ISYE 4034 DECISION AND DATA ANALYSIS

Concentration Elective

Credit: 3-0-3

Prepared Profs. Lu, Mei, Wang, Summer 2018

Prerequisite(s): ISYE 3133 Engineering optimization, CS 4400 Intro to Data Base

Prerequisite with concurrency (concurrent or prior): ISyE 4031 Regression and Forecasting

Catalog Description:
Integrate decision and data analytics together to solve real-world business problems. Hands-on system modeling, data collection and analysis, and reporting writing projects.

Textbook
Business Analytics by J. R. Evans (2012)

Course description:
Class materials will be divided into the following five components:
1) Problem Formulation (Business Goal(s) and Analytics Goal(s))
   a) Linking Business Analytics Goals to Decision-Data-Analytics (DDA) Processes
2) Data Analytics Methods and Tools
   a) Descriptive Analytics (Statistical Procedures, Data Mining Tools)
   b) Predictive Analytics (Regression Modeling, Forecasting, Simulation)
   c) Statistical and Data Mining Software Packages
3) Decision Analytics – Prescriptive Analytics Procedures
   a) Various Optimization Techniques
   b) Formulation of Optimization Model Supporting Real-world Applications
   c) Optimization Algorithms and Software Packages
4) Data Preparation and Application Examples of DDA
   a) Guidelines for Dealing with Various (Unstructured) Data Types
   b) Data Extraction, Cleaning, Segmentation and Summary
   c) Application of DDA Tools, Interpretation and Assessment
5) DDA Process Integration, System Dynamics and Automation

Participation
Attendance in recitation sessions: 5%
Participation in recitation sessions: 5%

Grading:
2 Exams: 22% each
4 team homework assignments, 5% each

Term project 33%,
8 pop up quizzes 0.5% each, 2 lowest ones will be dropped.

Assignment policy: Some assignments may be team tasks.

Regrade policy:
Return the regrade request within one weeks of obtaining graded item. Attach a note clearly stating your claim. Regrade will not take place on the spot nor will be considered face-to-face. The instructor keep the prerogative of performing a complete regrade of the item when you request the regrade of any of its parts.

Georgia Tech Honor Code and Student-Faculty Expectations
http://osi.gatech.edu/content/honor-code
http://www.catalog.gatech.edu/rules/22/

Topical Outline

Topics	Weeks
Basic decision and data analytics 1. Introduction, past project focus on goal formulation and DDA system architecture, overview of analytics methods and tools. 2. Statistical modeling techniques, multiple linear regression, nonlinear regession, generalized linear model, EWMA and time serious forecasting. Link data analytics goas to specific statistical modeling and analysis procedures. 3. Decision optimization modeling, linear programming integer and mixed-integer programming, nonlinear programming. 4. Real-world example focusing on problem and goal formulations, step-by-step guidelines for constructing decision and data analytic models, linkage between decision and data analytics.	4
In-depth decision decision and data analytics, project execution details 5. Discussion of data sources and data collection methods; classification and additive models including decision trees 6. Cluster analysis, dimention reduction, association rules and link analysis, support vector machine. 7. Economic decision models for logistics, supply chain management, health systems and other applications. 8. Multi-objective optimization, decision in uncertain environment, nonlinear, dynamic and stochastic optimization. 9. Continue, problem and issues in decision and data analytics integration, solution mothods for integrated decision-data-analytics. 10. Practical issues, analytic problems from student projects.	6
Advanced decision and data analytics, project completion 11. Business analytics system integration and system dynamics, model assessment and averaging. 12. Step-by-step guidelines for project report and presentation slide preparation, lesion learned from past projects, non-standard real-world problems for decision and data analytics, pop-up store procurement with advanced-information forcasting and sequential decision analytics. 13. More on dimension reduction focusing on recent advance on variable selection for a huge number of explanatory variables, monitoring progress on project studies. 14. More on decision data analytics focusing on large scale computing issues for dynamic optimization with updates of information forecast. 15. Future of business analytics, real world examples on novel initiatives, especially technical DDA procedures, project presentations	5
Total	15

Outcomes and their relationships to ISyE Program Outcomes

At the end of this course, students will be able to:

1. Formulate real life problems into business and analytics goals technically;
2. Construct decision and optimization mathematical models to meet business and analytics goals. Understand assumption and limitations of decision models;
3. Establish data-analytic models to meet needs of decision and optimization models. Understand assumption and limitations of data-analytic models;
4. Collect appropriate data to estimate parameters in data-models. Use statistical software to build and validate models;
5. Employ decision and optimization software to solve decision problems;
6. Understand issues involved in system dynamics and process integration for making the developed system sustainable;
7. Experience how to work in a team environment efficiently and effectively to prepare semester project reports and presentation slides.

Course outcome \ Program Outcomes	1. identify, formulate solve engg prob by engg, sci & Math	2. produce solutions consider public health, safety, welfare, global, cultural, social, environ & economic	3 communicate with a range of audience	4 recognize ethical & professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.	5. effective on a team provide leadership, collaborative and inclusive envirn, plan tasks & meet objectives	6. develop and conduct experiment, analyze and interpret data & use engineering judgement to draw conclusions.	7. acquire and apply new knowledge using appropriate learning strategies
Formulate real life problems into business and analytics goals	High						
Construct decision and optimization models to meet business and analytics goals. Understand assumption and limitations.	High						
Establish data analytic models to meet needs of decision and optimization models.	High						
Collect appropriate data to estimate parameters in data models, use statistical software to build and validate models.						High	
Employ decision and optimization software to solve decision problems.							
Understand issues in system dynamics and process integration for sustainable systems							
Experience how to work in teams efficiently and effectively in developing report and presentation.			High		High		

Student Outcomes a – k to new 1 - 7

OLD Criterion 3. Student Outcomes The program must have documented student outcomes that prepare graduates to attain the program educational objectives. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.	NEW Criterion 3: Student Outcomes The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.
(a) an ability to apply knowledge of mathematics, science, & engineering (e) an ability to identify, formulate, and solve engineering problems	(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health & safety, manufacturable, & sustainable	(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(g) An ability to communicate effectively.	(3) An ability to communicate effectively with a range of audiences.
(e) an understanding of professional and ethical responsibility (h) the broad education necessary to understand the impact of engg solutions in a global, economic, environmental, & societal context	(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
(i) a recognition of the need for, and an ability to engage in life-long learning	(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
(i) a knowledge of contemporary issues	Doesn't really map. There are aspects contained in (2) and (4)
(d) an ability to function on multidisciplinary teams	(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative & inclusive environment, establish goals, plan tasks, and meet objectives.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Moved to Criterion 5