Syllabus

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Course description Operations research (OR) is a broad field which, loosely speaking, investigates how mathematical techniques can be used to solve "real-life" decision-making problems. This course provides an introduction to linear programming, a fundamental technique used in OR. In particular, the course focuses on formulating mathematical optimization models (also called *mathematical programs*), and understanding the mathematical underpinnings of linear programming algorithms.

Textbook D. Rader, *Deterministic Operations Research: Models and Methods in Linear Optimization*, Wiley, 2010.

Schedule This schedule is subject to change.

Unit	Week	Topic	Readings	Homework
Overview	1	Introduction to operations research	1.1	
	1/12 – 1/15	Introduction to optimization modeling, classification of optimization models	1.2, 1.3	1.1(a,b,c,d) using trial-and-error
	2	Graphical solution of optimization models, sensitivity analysis	1.2	1.1(a,b,c,d), 1.2
Modeling	1/18–1/22	Resource allocation models, introduction to GMPL and GUSEK	2.1	2.1, 2.3*
		Work scheduling models	2.2	2.6
	3	Blending models	2.4	2.11*, 2.12
	1/25 –1/30	Production process models	2.5	2.9
		Production process models, cont.	2.5	2.10*
	2	Multiperiod models	2.6	inventory, finco
	2/1 – 2/5	Sets, summations, for statements	2.3	
		Resource allocation models, revisited	2.1	2.3†, 2.24†, diet*†
	5	Blending models, revisited	2.4	2.13*†, 2.14†, 2.16†
	2/8 –2/12	Multiperiod models, revisited	2.6	2.20†, 2.22†
		Review		
	6	**Exam 1**		
	2/15 – 2/19	Work scheduling models, revisited	2.2	2.6†(challenge: 2.7, 2.8)
		Production process models, revisited	2.5	2.9†, 2.10†

* = Formulate a model on paper and write accompanying GMPL code. † = Formulate a model using symbolic input parameters.

Unit	Week	Topic	Readings	Homework
Algorithms	7	Introduction to algorithm design	5.1–5.2	
	2/22 – 2/26	Improving search: finding better solutions	6.1–6.2	6.1, 6.2, 6.8, 6.9
	8	Improving search: convexity and optimality	6.3	6.14, 6.18
	2/29 – 3/4	Improving search: review	6.1–6.3	
		Geometry and algebra of corner points	7.1	7.2, 7.3
	9	Geometry and algebra of corner points, cont., fundamental theorem of LP	7.1–7.2	7.4
	3/7 – 3/11	Linear programs in canonical form	2.8, 7.3	7.14
		Basic solutions in canonical form LPs	7.3	7.16, 7.17
	10	Spring Break		
	3/14 – 3/18			
	11	The simplex method	8.1	
	3/21 – 3/25	The simplex method, cont.	8.1	8.1, 8.2
		The simplex method: review	8.1	8.3, 8.8
	12	Degeneracy, convergence, multiple optimal solutions	8.3	8.7
	3/28 – 4/1	The two-phase simplex method	8.4	8.11ab, 8.12a
Duality		Bounds and the dual LP	9.1, 9.2	9.1, 9.2, 9.3, 9.4
	13	Weak and strong duality, complementary slackness	9.3	9.5, 9.7
	4/4 – 4/8	Review		
		Exam 2		
	14	Duality review, maximin objectives	9.1–9.3, 2.7	pirates*†
	4/11 – 4/15	Maximin and minimax objectives	2.7	2.30†
		LP duality and game theory	handout	rock-paper-scissors
	15	An economic interpretation of LP duality	9.6	cars
Modeling revisited	4/18– 4/22	Introduction to networks and the shortest path problem	2.9	2.42
		Modeling with the shortest path problem	2.9	rental*
	16	Modeling with the shortest path problem, cont.	2.9	2.39
	4/25 – 4/29	Review		
		Review		
	17	Review		
	5/2 – 5/3			

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