing for Data Analytics 2. MGT 8803 Intro to Business for Analytics 3. ISyE 6414 Regression Analysis 4. ISyE 6669 Deterministic Optimization 5. ISyE 6650 Probabilistic Models	1. ISyE 7406 Data Mining and Statistical Learning 2. MGT 8803 Big Data Analytics in Business 3. CSE 6242 Data and Visual Analytics 4. ISyE 6402 Time Series Analysis 5. MGT 6400 Pricing Analytics and Revenue Management	1. CSE/ISyE/MGT 8803 Applied Analytics Practicum I 2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II
Example program 2	1. CSE 6040 Intro to Computing for Data	1. ISyE 7406 Data Mining and Statistical Learning	1. CSE/ISyE/MGT 8803 Applied

for Analytical Tools Track	Analytics 2. MGT 8803 Intro to Business for Analytics 3. ISyE 6414 Regression Analysis 4. ISyE 6669 Deterministic Optimization 5. ISyE 6650 Probabilistic Models	2. MGT 8803 Big Data Analytics in Business 3. CSE 6242 Data and Visual Analytics 4. CSE/ISyE 6740 Computational Data Analytics 5. ISyE 6644 Simulation	Analytics Practicum I 2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II

Business Analytics Track

The Business Analytics track provides students with a deeper understanding of the practice of using analytics in business and industry: how to understand, frame, and solve problems in marketing, operations, finance, management of information technology, and accounting in order to develop and execute analytics projects within businesses. The general MS Analytics requirements are tailored to the Business Analytics track in a way that provides students the opportunity to gain practical knowledge customized to their own individual interests within the field, as shown below:

- At least 2 electives other than introductory analytics courses must come from business courses (Category B)
- Required business course is MGT 8803 Big Data Analytics in Business
- Required computing course is CSE 6242 Data and Visual Analytics
- Recommended statistics courses are ISyE 6414 Regression Analysis and ISyE 6402 Time Series Analysis

The following table shows two examples of potential programs for MS Analytics students pursuing the Business Analytics track.

	Fall semester	**Spring semester**	**Summer semester**
Example program 1 for Business Analytics Track	1. CSE 6040 Intro to Computing for Data Analytics 2. ISyE 8803 Intro to Analytical Methods 3. ISyE 6414 Regression Analysis 4. ISyE 6334 OR for Supply Chains II 5. MGT 8803 Risk Analytics	1. ISyE 6402 Time Series Analysis 2. MGT 8803 Big Data Analytics in Business 3. CSE 6242 Data and Visual Analytics 4. MGT 6400 Pricing Analytics & Revenue Management 5. MGT 6310 Marketing Research	1. CSE/ISyE/MGT 8803 Applied Analytics Practicum I 2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II
Example program 2 for Business Analytics	1. CSE 6040 Intro to Computing for Data Analytics 2. ISyE 8803 Intro to	1. ISyE 6402 Time Series Analysis 2. MGT 8803 Big Data Analytics in Business	1. CSE/ISyE/MGT 8803 Applied Analytics Practicum I

Track	Analytical Methods 3. ISyE 6414 Regression Analysis 4. ISyE 6644 Simulation 5. MGT 6450 Project Management	3. CSE 6242 Data and Visual Analytics 4. MGT 6304 Customer Relationship Mgt 5. MGT 6057 Business Process Analysis and Design	2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II

Computational Data Analytics Track

The Computational Data Analytics track provides students with a deeper understanding of the practice of dealing with so-called "big data": how to acquire, preprocess, store, manage, analyze, and visualize data arriving at high volume, velocity, and variety. The general MS Analytics requirements are tailored to the Computational Data Analytics track in a way that provides students the opportunity to gain practical knowledge customized to their own individual interests within the field, as shown below:

- At least 2 electives other than introductory analytics courses must come from computing courses (Category C)
- Required business course is MGT 8803 Big Data Analytics in Business
- Required computing course is CSE 6242 Data and Visual Analytics
- One of the two statistics courses must be CSE/ISyE 6740 Computational Data Analytics

The following table shows two examples of potential programs for MS Analytics students pursuing the Computational Data Analytics track.

	Fall semester	**Spring semester**	**Summer semester**
Example program 1 for Computational Analytics Track	1. ISyE 8803 Intro to Analytical Methods 2. MGT 8803 Intro to Business for Analytics 3. ISyE 6414 Regression Analysis 4. ISyE 6669 Deterministic Optimization 5. CSE 6141 Massive Graph Analytics	1. CSE/ISyE 6740 Computational Data Analytics 2. MGT 8803 Big Data Analytics in Business 3. CSE 6242 Data and Visual Analytics 4. CSE/ECE 6730 Modeling and Simulation 5. CSE 6240 Web Search and Text Mining	1. CSE/ISyE/MGT 8803 Applied Analytics Practicum I 2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II
Example program 2 for Computational Analytics Track	1. ISyE 8803 Intro to Analytical Methods 2. MGT 8803 Intro to Business for Analytics 3. CSE/ISyE 6740 Computational Data Analytics 4. ISyE 6669 Deterministic	1. ISyE 6402 Time Series Analysis 2. MGT 8803 Big Data Analytics in Business 3. CSE 6242 Data and Visual Analytics 4. CSE 6240 Web Search and Text Mining 5. MGT 6400 Pricing	1. CSE/ISyE/MGT 8803 Applied Analytics Practicum I 2. CSE/ISyE/MGT 8803 Applied Analytics Practicum II

	Optimization 5. CSE 6230 High Perf. Parallel Computing	Analytics & Revenue Management	

Course listing

(* = new course; ^ = previously-taught course receiving a new number; all new and old courses are 3 credit-hours each)

Core introductory courses

I1. *CSE 6040 Computing for Data Analysis: Methods and Tools (F)
I2. *ISyE 8803 Introduction to Analytical Methods (F)
I3. *MGT 8803 Introduction to Business for Analytics (F)

Statistics courses

S1. CSE/ISyE 6740 Computational Data Analytics (F,S)
S2. ISyE 6402 Time Series Analysis (S)
S3. ISyE 6404 Nonparametric Data Analysis (F)
S4. ISyE 6405 Statistical Methods for Manufacturing Design/Improvement (F)
S5. ISyE 6412 Theoretical Statistics (F)
S6. ISyE 6413 Design of Experiments (S)
S7. ISyE 6414 Regression Analysis (F,S)
S8. ISyE 6416 Computational Statistics (F)
S9. ISyE 6420 Bayesian Statistics (S)
S10. ISyE 6810 Systems Monitoring and Prognostics (S)
S11. ISyE 7406 Data Mining and Statistical Learning (S)

Operations research courses (take no more than one of O1 and O5; take no more than one of O2 and O4)

O1. ISyE 6333 Operations Research for Supply Chains I (F)
O2. ISyE 6334 Operations Research for Supply Chains II (F)
O3. ISyE 6644 Simulation (F,S)
O4. ISyE 6650 Probabilistic Models (F)
O5. ISyE 6669 Deterministic Optimization (F)

Computing courses (most other graduate-level CSE courses can be counted with permission)

C1. ^CSE 6010 Computational Problem Solving for Scientists and Engineers (F)
C2. CSE 6140 Computational Science and Engineering Algorithms (F)
C3. ^CSE 6141 Massive Graph Analytics (F)
C4. CSE 6220 High Performance Computing (S)
C5. CSE 6230 High Performance Parallel Computing (F)
C6. CSE 6240 Web Search and Text Mining (S)
C7. CSE 6242 Data and Visual Analytics (F,S)
C8. CSE/ECE 6730 Modeling and Simulation: Fundamentals and Implementation (S)
C9. CS 6400 Database Systems Concepts and Design (F)
C10. CS 7450 Information Visualization (F)

Business courses

B1. MGT 6057 Business Process Analysis and Design (S)

B2. MGT 6304 Customer Relationship Management (S)
B3. MGT 6310 Marketing Research (S)
B4. MGT 6400 Pricing Analytics and Revenue Management (S)
B5. MGT 6450 Project Management (F)
B6. ^MGT 8803 Risk Analytics (F)
B7. *MGT 8803 Big Data Analytics in Business (S)
B8. MGT 8803 Privacy, Technology, Policy and Law (S)
B9. MGT 8803 Business Forecasting (S)

Applications of analytics (elective credit only)

A1. ISyE 6201 Manufacturing Systems (S)
A2. ISyE 6202 Warehousing Systems (F,S)
A3. ISyE 6203 Transportation and Supply Chain Systems (S)
A4. ISyE 6230 Public Impact Applications of OR (F)
A5. ISyE 6335 Supply Chain Engineering I (F)
A6. ISyE 6336 Supply Chain Engineering II (S)
A7. ISyE 6337 Supply Chain Engineering III (S)

Capstone courses

P1. *CSE/ISyE/MGT 8803 Applied Analytics Practicum I (Sum)
P2. *CSE/ISyE/MGT 8803 Applied Analytics Practicum II (Sum)

Note: Other courses may be approved for elective use by the analytics program committee (see below). Advanced students may be approved by the analytics program committee to substitute advanced courses for core/elective courses as appropriate.

Note: The new Master of Science Degree in Analytics was approved. No new courses were approved at this time. New courses proposed for this degree will be submitted at a later date to the Graduate Curriculum Committee. Some of the new courses will actually begin soon in the Special Topics format.

Professional standards

Because the field of analytics is relatively new, there are as yet no national accrediting agencies for degrees in analytics, nor are there any recognized curriculum standards. However, the Institute for Operations Research and the Management Sciences (INFORMS), which offers certification of individuals in analytics, provides an outline of topics; the next section describes the correlation between the proposed MS Analytics curriculum and the INFORMS standards.

Consistency with nationally-accepted trends and standards

Because the field of analytics is relatively new (the first program was created in 2007), there are as yet no national accrediting agencies for degrees in analytics, nor are there any recognized curriculum standards. The best available standards come from the Institute for Operations Research and the Management Sciences (INFORMS), which offers analytics certification for individuals. Below is a list of topics/learning goals that they suggest, and the list of MS Analytics courses (as labeled above) that cover those learning goals.

- Business Problem Framing (I3; B1-B9; A1-A7; P1-P2)
- Analytics Problem Framing (I2; S1-S11; O1-O5; B6-B7; A1-A7; P1-P2)
- Data (I1; C1, C5-C7, C9-C10; B7-B8; P1-P2)
- Methodology Selection (I2; S1-S11; O1-O5; A1-A7; P1-P2)
- Model Building (I1-I2; S1-S11; O1-O5; C1-C3, C6, C8; B3-B6, B9; A1-A7; P1-P2)
- Deployment (I1, I3; C2, C4-C7, C9-C10; B1-B9; P1-P2)
- Model Lifecycle Management (I3; C7, C9-C10; B1-B2, B5, B8; P1-P2)

Of course, some aspects of each of these learning goals will be integrated into other courses as well; the list above only shows courses with primary responsibility for those learning goals.

Internships/field experiences

The Applied Analytics Practicum requirement may be fulfilled by either an applied analytics internship or a project; either one will require working with a company, government agency, NGO, organization, etc. Availability of projects should not be a problem. We have many companies who have expressed interest in the program (quite a few have even written letters of support that appear in the appendix), and as a point of comparison ISyE's similar undergraduate capstone program attracts more than 50 projects per year from companies and organizations like Home Depot, Delta, US Environmental Protection Agency, World Food Programme, etc.

Adequacy of core offerings

Based on recent past enrollment and availability data taken from oscar.gatech.edu, there is sufficient availability of seats in most existing course offerings to accommodate a full 45-student MS Analytics load without needing to increase the number of sections offered. There will need to be 11 new sections offered, including 6 new courses, as shown in the list below. As discussed later in the faculty workload section, the faculty and unit heads have committed to offer the necessary courses and sections with current faculty.

Courses taught by CSE

- CSE 6040 Introduction to Computing for Data Analytics (Fall: new course)
- CSE 6242 Data and Visual Analytics (Spring: new section)
- CSE/ISyE 6740 Computational Data Analytics (Spring: new section)

Courses taught by ISyE

- ISyE 6402 Time Series Analysis (Spring: new section)
- ISyE 6414 Regression Analysis (Spring: new section)
- ISyE 7406 Data Mining and Statistical Learning (Spring: new section)
- ISyE 8803 Introduction to Analytical Methods (Fall: new course)

Courses taught by MGT

- MGT 8803 Big Data Analytics in Business (Spring: new course)
- MGT 8803 Introduction to Business for Analytics (Fall: new course)

Courses taught jointly

- CSE/ISyE/MGT 8803 Applied Analytics Practicum I (Summer: new course)
- CSE/ISyE/MGT 8803 Applied Analytics Practicum II (Summer: new course)

Obviously, every new course will require a new section to be offered. For existing courses, the table below shows the recent enrollment and availability data from oscar.gatech.edu for the courses where we project the need for a new section.

Course	Average empty seats (Spring 2011 – Fall 2013)	Estimated seats required for MS Analytics
CSE 6242 Data and Visual Analytics	0	45
CSE/ISyE 6740 Computational Data Analysis	0	20-30
ISyE 6402 Time Series Analysis	10	20-30
ISyE 6414 Regression Analysis	0	40-45
ISyE 7406 Data Mining and Statistical Learning	3	20-30

Method of instructional delivery

Aside from the two Applied Analytics Practicum courses, all courses listed above will follow the standard (lecture-based, case/discussion-based, etc.) methods of instructional delivery. The practicum courses will be project-based.

Admissions criteria

Minimum requirements for admission include a Bachelor's degree (or equivalent), and the completion of at least one college-level course in each of calculus, probability and statistics, and computer programming using a high-level language (C, C++, Java, Python, FORTRAN, etc.), each with a satisfactory grade of "C" or better. Applicants who do not meet the course requirements may be admitted with the provision that they complete those requirements prior to enrollment.

Application and admission to the MS Analytics program will be by track (i.e., applicants will specify the track they are applying for, and admissions decisions will be made by the MS Analytics Program Committee (see Section 7) in order to balance the number of students in each track as desired by the committee), in coordination with the participating units.

Applicants will be required to provide GRE or GMAT scores, TOEFL (for international students), academic transcripts, a personal statement, and three letters of recommendation. Required scores (minimums and anticipated admissions standards) will be commensurate with each unit's current standards for its existing Master's degree programs. As much as appropriate, there will be consistent admissions standards between the tracks; however, a strong background in certain areas might be more necessary for one track than another (for example, a broader computing background would be more helpful for students applying to the Computational Data Analytics track).

Availability of assistantships

MS Analytics students will be eligible for any of the assistantships that are available around campus. Funds permitting, the program itself may offer a limited number of assistantships to outstanding students.

Student learning outcomes

Students earning the MS Analytics degree will be able to:

a. Understand fundamental principles across a range of core areas in analytics, including computing, statistics, operations research, and business;
b. Identify and frame problems in business and other domains, as well as analytics problems related to those domains;
c. Understand and use methods for acquiring, managing, and utilizing large and fast-moving streams of data;
d. Select, build, solve, and analyze analytics models using appropriate methodology;
e. Develop a deep understanding and set of skills and expertise in at least one area of analytics;
f. Apply and integrate the knowledge and skills they have gained, to successfully develop and execute analytics projects;
g. Engage in multidisciplinary activities and work in diverse and/or multidisciplinary teams;
h. Communicate complex ideas to individuals in a variety of fields;
i. Demonstrate their expertise and proficiency in a capstone application project or internship of practical importance.

Each track has a specific additional outcome related to (e.) above, to "Develop a deep understanding and set of skills and expertise in...":

i. (Analytical Tools) ...how to select, build, solve, and analyze models using methodology such as parametric and non-parametric statistics, regression, forecasting, data mining, machine learning, optimization, stochastics, and simulation;
ii. (Business Analytics) ...how to understand, frame, and solve problems in marketing, operations, finance, management of information technology, and accounting in order to develop and execute analytics projects within businesses;
iii. (Computational Data Analytics) ...how to acquire, preprocess, store, manage, analyze, and visualize data arriving at high volume, velocity, and variety.

The table below shows the correspondence between the program's student learning outcomes and INFORMS' suggested analytics topics; for a list showing how those topics connect with specific courses, please refer to Section 3f.

	Business problem framing	Analytics problem framing	Data	Methodology selection	Model building	Deployment	Model lifecycle management
a. Understand fundamental principles… in analytics	X		X	X	X		
b. Identify and frame… problems	X	X					
c. Understand and use methods for… data			X			X	X
d. Select, build, solve, and analyze… models…				X	X	X	
e. Develop a deep understanding…	X	X	X	X	X		
f. Apply and integrate…	X	X	X	X	X	X	X
g. Engage in multidisciplinary activities…	X	X	X	X	X	X	
h. Communicate complex ideas…	X	X	X	X	X	X	
i. Demonstrate expertise…	X	X	X	X	X	X	X

Monitoring and quality assurance

Quality of the degree program will be tracked in three ways: (i) review by the program's external Analytics Industry Advisory Board (see Section 7), (ii) exit surveys of students completing (or otherwise leaving, if any) the program, and (iii) review of student placements and if possible, follow-up with employers. If any deficiencies are identified, the Analytics program committee and the units will take appropriate steps to rectify the problems.

Student exit interviews will cover the program's effectiveness at preparing the students for their career objectives, skills and knowledge gained while in the program, and the relevance and quality of courses. Students and alumni will also be asked to suggest areas where the program could be improved.

Graduating students will be asked to report their employer and position, as well as starting salary and bonus. After graduating, alumni will be periodically surveyed (as long as they are willing) with regard to current employment/position/salary, how well they

were able to apply the skills and knowledge learned in the program to their professional life, and whether they have in retrospect any suggested areas for improvement of the program.

Administration of the program

In developing the administrative structure of this program, we have tried to learn from the successes and difficulties experienced by previously-created interdisciplinary degree programs. The overall goals of the program administration are to give adequate representation to each academic unit in the program; to provide for uniform standards of quality of education, advising, admissions, etc. among the units; to allow sufficient autonomy in customizing track requirements and course content; and to create a single point of interface between the program and prospective employers and students.

The administration of the program will involve the following:

- *Analytics Unit Coordinators*. The head of each academic unit in the program (i.e., the School Chair in CSE and ISyE, and the Senior Associate Dean in COB) will designate one faculty member to be the unit's coordinator for the MS Analytics for a 5-year, repeatedly renewable term (unless circumstances dictate the need for earlier replacement). Each unit's analytics coordinator will be responsible for coordinating his/her unit's MS Analytics program activities within the unit, and will serve as the representative of the unit in the MS Analytics program's administrative activities.
- *Analytics Program Committee.* The units' analytics coordinators, and one additional faculty member from each unit elected to a 3-year term by the faculty of that unit who are affiliated with the analytics program and approved by the unit head, will comprise the analytics program committee. The committee will have oversight of significant governance, academic, and admissions decisions, but within the program committee, it is expected that the unit coordinators will carry the majority of the day-to-day workload (see *Analytics Program Director/Associate Director*, below). Any change in degree requirements, including addition or removal of a track, require unanimous approval of all members of the analytics program committee; it is expected that committee members and their units will be sensitive to the needs of each unit.
- *Analytics Program Director/Associate Directors*. The program director will be chosen from among the unit coordinators (and thus will be a faculty member of one of the participating academic units); the other unit coordinators will serve as associate directors. The selection of the director will be made by the heads of the participating academic units, for a 5-year, repeatedly renewable term. The analytics program director, assisted by the associate directors, will have overall responsibility for the management and administration of the program. The program director will chair the program committee, and work with the associate directors and the rest of the committee to ensure that all aspects of the program (including admission, advertising, advising, placement, reporting, consideration of program changes and policies, etc.) are handled in an effective and timely fashion. The director and associate directors will be responsible for administration, governance, and financial activity of the program, as well as academic oversight

and admissions decisions. Initially, the program director will be responsible for academic advising issues related to course registration, etc. to make sure that things are resolved consistently; in the long term, once startup issues have been ironed out, those responsibilities will be assigned to an academic advisor. The program director and associate directors will be responsible for ensuring that each student in the program receives proper academic advisement, especially upon entry into the program. Each director/associate director will be responsible for academic advising of students in tracks primarily within their unit; if the program gets large enough, other program committee members may be assigned to assist in this task. In the event of cross-unit tracks, an appropriate faculty member will be assigned for each student.

- *Analytics Program Manager(s)*. The analytics program manager(s) will be responsible for the day-to-day non-academic operation of the program. This includes operations, recruiting, job and internship placement, applied practicum project-finding, industry contacts, etc. The program manager(s) will also be responsible for career advising of students. The program manager(s) will be a non-academic with an analytics-related background, and will be a full-time employee of the program.
- *Analytics Program Office*. The analytics program office will include the program manager(s), and the academic, administrative, financial, IT, etc. support staff necessary to run the program. It will collectively coordinate all of the various program activities and provide a single point of contact for the program with those outside Georgia Tech as well as other parts of the institute. The physical office will be located within the Stewart School of Industrial and Systems Engineering, with some members participating virtually (e.g., the program's specialized computing resources, which will be located within the College of Computing at the School of Computational Science and Engineering).
- *Analytics Industry Advisory Board*. Because the MS Analytics program is being created in response to a significant need both locally and globally, the program will solicit advice from an industry advisory board made up of highly-placed practitioners and consumers of analytics. The board will provide advice and feedback regarding the program's objective, outcomes, curriculum, quality of graduates, etc. It is expected that the Board will include national representation, and that Georgia employers may be over-represented on the board.

For program stability, it is generally advisable that unit coordinators and other members of the program committee not be replaced *en masse*. Therefore, especially when the first members' terms are up, a term might extend for a year so that replacements are staggered.

Evaluation of the program director and associate directors will be by their unit heads.

The initial members of the program committee are the following:

Program Director: Joel Sokol (ISyE), Fouts Family Associate Professor
Associate Directors: Sandra Slaughter (COB), Alton M. Costley Chair and Professor; and Polo Chao (CSE), Assistant Professor

Additional Program Committee Members: Richard Fujimoto (CSE), Regents' Professor; Jeffrey Hu (COB), Associate Professor; and TBA (ISyE)

Enrollment projections and monitoring

Projected enrollment for the first years of implementation

	First FY	Second FY	Third FY	Fourth FY
I. ENROLLMENT PROJECTIONS				
Student Majors				
Shifted from other programs	5	0	0	0
New to the institution	15	30	40	45
Total Majors	20	30	40	45
Course Sections Satisfying Program Requirements				
Previously existing	39	39	39	39
New	11	11	11	11
Total Program Course Sections	50	50	50	50
Credit Hours Generated by Those Courses				
Existing enrollments	180	0	0	0
New enrollments	540	1080	1440	1620
Total Credit Hours	720	1080	1440	1620

Methodology used to determine projections

Total enrollment projections for the new program are conservative approximations based on the experiences shared with us by recently-started MS Analytics degrees at other institutions. Among single-track programs, Northwestern University limits their program (most comparable to our Analytical Tools track) to 32 students; and NYU, UT Austin, Arizona State, and University of Connecticut (most comparable to our Business Analytics track) enrolled 60, 52, 55, and 70 this year. North Carolina State's interdisciplinary analytics program enrolled 81 students in 2012 and 84 students in 2013. Other relevant data we received was that UT Austin expects 800-1000 applications this year.

Program review year

We expect that the MS Analytics program will be reviewed by Georgia Tech after its fourth year, once the program has reached steady-state.

Anticipated actions if enrollment does not meet projections

If enrollment does not meet projections and the program becomes unsustainable at a high level of quality due to lack of demand, then there would be no choice but to stop admitting students to the program and close it down. It is not intended for this program to become a drag on Georgia Tech or the participating units.

Faculty

Total Number of Faculty: _____62_____

There are 62 faculty listed in the table included in the full proposal packet, for the 47 courses listed in Section 3a; this is because many of the courses are taught in rotation (i.e., several instructors take turns teaching in different semesters) and/or are team-taught by multiple instructors at the same time.

New faculty qualifications and timetable

Although the MS Analytics can be staffed initially using existing faculty, in the long term it might be beneficial to add faculty specializing in analytics to each of CSE, ISyE, and COB. Such faculty should have a PhD in analytics or a closely-related field, and each unit's new hires should specialize in an area of analytics appropriate to the unit.

Faculty load analysis

The MS Analytics can be staffed initially using existing faculty. Of the courses listed above, most will not require an additional offering; there is available space in existing sections of the courses to accommodate the demand from MS Analytics students. It is estimated that there will be 11 new sections of courses offered each year due to the MS Analytics program, 9 of which will be during the regular academic year. Currently, the existing faculty are teaching at their full academic-year loads. They and their unit heads have committed to rearranging their academic-year teaching to accommodate the needs of the MS Analytics, because it aligns with the faculty teaching interests and it will be a differential-tuition program that needs top-notch instructors. For the summer, the budget (see Section 15) also includes money for faculty to oversee/advise the practicum courses, and many faculty have expressed interest in this summer duty/support.

Budget

a. <u>Expenditures</u>
   i. Institutional resources required

      The main institutional resource required by the MS Analytics will be personnel. Faculty time will be required to teach all of the courses (note that for existing courses that will be shared with other students, a fraction of faculty time was allocated relative to the fraction of Analytics students in the course, so as enrollment increases those

allocations also increase). Faculty time is also necessary to create the required new courses and provide the desired interdisciplinary integration within new and existing courses, and also to periodically review and update courses to keep them up-to-date with current practice. Graduate teaching assistants are also required for the courses. Additional personnel time needed are support staff (academic, administrative, financial, marketing/communications, IT) and the new position of program manager (see Section 7). A virtual lab for MS Analytics is required, that will include big-data capable hardware and specialized analytics software. Because the lab will be virtual (so students may log in from anywhere on campus, or from home via a VPN), the only physical space it requires is a machine room within CSE. Other physical space required by the program includes classrooms (one within ISyE for the cohort-based courses, and others around campus used by the other analytics courses), office space in ISyE for program manager(s), a common area in ISyE for professional degree programs, a common area/lounge in ISyE for students, and meeting/seminar room space within ISyE. None of the physical resources require construction or updating; they all exist and can be used as-is.

ii. Reassignment of existing faculty/staff

In the short term, the units have committed to staffing the necessary initial MS Analytics courses and new sections using existing resources. As the program gets larger, the costs of adding resources to replace the faculty assigned to teach additional MS Analytics courses is shown in the budget and will be paid for by the program revenue.

b. <u>Revenue</u>

i. Sources and impact of reallocation of existing funds

There is no reallocation of funding; the MS Analytics program needs to be fully self-supporting in order for the degree to be offered.

ii. Calculation of new tuition amounts

The estimated tuition amounts assume 1/3 of students will be Georgia residents and 2/3 will be out-of-state. The tuition amounts are for the full-year program, with full-time registration in the fall and spring, and 6 hours in the summer. For each semester, each student's estimated tuition is the base Georgia Tech rate for Master's students ($5662/semester in-state, $13,665/semester out-of-state) plus the differential we have requested ($7571/semester in-state, $5001/semester out-of-state; both amounts are equal to Georgia Tech's MBA tuition differential).

iii. Nature of student fees

The student fees are the standard Georgia Tech fees for Master's students, plus a $2000 matriculation fee that is instituted to ensure that potential students do not accept a spot in more than one institution (taking up a spot another student could use) and then fail to show up and register. [Apparently, this was a common practice in similar MBA programs until they instituted such a fee, and it was

highly recommended that we, as competitors of such programs, would need to do the same.]

iv. Revenues from other grants

None.

v. Other revenues

None.

c. Difference between total revenue and total costs

The difference between total revenue and total cost is 0.25% or less in each year, much less than the potential estimation inaccuracies in revenue and cost; i.e., the estimated budget is essentially balanced each year. Of course, the actual expenditures and revenue will never match exactly to the last dollar.

I. EXPENDITURES	First FY Dollars	Second FY Dollars	Third FY Dollars	Fourth FY Dollars
Personnel – reassigned or existing positions				
Faculty **(see 15.a.ii)**	$331,000	$437,250	$639,250	$738,000
Part-time Faculty **(see 15 a.ii)**				
Graduate Assistants **(see 15 a.ii)**	$46,500	$55,500	$96,000	$103,500
Administrators**(see 15 a.ii)**				
Support Staff **(see 15 a.ii)**	$61,800	$61,800	$61,800	$61,800
Fringe Benefits	$107,132	$143,284	$201,623	$229,910
Other Personnel Costs				
Total Existing Personnel Costs	$526,432	$697,834	$998,673	$1,133,210

EXPENDITURES (Continued)				
Personnel – new positions (see 15 a.i)				
Faculty				
Part-time Faculty		$50,000	$105,000	146,000
Graduate Assistants	$21,000	$67,500	$67,500	$67,500
Administrators				
Support Staff	$60,000	$120,000	$120,000	$120,000
Fringe Benefits	$17,499	$35,483	$35,483	$35,483
Other personnel costs				
Total New Personnel Costs	$99,499	$272,983	$327,983	$368,983
Start-up Costs (one-time expenses) (see 15 a.i)				
Library/learning resources				
Equipment				
Other				
Physical Facilities: construction or renovation (see section on Facilities)				

Total One-time Costs	$0	$0	$0	$0
Operating Costs (recurring costs – base budget) (see 15 a.i)				
Supplies/Expenses	$15,000	$15,000	$15,000	$15,000
Travel	$5,000	$5,000	$5,000	$5,000
Equipment	$20,000	$20,000	$20,000	$20,000
Library/learning resources				
Other (Job and interview student travel)	$15,000	$22,500	$30,000	$33,750
Other (Recruting)	$20,000	$25,000	$25,000	$25,000
Other (Advisory Board)	$25,000	$25,000	$25,000	$25,000
Other (F&A Instructional Costs)	$231,978	$346,661	$462,930	$520,301
Total Recurring Costs	$331,978	$459,161	$582,930	$644,051
GRAND TOTAL COSTS	$956,908	$1,429,977	$1,909,586	$2,146,243
III. REVENUE SOURCES				
Source of Funds				
Reallocation of existing funds **(see 15 b.i)**				
New student workload				
New Tuition (base) **(see 15 b.ii)**	$549,893	$824,840	$1,099,787	$1,237,260
New Tuition (requested differential) **(see 15 b.ii)**	$292,883	$439,325	$585,767	$658,988
Federal funds				
Other grants **(see 15 b.iv)**				
Student fees **(see 15 b.iii)**	$111,760	$167,640	$223,520	$251,460
Other **(see 15 b.v)**				
New state allocation requested for budget hearing				
Nature of Funds				
Base budget	$954,537	$1,431,805	$1,909,073	$2,147,708
One-time funds				
GRAND TOTAL REVENUES **(see 15 c.i & c.ii)**	$954,537	$1,431,805	$1,909,073	$2,147,708

Facilities

		Total GSF
a.	**Indicate the floor area required for the program in gross square feet (gsf). When addressing space needs, please take into account the projected enrollment growth in the program over the next 10 years.**	**4254**
b.	**Indicate if the new program will require new space or use existing space. (Place an "x" beside the appropriate selection.)**	

	Type of Space		Comments
i.	Construction of new space is required		
ii.	Existing space will require modification		
iii.	If new construction or renovation of existing space is anticipated, provide the justification for the need.		
iv.	Are there any accreditation standards or guidelines that will impact facilities/space needs in the future? If so, please describe what the impact will be.		No
v.	Will this program cause any impacts on the campus infrastructure, such as parking, power, HVAC, etc. If so, indicate the nature of the impact, estimated cost and source of funding.		No
vi.	Existing space will be used as is	x	
c.	**If new space is anticipated, provide information in space below.**		
i.	Estimated construction cost		
ii.	Estimated total project budget cost		
iii.	Proposed source of funding		
iv.	Availability of funds		
v.	When will the construction be completed and ready for occupancy? (Indicate semester and year).		
vi.	How will the construction be funded for the new space/facility?		
vii.	Indicate the status of the Project Concept Proposal submitted for consideration of project authorization to the Office of Facilities at the BOR. Has the project been authorized by the BOR or appropriate approving authority?		
d.	**If existing space will be used, provide information in space below.**		
	Provide the building name(s) and floor(s) that will house or support the program. Indicate the campus, if part of a multi-campus institution and not on the main campus. Please do not simply list all possible space that could be used for the program. We are interested in the actual space that will be used for the program and its availability for use.		
	Parts of: Groseclose building, 2nd & 3rd floor; ISyE Main, 2nd and 3rd floor; College of Computing building, 2rd floor. Also current offices of participating faculty and staff.		
e.	**List the specific type(s) and number of spaces that will be utilized (e.g. classrooms, labs, offices, etc.)**		

i.	No. of Spaces	Type of Space	Number of Seats	Assignable Square Feet (ASF)
	1	Classrooms	80 (Classroom is tailored for professional degree courses)	1290
	0	Labs (dry)		0
	0	Labs (wet)		0
	1	Meeting/Seminar Rooms		212
	2	Offices		308
	3	Other (specify)	Common area in office suite, common area/lounge for students, machine room for virtual computer lab equipment	2434
			Total Assignable Square Feet (ASF)	**4254**

ii.	If the program will be housed at a temporary location, please provide the information above for both the temporary space and the permanent space. Include a time frame for having the program in its permanent location.

Chief Business Officer or Chief Facilities Officer Name & Title	**Phone No.**	**Email Address**
	Signature	

Note: A Program Manager from the Office of Facilities at the System Office may contact you with further questions separate from the review of the new academic program.

Course descriptions are available in the full proposal packet.

There are six new courses that will be offered as part of the MS Analytics: CSE 6010 Computational Problem Solving, CSE 6040 Introduction to Computing for Data Analytics, CSE 6141 Massive Graph Analytics, ISyE 8803 Introduction to Analytical Models, MGT 8803 Introduction to Business for Analytics, and MGT 8803 Big Data Analytics in Business, as well as the cross-listed Applied Analytics Practicum courses. The new ISyE and MGT courses will first be offered as 8803 special topics sections for three times before being proposed as permanent courses, according to the usual policy of those two units. The new course descriptions for the three new CSE courses (6010, 6040, 6141) are below. (**Note:** The new courses have not been approved at this time. A follow-up proposal will be submitted to the Graduate Curriculum Committee. The Special Topics format will be used to develop the new courses to be proposed at a later date.)

5. Discussion on Cotutelle Agreements for the doctoral thesis was tabled. (In a follow-up discussion after the meeting, it was determined that, due to time constraints, the Graduate Committee will consider scheduling a conference call on this topic.)

6. A motion was made to eliminate the following Undesignated Master of Science Degrees. The motion was seconded and approved.

   Following are the CIP codes, degree title, and majors associated with these Undesignated Master of Science degrees that are being eliminated.

   The undesignated Master's degrees will be eliminated after all current students who are enrolled in them have graduated. We will not ask the System office to take them off the DMA table until we have graduated all the students. No additional students will be admitted to these programs.

   In addition to the undesignated MS degrees listed below, we are also requesting the elimination of the following degrees that were discontinued locally years ago. This action will serve to help cleanse these degrees that are already defunct from the DMA degree table.

   MSPTFE 14280101 Master of Science in Polymer, Textile and Fiber Engineering
   MSTFCH 40059901 Master of Science in Textile and Fiber Chemistry

UNDESIGNATED MS DEGREES

04020101	Master of Science	Architecture
11010101	Master of Science	Computer Science
14020101	Master of Science	Aerospace Engineering
14070100	Master of Science	Chemical Engineering
14080101	Master of Science	Civil Engineering
14100102	Master of Science	Electrical and Computer Engineering
14110101	Master of Science	Engineering Science and Mechanics
14140101	Master of Science	Environmental Engineering
14180101	Master of Science	Materials Science and Engineering
14190100	Master of Science	Mechanical Engineering
14230101	Master of Science	Nuclear and Radiological Engineering
14280101	Master of Science	Polymer, Textile and Fiber Enginneering
14320101	Master of Science	Polymer*
14350100	Master of Science	Industrial Engineering
27010101	Master of Science	Mathematics
40050101	Master of Science	Chemistry
40059901	Master of Science	Textile and Fiber Chemistry*
40069901	Master of Science	Earth and Atmospheric Science
40080101	Master of Science	Physics
42280401	Master of Science	Psychology
51070101	Master of Science	Health Systems
52020101	Master of Science	Management
52060101	Master of Science	Economics

*These degrees were discontinued, but the records were not updated until now.

The Undesignated Master of Science degree itself will remain available for very limited use for programs that are in the process of re-evaluating their Master's level offerings or that need this generic degree for other reasons.

Student Petitions

1. A motion was made to approve Petitions Subcommittee actions in the following areas. The motion was seconded and approved.

   Petitions reviewed from 01/17/14 to 02/04/14.

   All petitions fell into the administrative action category. (All approved except where noted.)

   5- Full Graduate Standing
   11- Late registration for Spring 2014
   3- Cancel registration for Spring 2014
   3- Use PHD Thesis hours as MS Thesis hours
   1- Six-year rule waiver
   1- Seven-year rule waiver
   2- Adjust registration hours for current term
   1- Count MGT6113 twice, registered incorrectly, allow both instances to count

Adjourned,
Reta Pikowsky
Registrar