ISyE 8803(LUJ) - DDA (Decision and Data Analytics)

1. Instructor: Dr. Jye-Chyi (JC) Lu
2. Lecture Hours and Location: Tu, Th 8:00 am – 9:15 am at MRDC 2404
3. This class will be taught in-person and all exams are in-person and in-class exams.
4. Pre-requisites: Introductory Statistics, Introductory Regression and Introductory Database background.
5. Recommended Books for Self-Reading (not the textbook): This course will *train* students to find relevant and creditable materials from possible sources in textbooks, past lecture notes, publications and online searches, etc. Many *examples* are given in our *Canvas web pages*. However, the following two books provide some basics: Business Analytics by J. R. Evans (2012) and Competing on Analysis: New Science of Winning by T. H. Davenport and J. E. Harris (2007).
6. Office hours: 10:55 am – 11:55 am (and by appointments) Tu, Th. **All Q&As will be summarized and posted on Canvas.**
7. Email: jclu@isye.gatech.edu (JCLU) – This is the main contact.
8. Software package: Any software including Minitab (available in the ISyE undergraduate lab) and R (free) package -can be downloaded at http://cran.r-project.org/ Students need to find optimization software themselves.
9. **Class materials** will be divided into FIVE components
   1) Problem Formulation (Business Goal(s) and Analytics Goal(s))
      a) Linking Business Goals to Decision-Data-Analytics (DDA) Processes
   2) Decision Analytics–Part I: Data Analytics Tools
      a) Descriptive Analytics (Basic Statistical Procedures, Data Mining Tools)
      b) Predictive Analytics (Regression Modeling, Forecasting, Simulation)
      c) Statistical and Data Mining Software Packages
   3) Decision Analytics –Part II: Prescriptive Analytics Procedures
      a) Basic Optimization Techniques
      b) Formulation of Optimization Model (Logistics, Supply-chain Management, Material Design)
      c) Optimization Algorithms and Software Packages
   4) Data Preparation and Application Examples of Decision Analytics
      a) Dealing with Various (Unstructured) Data Types
      b) Data Cleaning, Segmentation and Summary
      c) Application of Decision Analytics Tools, Interpretation and Assessment of Results
   5) DDA Process Integration, System Dynamic sand Automation

10. **Homework Assignments:** There will be **THREE Team-Project Assignments** on subjects including (1) Statistics/Data-Mining procedures/Tools, (2) Optimization procedures/Tools, and (3) Dynamic Decision-Data-Analytics Modeling for a total of 12% class grades. See Canvas posting for details.

11. **Exams:** There will be a total of 50% credits for ***two exams*** **each with 25%** course grades. Subjects include: (1) data analytics and computing (50%) and (2) decision and optimization modeling/analytics (50%). We will monitor COVID-19 issues and decide whether an exam is take-home or in-class. The decision will be announced one month before the exam date or due date. If it is a take-home exam, exam problems will be posted about four weeks before the due date.

12. **Two Mini-Projects** (with teammates) each with 4% semester credits for a total of 8% credits.

13. **Two Computer Projects (for every individual student) each with 6% semester credits for a total of 12% credits.**

13. **Semester Projects:** There will be ***ONE semester project*** with 15% credits (12% for the report and 3% for PPT and presentation). Students will form their own **teams**, and work with the instructor on pre-structured projects. It will include formulations of "business" and DDA goals, data analysis strategies, illustrative examples of data analysis procedures, optimization models and solutions, and finally DDA dynamics and process integrations. Guidelines will be provided in Canvas. Milestones for submitting partial project results will be planned.

14. **Class Attendance and Instructional Survey: Four attendance-checks with a total of 2% credits; 1% is allocated for the instructional survey.**

15. **Differentiation between the undergraduate and graduate levels of this business analytics course:**

    i) Compared to the undergraduate level course, graduate course will be much more creative and rigorous. Students' **semester projects** will be required to show a rigorous evaluation of their creativities following the guidelines provided in lecture notes.

    ii) Graduate level course will require **assignments** to review important course subjects in a much **deeper and rigorous manner**. For example, dynamic and stochastic optimizations need to be covered in the review of optimization procedures/tools. Nonlinear regression, cluster analysis, dimension-reduction and other data mining methods need to be covered in the review of statistical/data-mining procedures/tools.

    iii) **In-class exam questions** for the graduate level courses will be more technical. It will challenge students to *develop* new decision/optimization and data-analytic modeling/solution methods. Undergraduate student's exams will focus on applying lesson learned to solve problems similar to what have been presented in lectures and reviewed in assignments.

16. **Outcomes and their Evaluations:**

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

- Formulate real life problems into business and analytics goals using business analytics procedures.

- Construct decision and optimization mathematical models to meet the business and analytics goals formulated. Understand the assumptions and limitations of the decision models.
- Establish data-analytic models to meet the needs of decision and optimization models. Understand the assumptions and limitations of the data-analytic models.
- Collect appropriate data to estimate data-models and understand which data are useful in solving the problem. Use statistical software to estimate models from real-life data.
- Employ decision and optimization software to solve decision problems.
- Understand issues involved in system dynamics and tool-integration for making the developed system sustainable.

Evaluation of the important outcomes:

1. One semester project will be assigned to a team of **eight students**. Students are expected to identify a real life problem, formulate it using decision/optimization and data-analytic procedures, collect necessary data, analyze it, include data-analytic results in the decision and optimization solutions, draw conclusions for the project and validate that business and analytic goals are met, and present the study report in a class presentation.
2. Two in-class exams will be used for evaluating student's ability to (1) formulate and solve decision and optimization problems, and (2) formulate and solve data-analytic problems.
3. Three homework assignments will require students to review and acquire details in the following subjects: (1) Statistics/Data-Mining Tools, (2) Optimization Tools, (3) Dynamic Decision-Analytics Modeling, and (4) Decision-Analytics Implementation/Architecture.