USCViterbi

ISE 533: Integrative Analytics
Spring 2019
Class Schedule: M, W: 3:30 pm – 4:50 pm
Location: KAP 147

Instructor: Suvrajeet Sen
Office: OHE 310P
Office Hours: T, W 10 – 11
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Course Description

This course is intended to bring the three pillars of analytics (descriptive/predictive, prescriptive, and validation) together under one integrated framework. This will be achieved via projects from several application areas such as energy, communications, finance, supply-chain and inventory, and others.
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Learning Objectives

As the name suggests, this course has two objectives. It is principally devoted to "Analytics" and its scope is "Integrative". What this means is that we will present several seemingly disparate tools, such as programming concepts from *Python*, data analysis concepts such as *Regression*, and decision models based on *Optimization* with the intent of building models which will help students understand the "workflow" necessary for a project requiring a spectrum of models.   This one-of-a-kind course is intended to highlight the integrative features within the lifecycle of an analytics project.   A week-by-week plan appears next.

Week	Topics	Source
1.1	Examples of Predictive and Prescriptive Analytics	Preview of Projects For the Course
1.2	Motivation for Data and Decision Sciences	Formalizing the setting
2.1	Data Science Technology	https://docs.python.org/2/contents.html, https://www.r-project.org/
2.2	Data Science: Collaborative Filtering	Matrix Completion (Netflix Challenge)
3.1	Decision Science: MIP and Meal Planning	Predict-then-Optimize (Tutorial)
3.2	Deterministic MIP Technology	CPLEX/Gurobi
4.1	Planning under Uncertainty	Tutorial
4.2	Stochastic LP Technology	Notes + Pyomo Book,
5.1	Primal Policy in Networks	Hedging
5.2	Pricing-based (Dual) Policy	Bid-prices in Priceline
6.1	SP Model Validation	
6.2	SP Model Verification	
7.1	Regression (Linear & Logistic)	Concepts
7.2	Support Vector Machines (SVM) as a QP	Notes
8.1	Mid-term Presentations	
8.2	Mid-term Presentations	
9.1	SVM as SP	Notes
9.2	Marketing and Production -1	Does SP work here?
10.1	Marketing and Production -2	Tutorial

10.2	Model Validation	Tutorial
11.1	Model Validation	Tutorial
11.2	Conf. v Prediction Intervals	LEO Paper
12	Time Series Data	https://www.otexts.org/fpp/4
13	Inventory Modeling	LEO Paper
14-15	Portfolio Presentations	

Prerequisite(s): Basic courses in Computer Programming, Optimization and Statistics.

Course Notes:

The instructor will cover topics mentioned above, and students will learn from projects, rather than specific homework assingments.

Supplementary Materials

- For Python: https://developers.google.com/edu/python/?hl=en
- Statistical Primer (from NOAA, using Climate Data)
    - http://www.nws.noaa.gov/om/csd/pds/PCU2/statistics/Stats/part2/SPrimer2.htm
- Agriculture (USDA) http://nassgeodata.gmu.edu/CropScape/
    - Has crops, and other USDA data, and also includes all freeways as well.
- Midwest Study: http://www.decision-innovation.com/spatial-time-series-analysis/case-study-multi-state-land-use-survey.aspx
- Crime (FBI)   https://www.fbi.gov/stats-services/crimestats
- Energy Information Administration
    - Total Energy: https://www.eia.gov/totalenergy/
    - Renewables: https://www.eia.gov/renewable/data.cfm
    - Electricity: https://www.eia.gov/electricity/data.cfm

Grading Breakdown

This course is intended as a capstone experience, and there will be several assignments in which students will be asked to create data sets and examples, with proposed solutions during the course of the semester. These assignments will be due on a bi-weekly basis, and will be compiled throughout the semesters. At the end of the semester, each student will present a portfolio of their work to the class. The portfolio should involve data sets, methods, and results. Homework assignments will account for 30% of the grade, 30% for the portfolio, 30% for class presentations, and 10% for participation/exploration. This last category will be recorded via new resources (data, model, methods) discovered by the student. Such discoveries do not have to be original, but something that the student discovers in the process of exploring the literature/web etc.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as

possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/. Information on intellectual property at USC is available at: http://usc.edu/academe/acsen/issues/ipr/index.html.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

Please activate your course in Blackboard with access to the course syllabus. Whether or not you use Blackboard regularly, these preparations will be crucial in an emergency. USC's Blackboard learning management system and support information is available at blackboard.usc.edu.