

# Contents

<b>Preface</b> .....	v
<b>1. What Is It, and What For?</b> .....	1
1.1 A Linear Program .....	1
1.2 What Can Be Found in This Book .....	6
1.3 Linear Programming and Linear Algebra .....	7
1.4 Significance and History of Linear Programming .....	8
<b>2. Examples</b> .....	11
2.1 Optimized Diet: Wholesome and Cheap? .....	12
2.2 Flow in a Network .....	14
2.3 Ice Cream All Year Round .....	16
2.4 Fitting a Line .....	19
2.5 Separation of Points .....	21
2.6 Largest Disk in a Convex Polygon .....	23
2.7 Cutting Paper Rolls .....	26
<b>3. Integer Programming and LP Relaxation</b> .....	29
3.1 Integer Programming .....	29
3.2 Maximum-Weight Matching .....	31
3.3 Minimum Vertex Cover .....	37
3.4 Maximum Independent Set .....	39
<b>4. Theory of Linear Programming:</b>	
<b>First Steps</b> .....	41
4.1 Equational Form .....	41
4.2 Basic Feasible Solutions .....	44
4.3 ABC of Convexity and Convex Polyhedra .....	48
4.4 Vertices and Basic Feasible Solutions .....	53
<b>5. The Simplex Method</b> .....	57
5.1 An Introductory Example .....	57
5.2 Exception Handling: Unboundedness .....	61
5.3 Exception Handling: Degeneracy .....	62

5.4	Exception Handling: Infeasibility . . . . .	63
5.5	Simplex Tableaus in General . . . . .	65
5.6	The Simplex Method in General . . . . .	66
5.7	Pivot Rules . . . . .	71
5.8	The Struggle Against Cycling . . . . .	72
5.9	Efficiency of the Simplex Method . . . . .	76
5.10	Summary . . . . .	79
<b>6.</b>	<b>Duality of Linear Programming . . . . .</b>	<b>81</b>
6.1	The Duality Theorem . . . . .	81
6.2	Dualization for Everyone . . . . .	84
6.3	Proof of Duality from the Simplex Method . . . . .	87
6.4	Proof of Duality from the Farkas Lemma . . . . .	89
6.5	Farkas Lemma: An Analytic Proof . . . . .	95
6.6	Farkas Lemma from Minimally Infeasible Systems . . . . .	97
6.7	Farkas Lemma from the Fourier–Motzkin Elimination . . . . .	100
<b>7.</b>	<b>Not Only the Simplex Method . . . . .</b>	<b>105</b>
7.1	The Ellipsoid Method . . . . .	106
7.2	Interior Point Methods . . . . .	115
<b>8.</b>	<b>More Applications . . . . .</b>	<b>131</b>
8.1	Zero-Sum Games . . . . .	131
8.2	Matchings and Vertex Covers in Bipartite Graphs . . . . .	142
8.3	Machine Scheduling . . . . .	148
8.4	Upper Bounds for Codes . . . . .	156
8.5	Sparse Solutions of Linear Systems . . . . .	167
8.6	Transversals of $d$ -Intervals . . . . .	177
8.7	Smallest Balls and Convex Programming . . . . .	184
<b>9.</b>	<b>Software and Further Reading . . . . .</b>	<b>193</b>
	<b>Appendix: Linear Algebra . . . . .</b>	<b>195</b>
	<b>Glossary . . . . .</b>	<b>201</b>
	<b>Index . . . . .</b>	<b>217</b>



<http://www.springer.com/978-3-540-30697-9>

Understanding and Using Linear Programming

Matousek, J.; Gärtner, B.

2007, VIII, 226 p. 62 illus., Softcover

ISBN: 978-3-540-30697-9