Deterministic Optimization Models and Methods
MSCI 332 Fall 2018
Schedule of Classes

This schedule is tentative and is subject to change. Any changes and updates will be posted on Learn. Teaching and evaluation is based on lecture notes, class discussions, and tutorials. This schedule provides the following information:

- Weekly lecture and tutorial topics and corresponding lecture notes and tutorial notes
- Practice sets
- Assignment post and due dates
- Test dates, additional information on test content will be posted on Learn.
- Required readings to be reviewed before the start of Part 3 on Week 9.
- Suggested readings refer to relevant book chapters. These are provided in case you need additional material to support your learning. WV refers to the book by Winston and Venkataramanan, and HL refers to the book by Hillier and Lieberman. Refer to the course outline for additional information on these books.

Required Review
- Linear Algebra
  - matrix and vector notation,
  - addition and multiplication of matrices, and other matrix operations,
  - inverse of a matrix,
  - solution of a system of linear equations,
  - linear independence/dependence.
- Linear optimization
  - modeling, model/formulation/optimization problem
  - decision variable, objective function, constraints
  - assumptions of LO
  - graphical solution, constraint lines, objective function line, corner point feasible solution, feasible region, binding nonbinding and redundant constraints, feasible and infeasible

problems, unique optimal and multiple optimal solutions, unbounded problem
- solution by Simplex, entering and leaving variables, ratio test, reduced cost, optimality test
- Sensitivity analysis, reduced cost, dual/shadow price, range of feasibility, range of optimality
  - Duality, deriving the dual, primal dual relationships, optimality conditions
- Integer optimization
  - Modelling using binary variables
  - Branch-and-bound

Date	Topics covered	Learning Material
	Part 1. Advanced modelling using optimization **Solution using optimization solvers**	
	Week 1	
Sept 6 Sept 7	• Course Introduction • Tutorial 1: Optimization via R and Gurobi Example: The facility location problem	• Outline.pdf • Schedule_classes.pdf • Week1_Introduction.pdf • Tutorial1.pdf
	Week 2	
Sept 11-13 Sept 14	• Modelling using goal optimization (GO) • Interpretation of GO solution: review of sensitivity analysis • Assignment 1 posted, due on September 24 • Tutorial 2: Optimization via R and Gurobi More on Gurobi input and output	• Week2_GoalOptimization.pdf • Tutorial2.pdf • Assignment1.pdf • Week2_Practice.pdf • Suggested readings: WV 4.16
	Week 3	
Sept 18-20 Sept 21	• Modelling using integer and nonlinear optimization: Transportation with volume discounts • Tutorial 3: Transportation with volume discounts	• Weeks3-4-5_NLO.pdf • Weeks3-4-5_Practice.pdf • Tutorial3.pdf • Suggested readings: HL 13
	Week 4	
Sept 25-28 Sept 29	• Modelling using integer and nonlinear optimization: Portfolio selection • Assignment 2 posted, due on October 4 • Tutorial 4: Portfolio selection	• Weeks3-4-5_NLO.pdf • Weeks3-4-5_Practice.pdf • Tutorial4.pdf • Assignment2.pdf • Suggested readings: HL 13
	Week 5	
Oct 2-4	• Modelling using integer and nonlinear optimization: Other nonlinear functions	• Weeks3-4-5_NLO.pdf • Weeks3-4-5_Practice.pdf

Oct 5	• Tutorial 5: More modelling	• Tutorial5.pdf • Suggested readings: HL 13
Part 2: Solution of optimization problems using heuristics/metaheuristics		
Week 6		
Oct 9 Oct 11 Oct 12	No class, Study day • Construction heuristics No Tutorial (Oct 11 schedule)	• Weeks6-7-8_Heuristics.pdf • Weeks6-7-8_Practice.pdf • Suggested readings: HL 14
Week 7		
Oct 16	• <mark>Test 1 covers up to and including Oct 5</mark>	• Test1_Info.pdf
Oct 18 Oct 19	• Improvement heuristics and local search • Tutorial 6: Heuristics	• Weeks6-7-8_Heuristics.pdf • Weeks6-7-8_Practice.pdf • Tutorial6.pdf • Suggested readings: HL 14
Week 8		
Oct 23-25 Oct 26	• Metaheuristics: Simulated annealing • <mark>Assignment 3 posted, due on November 5</mark> • Tutorial 7: Simulated Annealing	• Weeks6-7-8_Heuristics.pdf • Weeks6-7-8_Practice.pdf • Tutorial7.pdf • Assignment3.pdf • Suggested readings: HL 14
Part3: Exact solution of linear and integer optimization		
Required Review for Part 3, refer to review material provided on learn • **Linear algebra review, WV 2** • **Linear optimization: MSCI 331 material, HL 2-4** • **Integer optimization: MSCI 331 material, HL 12.5-12.8**		
Week 9		
Oct 30- Nov 1 Nov 2	• Revised simplex • Tutorial 8: Revised simplex example	• Weeks-9-10-11-Exact_methods.pdf • Weeks9-10-11_Practice.pdf • Tutorial8.pdf • Suggested readings: HL 5
Week 10		
Nov 6-8 Nov 9	• Duality and Optimality conditions • Tutorial 9: Duality and Optimality conditions	• Weeks-9-10-11-Exact_methods.pdf • Weeks9-10-11_Practice.pdf • Tutorial9.pdf • Suggested readings: HL 6

Week 11		
Nov 13-15	• Dual simplex • Gomory cutting planes for integer optimization	• Weeks-9-10-11-Exact_methods.pdf • Weeks9-10-11_Practice.pdf • Tutorial10.pdf
Nov 16	• Tutorial 10: Gomory cutting planes	• Suggested readings: HL 6, WV 9.8
Week 12		
Nov 20	• Test 2 Covers Part 3	• Test2_Info.pdf
Nov 22	• Introduction to dynamic programming (DP)	• Weeks12-13_DP.pdf • Weeks12-13_Practice.pdf
Nov 23	• Tutorial 11: Modelling using DP	• Tutorial11.pdf • Suggested readings: HL 11
Week 13		

Nov 28-30	• Modelling using DP:
	  - Shortest path
	  - Resource allocation
		• Weeks12-13_DP.pdf
		• Weeks12-13_Practice.pdf
		• Tutorial12.pdf

Dec 1	• Tutorial 12: More DP modelling	• Suggested readings: HL 11
The final exam will be held during the final exam period. Date TBD.		