YSC2254, Modelling and Optimization

NOTE: This draft syllabus may be subject to change.

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Course Description: This module introduces the fundamental methods of discrete and continuous optimization and their applications to a broad range of problems in economics, physics, signal processing and data science. Specific topics include linear, integer, and non-linear programming, and transportation and network modelling. Additional topics may include clustering, Markov chain models, and decision making under uncertainty. Emphasis will be placed on practical methods for solving optimization problems using standard computational tools and packages.

Learning Objectives and Course Goals: By the end of the course, students should be able to

- Apply systematic approaches to modelling an assortment of scenarios in economics, physics, scheduling, transportation, decision science and data science.
- Recognize and correctly set up linear/integer/nonlinear programs where appropriate.
- Understand and precisely communicate necessary and sufficient conditions for feasible/optimal solutions to exist.
- Solve linear/integer/nonlinear programs using appropriate techniques by hand when feasible and with the assistance of a standard solver otherwise.
- Model and solve a variety of optimization problems for scenarios involving networks.

Pre-requisites: there are no formal prerequisites, but familiarity with differential calculus will be assumed. Prior exposure to matrix arithmetic will be helpful, but is not required.

Required Textbooks: We will primarily use the texts *Operations Research*, 4th edition, by Wayne Winston and *Optimization Methods in Finance* by Cornuejols and Tutuncu . Students might find *Introduction to Applied Linear Algebra* and *Convex Optimization*, both by Stephen Boyed and Lieven Vanderberghe, to be helpful references.

Course Assessment Breakdown:

- Homework – 50%
- Projects – 50%

Description of Assignments: Homework assignments will be a mix of written exercises and programming exercises. Written exercises will be mostly computational rather than proof-based. Programming exercises can be completed in Julia, Python, or R.

The midterm exam will occur in approximately Week 7 and will cover the discrete optimization topics. The final exam will occur at the time scheduled by Registry and will cover the continuous and stochastic optimization topics.

Specific information about the timing and due dates of assignments, as well as rubrics for those assignments, will be posted to the Canvas course page by the beginning of the semester.

Late Assignment Policy: Your assignment will be considered late if it misses the deadline without a VR note or Medical Certificate from a Doctor. There will be no make-up assignments, and extensions will only be given in the case of a VR note or MC. Late assignments will receive a score of 0, so it is always better to submit whatever you have finished.

Canvas Page Usage Policy: Submission of homework assignments will be done via Canvas. Topics for class meetings and suggested readings will be posted to Canvas ahead of time, so students should check the course page regularly.

Attendance: In general, attendance at class meetings will not be tracked.

Academic Integrity Policy

Yale-NUS College expects its students to abide by the highest standards of academic integrity as a matter of personal honesty and communal responsibility. Acting with academic integrity requires that (a) students do their own work, (b) students not interfere with the work of others, (c) students accurately and honestly represent the content of their work, and (d) students properly attribute others' work. Violations of the College's academic integrity standards undermine both the community and the individual growth of students. Accordingly, they will be addressed with the utmost seriousness and sanctions ranging from grade penalties to expulsion. Examples of violations of academic integrity include plagiarism, copying or sharing homework answers, submitting work completed for one course as 'new' work for another course, or fabricating or falsifying research data. For more information please visit the Student Services website, Policies and Procedures section: https://studentlife.yale-nus.edu.sg/policies/academic-integrity/

The Yale-NUS Library provides resources on citations and plagiarism here: http://library.yale-nus.edu.sg/plagiarism/

Nondiscriminatory Language and Conduct:

This course encourages non-discriminatory language and conduct. Students should not use racist, sexist or other discriminatory language in class discussions or written work.

Health and Wellness Contacts

If you are experiencing undo stress or feel you might benefit from private counseling, please contact the Yale-NUS Health and Wellness Centre. The wellness centre also offers a wide range of enriching workshops and events. You may also wish to reach out to Vice Rector within your residential College. For this and other kinds of support.
https://studentlife.yale-nus.edu.sg/wellness/