

Contents

1	Introducing the ADAC-Problem	1
2	The Vehicle Routing Problem With Time Windows. A Survey.	11
2.1	Introduction	11
2.2	Related Problems	15
2.2.1	Fixed Schedule Problems	15
2.2.2	The ATSP with Time Windows	16
2.2.3	Pick-up and Delivery Problems	21
2.3	Optimal Algorithms and Approximation Schemes	24
2.3.1	Danzig-Wolfe Decomposition	24
2.3.2	Lagrangian Relaxation	30
2.3.3	State-Space Relaxation	32
2.3.4	The Shortest Path Problem with Resource Constraints . .	34
2.4	Heuristics and Meta-Heuristics	41
3	Online Vehicle Routing. A Survey.	45
3.1	Introduction	45
3.2	Basic Concepts and Notation	46
3.2.1	Online Problems and Online Algorithms	46
3.2.2	Randomized Algorithms	51
3.3	Online Transportation Problems	53
3.3.1	The k -Server Problem	54
3.3.2	The Online Dial-a-Ride Problem	58
4	A Tutorial on Set Partitioning	69
4.1	Introduction	69
4.2	Set Packing	72
4.2.1	Perfect Matrices and Perfect Graphs	74
4.2.2	Facet Defining Subgraphs	83
4.3	Set Covering	90
5	The ADAC-Problem. Competitive Analysis Results.	97
5.1	Introduction	97
5.2	Relation to Other Problems	99

5.3	Lower Bounds and Problem Restriction	103
5.3.1	No Overtime Allowed	103
5.3.2	Degenerated Service Costs	104
5.3.3	Arbitrarily Small Durations	106
5.3.4	Unbounded Metric Space	108
5.3.5	Heavy Load	111
5.4	A Competitive Deterministic Algorithm	113
6	Set Packing with Small Subsets	119
6.1	Introduction	119
6.2	A Combinatorial Formulation: Packing Triangles	121
6.3	Clique Inequalities	123
6.4	About the Fractional Vertices Associated to Cliques	134
6.5	Antiwebs and Webs	144
6.6	About the General κ -Set Packing Polytope	152
6.6.1	Cliques	152
6.6.2	Antiwebs and Webs	158
7	The ADAC-Problem Revisited. A Solution Approach.	161
7.1	Introduction	161
7.2	An IP Model for the VDP	162
7.3	Solution Approach	166
7.3.1	Solving the VDP	166
7.3.2	Online Strategies	178
7.4	Computational Results	179
7.4.1	Solution of VDP Instances	179
7.4.2	Simulation Tests for the OLVDP	184
A	Fractional vertices associated to cliques of triangles	193
Bibliography		195
Index		207