DSO 570 – The Analytics Edge: Data, Models, and Effective Decisions

Syllabus – Spring 2019 – 3.0 Units

USC Marshall School of Business

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Course Times: Section 16298: Tuesday/Thursday 12:30-1:50pm JKP-110
Section 16301: Tuesday/Thursday 5:00-6:20pm JKP-102

Office Hours: Friday 3:00-5:00pm. If this time does not work for you, you can make an appointment by email to meet with me, but please give me at least 2 business days of advanced notice.

Course Description

This course equips students to be practitioners of *prescriptive analytics*, which is the science of decision making using rigorous mathematical tools of optimization. Students will develop optimization models in Python to analyze real-world problems in diverse application areas, including business strategy, inventory management, revenue management, resource allocation, matching, scheduling, and portfolio optimization. This class is required for the Master of Science in Business Analytics program and is an elective for the Marshall graduate program.

Learning Objectives

Upon successful completion of this course, students will be able to:

1. **Model** a decision as an optimization problem, and clearly describe the assumptions.
2. **Analyze** and solve problems involving optimization.
3. **Code** simulation models and optimization models in Python.
4. **Communicate** optimization analyses using both technical and business language.

Textbooks:

The course will rely on the following textbooks:

- Chapters 1-9 of "Python for Everybody" by Charles R. Severance, available at https://www.py4e.com/book.php. (Both the PDF and HTML versions are free.)
- Chapters 2, 3, 5, 7-9 of "Data, Model, and Decisions: The Fundamentals of Management Science." By Dimitris Bertsimas and Robert M. Freund, Dynamic Ideas, 2004. (ISBN-13: 978-0975914601 and ISBN-10: 097591460X) Available at the bookstore, on Amazon, or through the publisher.

The readings associated with each class are listed in the course calendar at the end of the Syllabus.

Prerequisites:

This course requires students to have access to a laptop that they can bring to class with Python 3, Jupyter notebook, and the Pandas package installed. All of these are available via installing the latest Miniconda or Anaconda distribution for Python 3.X, available at https://conda.io/docs/user-guide/install/index.html. You should complete the installation as soon as possible, preferably before the first class session. Using Miniconda or Anaconda to install Python, Jupyter and Pandas, rather than using another method, will minimize technical difficulties.

Communication Policy:

I am committed to respond to your email within 24 hours if it is received on a business day during 9am-5pm. If it is received in the evenings or on the weekends, then I will treat the email as if it was received at

9am the following business day, and respond within 24 hours from then. (For example, for an email received on Monday at 3pm, I will respond by Tuesday at 3pm. For an email received at Monday at 6pm, I will respond by Wednesday at 9am. For an email received on the weekend between Friday 5pm and Monday 9am, I will respond by Tuesday 9am. If it were a long weekend and Monday is a holiday, then I will respond by Wednesday 9am.)

Classroom Policy:

It is very important for each student to read the assigned readings and positively contribute to the class discussions. On the weeks without textbook readings, the instructor may post other readings on Blackboard. Students will be cold called regarding the textbook readings and additional readings during class.

Students should bring a computer to each class, but should only use it during the time allotted for the hands-on coding activity. During all other times, students should close all laptops and refrain from using cell-phones or tablets. When computer use is not allowed, students should take notes by hand using paper. Throughout the duration of the class, students should not access Facebook, YouTube, Twitter, Instagram, or any other website that is not related to the course.

The instructor may videotape the lecture and distribute to students. The use of such material is reserved exclusively for the USC students registered in this class. Videotaping or audiotaping lectures using your own devices is not permitted due to copyright regulations.

Grading:

Grading will be based on adding up the number of points obtained in each of the following assessments, weighted according to the proportion given in the third column below. A final letter grade will be assigned based on both your total number of points and how it compares to other students in the course.

Assessment	Description	Weight
Homework	Individual assignments to applying concepts learned to solve problems. Certain questions may require programming using Python. The work is only graded on timely completion, but not on correctness. Doing this work prepares students for exams and for completing the final project.	**8%**
Quizzes	Fifteen minute multiple choice quizzes during class. If you understand how to solve previous homework questions and practice problems in class, then you will be well prepared. There are three quizzes. If you miss a quiz, the weight will be transferred to the next exam.	**6%**
Labs	In-class activities in team (same as final project) to apply techniques learned in class to solve a real-world problem using Python. While the in-class activities are conducted in teams, each individual must submit working code before the given due date to receive the credit (see schedule for precise date when code submission is due).	**6%**
Exams	There are two open notes, closed computer, in-class exams, worth 25% each. While computers are not allowed, students may be asked to write code on paper, or to predict the output of a piece of code.	**50%**
Final Project	Work in teams of 4-5 (assigned by the professor) to apply prescriptive analytics on a real-world business problem. This year, the problem is to improve classroom scheduling at USC Marshall. Students will analyze the current schedules and quantify potential benefits from various types of optimization. *Final Deliverables:* - A 10-15 page report, with the main body targeted to a broad audience and a technical appendix targeted to data analysts (20%).	**30%**

	- All Python code used, properly commented and functioning, with clear documentation of what each part does (5%). - A 10 min final presentation during exam week (5%). - A 1 page memo describing the roles and contributions of each person in the project. (Used to adjust individual grades.)	
	Total	**100%**

Exam Rescheduling:

Students must attend all exams at the indicated times and dates. If you foresee a conflict, you must contact the professor within the first two weeks of the semester to explore alternative options. **No rescheduling of exam will be allowed after the first three weeks of class.** The only exception is a **documented medical or family emergency**, for which the student must either provide a signed doctor's note with the name and phone number of the medical professional verifying the medical emergency, or have a professional counselor contact the professor directly verifying the nature and seriousness of the emergency. For all other reasons of missing the exam, including travels for non-emergencies, interviews, adverse traffic conditions, or forgetfulness about exam time, the student will not be allowed to reschedule and will receive a zero for the exam.

Assignment Submission Policy:

Assignments must be submitted electronically via Blackboard before it is due. If your internet breaks down on the due date, you must deliver ad hard copy at the beginning of class on that day. If you are unable to attend class on that day, make arrangements for it to be delivered to the classroom or to my office by the start of class. Late or not, however, you must complete all required assignments to pass this course. **Any assignment turned in late, even if by only a few minutes, will receive an additive grade deduction of 10 percentage points at the beginning of every 12 hours for which it is delayed.** For example, a report that would have gotten a grade of 85% that is ten minutes late will receive a grade of 75%. If it is 13 hours late, it will receive a grade of 65%. If it is 25 hours late, it will receive a grade of 55%. The deductions continue until the grade reaches zero.

Academic Integrity

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

IMPORTANT: The homework and reports in this course are assumed to be independent work. You may discuss with other students about how to do the analysis, but the write-up itself must be independent work. No communication between students is tolerated during a quiz or an exam, and a student who has taken a test cannot discuss the test with a student who has not completed the test, including the students in the other section. Any suspicion of plagiarism or cheating will be reported and investigated. Students are encouraged to report any suspicious behavior of peers; the identity of the student who reports cheating will be held confidential. **Any documented act of plagiarism or cheating will result at a minimum in a failing grade of "F" for all responsible parties and accomplices, and depending on the result of the investigation, may also result in higher penalties such as suspension or expulsion.** In order to uphold the academic integrity of the university, such disciplinary actions will be executed without mercy on the first violation. By USC policy, any student who is investigated for cheating will not be allowed by the system to drop the course, and will be added back even if they do manage to drop.

Team Work:

For any career related to business analytics, it is important that you work well in teams. Most teams in the workplace are assigned by others rather than chosen by team members. Therefore, you must learn to work effectively in the assigned teams for the final project. The teams are assigned to maximize diversity of background and expertise. The assignment may be imperfect but you must work with it. Upon receiving the team assignment, please meet with all team members and communicate expectations and establish a plan to hold one another accountable. The instructor will not act as an intermediary in any team disputes; you must work out differences among yourselves. With the submission of the final project report, you will also submit a 1-page memo describing the role of each person for the project and the individual contributions, signed by all team members. This will be used to adjust individual grades if certain members contributed little.

Evaluation of Your Work:
You may regard each of your graded submissions as an "exam" in which you apply what you've learned according to the assignment. I will do my best to make my expectations for the various assignments clear and to evaluate them as fairly and objectively as I can. If you feel that an error has occurred in the grading of any assignment, you may, within one week of the date the assignment is returned to you, write me a memo in which you request that I re-evaluate the assignment. Attach the original assignment to the memo and explain fully and carefully why you think the assignment should be re-graded. Be aware that the re-evaluation process can result in three types of grade adjustments: positive, none, or negative.

The Importance of Course Evaluations:
This course is continuously improved, based on feedback from students and instructor observations. Please participate in the final course evaluations online. Your instructor will read each evaluation carefully and address the feedback in future iterations of the course.

ADDITIONAL INFORMATION

Add/Drop Process
Most Marshall classes are open enrollment (R-clearance) through the Add deadline. If there is an open seat, students can add the class using Web Registration. If the class is full, students will need to submit a Wait List application to secure a seat if one becomes available. The wait list request form can be downloaded at www.marshall.usc.edu.registrationpolicies. The last day to add the class or withdraw without receiving a "W" (and receive a refund) is Friday, February 23, 2018. The last day to drop with a mark of a "W" (no refund) is Friday, April 6, 2018.

Retention of Graded Coursework
Exams and all other graded work which affected the course grade will be retained for one year after the end of the course, but only if the graded work has not been returned to the student. If a graded assignment or exam has been returned to the student, it is the student's responsibility to file it.

Support Systems
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship & Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

Student Support & Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC – https://diversity.usc.edu/
Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students

Students with Disabilities
USC is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this course and require accommodations, you must first register with the Office of Disability Services and Programs (www.usc.edu/disability). DSP provides certification for students with disabilities and helps arrange the relevant accommodations. 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. **This letter must be delivered to the professor by the end of the third week of class in order to apply accommodations for this course.** DSP is located in GFS (Grace Ford Salvatori Hall) 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. Email: ability@usc.edu.

Grade Disputes
All grades assigned by faculty members are final. Students have the right to seek explanation, guidance, counsel and reasons for the assignment of a grade. Faculty may initiate a change in grade if there is an error in the calculation of a grade. Students may appeal a grade according to university policy as set forth in *SCampus*. A faculty member may not change a disputed grade outside the formal appeals process. In response to a disputed academic evaluation by an instructor, a student is entitled to two levels of appeal after review by the instructor: first to the chairperson of the department and then to the appropriate dean of the school. The full university policy can be found in *SCampus* under University Governance / Academic Policies at https://policy.usc.edu/scampus-part-c/.

COURSE CALENDAR

Session/Date		Topic	Readings	Deliverable Due
1	Tue 1/8	Introduction to optimization and Python	PY4E 1	**Pre-class survey**
2	Thu 1/10	Python I: variables and conditional statements	PY4E 2-3	**Homework 0**
3	Tue 1/15	Python II: functions and types	PY4E 4	**Homework 1**
4	Thu 1/17	Python III: iterations	PY4E 5	
5	Tue 1/22	Python IV: lists and dictionaries	PY4E 8-9	**Homework 2**
6	Thu 1/24	Python V: Numpy arrays	See Blackboard	
7	Tue 1/29	Python VI: Pandas Series and DataFrames	See Blackboard	**Homework 3**
8	Thu 1/31	Python VII: data manipulation	See Blackboard	Quiz 1
9	Tue 2/5	Probability	DMD 2.1-2, 2.4-5, 8-13	**Homework 4**
10	Thu 2/7	Probability distributions	DMD 2.6-7, 3.1-5	
11	Tue 2/12	Problem solving with probability		**Homework 5**
12	Thu 2/14	Simulation modeling I	DMD 5.1-9	
13	Tue 2/19	Simulation modeling II		Quiz 2
14	Thu 2/21	**Lab 1**: revenue management		**Homework 6**
15	Tue 2/26	Project discussion		
16	Thu 2/28	Review		**Lab 1 code**
	Tue 3/5	**Exam 1**		
17	Thu 3/7	Introduction to linear programming (LP)	DMD 7.1-3, 7.5-6, 7.8	
	Tue 3/12	**Spring break**		
	Thu 3/14			
18	Tue 3/19	Mixed integer programming (MIP)	DMD 9.1-5	
19	Thu 3/21	LP/MIP Modeling I		
20	Tue 3/26	LP/MIP Modeling II		**Homework 7**
21	Thu 3/28	LP/MIP Modeling III		
22	Tue 4/2	**Lab 2:** logistics of online retailing		**Homework 8**
23	Thu 4/4	Introduction to non-linear programming (NLP)	DMD 8.1-2, 8.4-6	Quiz 3
24	Tue 4/9	**Lab 3**: shift scheduling		**Lab 2 code**
25	Thu 4/11	Project discussion		
26	Tue 4/16	**Lab 4:** portfolio optimization		**Lab 3 code**
27	Thu 4/18	Review		
	Tue 4/23	**Exam 2**		
28	Thu 4/25	Research presentation		
	Finals Week	**Final Presentations:** Section 16298: Wed. May 8 2:00-4:00pm Section 16301: Thur. May 2 4:30-6:30pm	**All final project reports, code, and presentation slides are due Tuesday April 30 at 6pm PST.**	

Notes:

- **PY4E** denotes the textbook "Python for Everybody" by Charles Severance.
- **DMD** denotes the textbook "Data, Models, and Decisions" by Bertsimas and Freund.
- The meeting times during finals week is scheduled by the university and cannot be changed. See the current semester's schedules at: https://classes.usc.edu/term-20191/finals/.

After carefully reviewing the above syllabus, please complete the following and return a hard copy to the instructor.

Acknowledgement of Understanding

I, _____, USC # _____, hereby acknowledge that I have carefully reviewed the DSO 570 Syllabus in spring 2019 and that I fully understand and agree to the policies written therein. Specific policies include:

- Any documented act of plagiarism or cheating for an assignment or a test will result, at a minimum, in a failing grade of F for the course with no option of withdrawal, for all responsible persons. The penalty will be applied without mercy upon the first offence.
- No exam rescheduling is allowed after the first three weeks of class. Except for documented medical or family emergencies, missing the exam will result in a grade of zero.
- DSP students must provide the instructor with the official letter of verification by the third week of class for any accommodations to be applied for this course.
- No use of laptops, tablets, and cellphones during class session outside of allotted times.
- No audiotaping or videotaping of class sessions using own devices.
- Although discussion among students is allowed, all homework and reports must be written up individually.
- Any late assignment, even by a few minutes, will be subject to the reductions in grade described in the Syllabus.
- The teams for the final assignment will be assigned by the instructor. The instructor will not act as an intermediary for team disputes during the term. At the end of the term, each team will submit a write-up documenting individual member contributions, signed by all team members, which the instructor will use to adjust grades if needed.

Signature: _____

Date: _____