

Table of Contents

Contributors	xxxi
Preface	xxxix
A* Algorithm.....	1
Acceptance sampling.....	1
Accounting prices	1
Accreditation.....	1
Active constraint	1
Active set methods	1
Activity.....	1
Activity-analysis problem	1
Activity level.....	1
Acyclic network	1
Adjacent	1
Adjacent (neighboring) extreme points.....	1
Advertising <i>Kalyanaram/Bass</i>	4
Affiliated values bidding model	4
Affine transformation	4
Affine-scaling algorithm	4
Agency theory.....	4
Agriculture and the food industry <i>Bender/Kahan</i>	7
AHP	7
AI	7
Air force operations analysis <i>Thomas</i>	10
Airline industry <i>Ryan</i>	12
Algebraic modeling languages for optimization <i>Rosenthal</i>	16
Algorithm.....	16
Algorithmic complexity	16
Alternate optima	16
Alternate paths.....	16
Analytic combat model.....	16
Analytic hierarchy process <i>Saaty</i>	24
Animation.....	24
Anticycling rules	24

Antithetic random variates.....	25
Applied probability.....	25
Arc.....	25
Archimedean axiom.....	25
ARIMA.....	25
Arrival process.....	25
Arrival-point distribution.....	25
Arrow diagram.....	25
Artificial intelligence <i>Greenberg</i>	25
Artificial variables.....	28
Assignment problem.....	28
Automation <i>Liberatore</i>	28
Availability <i>Ushakov</i>	31
Averch-Johnson hypothesis.....	31
Backward chaining.....	33
Backward Kolmogorov equations.....	33
Backward-recurrence time.....	33
Balance equations.....	33
Balking.....	33
Banking <i>Zenios</i>	33
Bar chart.....	37
Barrier and distance functions <i>Polyak</i>	37
Basic feasible solution.....	40
Basic solution.....	40
Basic variables.....	40
Basis.....	40
Basis inverse.....	40
Basis vector.....	41
Batch shops.....	41
Battle modeling <i>Hartley</i>	41
Bayesian decision theory, subjective probability and utility <i>Laskey</i>	44
Bayes rule.....	45
Beale tableau.....	47
Bender's decomposition method.....	47
Best-fit decreasing algorithm.....	47
Bidding models <i>Rothkopf</i>	47
Big-M method.....	50
Bilevel linear programming.....	50
Binary variable.....	50
Bin-packing <i>Wang/Coleman</i>	50
Bipartite graph.....	53
Birth-death process.....	53
Bland's anticycling rules.....	53
Blending problem.....	54

Block-angular system	54
Block pivoting.....	54
Block-triangular matrix	54
Bootstrapping	54
Bounded rationality.....	54
Bounded variable.....	54
Branch.....	54
Branch and bound.....	54
Brownian motion	54
BTRAN	55
Buffer.....	55
Bulk queues.....	55
Burke's theorem	55
Busy period	55
Calculus of variations <i>Nash</i>	57
Call priorities	59
Candidate rules.....	59
Capacitated transportation problem.....	59
Capital budgeting <i>Levary</i>	59
CASE	62
CDF	62
Center for Naval Analyses <i>Harris</i>	62
Certainty equivalent	66
Certainty factor	66
Chain.....	66
Chance-constrained programming	66
Chance constraint	66
Chaos.....	66
Chapman-Kolmogorov equations.....	66
Chinese postman problem <i>Stewart</i>	67
Choice strategies	69
Choice theory <i>Adelman</i>	69
Chromatic number.....	72
Chromosome.....	72
Circling.....	72
CIM	72
Classical optimization.....	72
Closed network.....	72
Cluster analysis <i>Aronson/Sundaram</i>	72
Cobb-Douglas production function	75
COEA.....	75
Coefficient of variation.....	75
Cognitive mapping.....	75
Coherent system	75
Column generation	76
Column vector.....	76

Combat model	76
Combat simulation.....	76
Combinatorial and integer optimization <i>Hoffman/Padberg</i>	76
Combinatorial explosion	83
Combinatorics <i>Lawler</i>	83
Common random variates	85
Common value bidding model	85
Communications networks <i>Sykes</i>	86
Community operations research	91
Complementarity condition.....	91
Complementarity problems <i>Cottle</i>	92
Complementary pivot algorithm	92
Complementary slackness theorem.....	95
Computational complexity <i>Hall</i>	95
Computational geometry <i>Beichl/Bernal/Witzgall/Sullivan</i>	98
Computational probability.....	103
Computer science and operations research <i>Sharda</i>	103
Concave function	106
Conclusion	106
Condition number	106
Cone.....	106
Congestion system	106
Conjugate gradient method.....	106
Connected graph	106
Conservation of flow	106
Constrained optimization problem	107
Constraint	107
Constraint qualification	107
Construction applications <i>Perry</i>	107
Continuous-time Markov chain (CTMC).....	109
Control charts.....	109
Controllable variables	109
Control theory <i>Manitius</i>	109
Convex combination	113
Convex cone	113
Convex function	113
Convex hull	113
Convex polyhedron	113
Convex-programming problem	113
Convex set	113
Convexity rows	113
Corner point	113
Corporate strategy <i>Hax/Majluf</i>	114
Cost analysis <i>Balut/Gulledge</i>	119
Cost coefficient	122

Cost effectiveness analysis <i>Womer</i>	122
Cost range	125
Cost row	125
Cost slope.....	125
Cost vector.....	125
COV.....	125
Covering problem.....	125
Coxian distribution	125
CPM.....	125
CPP	125
Cramer's rule.....	125
Crash cost	125
Crash time	125
Crew scheduling.....	125
Crime and justice <i>Barnett/Maltz</i>	126
Criterion cone.....	131
Criterion space	132
Criterion vector	132
Critical activity	132
Critical path	132
Critical path method (CPM).....	132
Crossover	132
Curse of dimensionality	132
Customer distribution.....	132
Cut	132
Cut set.....	132
Cutting stock problems <i>Haessler</i>	132
CV.....	137
Cybernetics <i>Sage</i>	137
Cycle	142
Cyclic queueing network	142
Cyclic service discipline.....	142
Cycling	143
Danzig-Wolfe decomposition algorithm	145
Database design	145
Data envelopment analysis <i>Cooper</i>	145
DEA	150
Decision analysis <i>Schum</i>	150
Decision maker (DM)	155
Decision making <i>Buede</i>	155
Decision problem	156
Decision support systems <i>Vazsonyi</i>	156
Decision trees <i>Eriksen/Keller</i>	159
Decision variables	161
Decomposition algorithm.....	161

Degeneracy.....	161
Degenerate solution.....	161
Degree.....	161
Delaunay triangulation.....	161
Delay.....	161
Delphi method <i>Dewar/Friel</i>	161
Density.....	163
Density function.....	163
Departure process.....	163
Descriptive model.....	163
Design and control.....	164
Detailed balance equations.....	164
Determinant.....	164
Deterministic model.....	164
Developing countries <i>Galvão</i>	164
Development tool.....	166
Devex pricing.....	166
Deviation variables.....	166
DFR.....	166
Diameter.....	166
Diet problem.....	166
Diffusion approximation.....	166
Diffusion process.....	166
Digraph.....	166
Dijkstra's algorithm.....	166
Directed graph.....	167
Direction of a set.....	167
Directional derivative.....	167
Discrete-programming problem.....	167
Discrete-time Markov chain (DTMC).....	167
Distribution selection for stochastic modeling <i>Gross</i>	167
DMU.....	169
Documentation <i>Gass</i>	169
Domain knowledge.....	170
DSS.....	171
Dual linear-programming problem.....	171
Dual-simplex method.....	171
Duality theorem.....	171
Dualplex method.....	171
Dummy arrow.....	171
Dynamic programming <i>White</i>	171
Earliest finish time.....	175
Earliest start time.....	175
Econometrics <i>Kelejian/Prucha</i>	175
Economic order quantity.....	177

Economics <i>Murphy</i>	178
Edge	184
Efficiency	184
Efficiency frontier	184
Efficient algorithm	184
Efficient point	184
Efficient solution	184
Eigenvalue	184
Eigenvector	185
Electric power systems <i>Yu</i>	185
Elementary elimination matrix	187
Elimination method	187
Ellipsoid algorithm	187
ELSP	188
Embedding	188
Emergency services <i>Chelst</i>	188
EMS	191
Entering variable	191
Environmental systems analysis <i>ReVelle</i>	191
EOQ	196
Ergodic theorems	196
Erlang	196
Erlang B formula	196
Erlang C formula	196
Erlang delay model	196
Erlang distribution	196
Erlang loss model	196
Error analysis	196
Eta file	196
Eta matrix	196
Eta vector	196
Ethics <i>Engel</i>	197
Euler tour	199
Evaluation	199
Event-driven simulation	199
EVOP	199
Ex ante forecasts	199
Exclusive-or node	199
Expected utility theory	199
Expert systems <i>Holsapple/Whinston</i>	199
Exploratory modeling <i>Bankes</i>	203
Exponential arrivals	205
Exponential-bounded (-time) algorithm	205
Exponential smoothing <i>Brown</i>	205
Extremal	207

Extremal column	207
Extremal problem	207
Extreme direction	207
Extreme point	207
Extreme point solution	207
Extreme ray	207
Face validity	209
Facilities layout <i>Kaku</i>	209
Facility location <i>Chhajed, Francis, Lowe</i>	213
Factorable programming <i>Jackson</i>	216
Failure-rate function	219
Farkas' lemma	219
Farrell measure	219
Fathom	219
FCFS	219
Feasible basis	219
Feasible region	220
Feasible solution	220
FEBA	220
Feedback queue	220
Field analysis <i>Kreiner</i>	220
FIFO	223
Finite source	223
Fire models <i>Levin</i>	223
Firing a rule	226
First feasible solution	226
First-fit decreasing algorithm	226
First-order conditions	226
Fixed-charge problem	226
Flexible manufacturing systems <i>Stecke</i>	226
Float	229
Flow	229
Flow shop	229
Flow time	229
FMS	229
Forecasting <i>Armstrong</i>	229
Forward chaining	233
Forward Kolmogorov equations	233
Forward-recurrence time	233
Fourier-Motzkin elimination method	233
Fractional programming <i>Schaible</i>	234
Framing	237
Frank-Wolfe method	237
Free float	237

Free variable	237
Freight routing	237
FTRAN	237
Fuzzy sets <i>Gass</i>	237
GA	241
Game theory <i>Lucas</i>	241
Gaming <i>Schwabe</i>	245
Gamma distribution	248
Gantt charts <i>Nahmias</i>	248
Gaussian elimination	250
Gauss-Jordan elimination method	250
Gene	250
Generalized Erlangian distribution	250
Generalized upper-bounded (GUB) problem	250
Generator (of a Markov process)	250
Genetic algorithms <i>Michalewicz</i>	250
Geographic information systems <i>Gray/Suchocki</i>	253
Geometric programming <i>Ecker</i>	255
GERT	257
GIS	257
Global balance equations	257
Global maximum (minimum)	258
Global models <i>Gass</i>	258
Global solution	259
Goal constraints	259
Goal programming <i>Schniederjans</i>	259
Gomory cut	261
Gordan's theorem	261
GP	261
Gradient vector	261
Graeco-Latin square	261
Graph	261
Graphical evaluation and review technique	261
Graphics	261
Graph theory <i>Shier</i>	261
Greedy algorithm	264
GRG method	264
Group decision computer technology <i>Buede</i>	264
Group decision making <i>Zahedi</i>	264
GUB	271
Half space	273
Hamiltonian tour	273
Hazard rate	273
Health care systems <i>Gascon/Pierskalla</i>	273
Heavy-traffic approximation	275

Hessenberg matrix	275
Hessian matrix	276
Heterogeneous Lanchester equations	276
Heuristic procedure	276
Hierarchical production planning <i>Hax</i>	276
Higher education <i>Hearn/Lough</i>	279
Hirsch conjecture	283
Homogeneous Lanchester equations	283
Homogeneous linear equations	284
Homogeneous solution	284
Horn clause	284
Hospitals <i>Morey</i>	284
Hundred percent rule	286
Hungarian method	286
Hypercube queueing model <i>Larson</i>	286
Hyperexponential distribution	291
Hypergame analysis	291
Hyperplane	291
Identity matrix	293
IFORS	293
IFR	293
IIASA	293
IID	293
Imbedded Markov chain	293
Implementation <i>Woolsey</i>	293
Implicit enumeration	294
Implicit price	294
Importance sampling	294
Impossibility theorem	294
Inactive constraint	294
Incidence matrix	295
Incident	295
Independent float	295
Independent private values bidding model	295
Indirect costs	295
Industrial applications and OR <i>Fortuin/van Beek/Van Wassenhove</i>	295
Industrial dynamics	299
Industrial engineering and operations research <i>Jarvis</i>	299
Infeasible solution	301
Inference engine	301
Influence diagrams	301
Information systems and database design in OR/MS <i>Müller-Merbach</i>	301
INFORMS	304
Initial feasible solution	304
Input process	304

Input-output analysis	304
Input-output coefficients.....	304
Insensitivity.....	305
Institute for Operations Research and the Management Sciences (INFORMS).....	305
Integer goal programming.....	305
Integer-programming problem	305
Intensity function.....	305
Interactive optimization.....	305
Interchange heuristic	305
Interfering float	305
Interior point.....	305
Interior-point methods <i>Boggs</i>	305
International Federation of Operational Research Societies (IFORS).....	308
International Institute for Applied Systems Analysis (IIASA).....	308
Intervention model	309
Inventory modeling <i>Silver</i>	309
Inverse matrix.....	315
IP	315
IS.....	315
Isomorphic graph	315
ISOP 9000 standard.....	315
Isoquant	315
Iteration	315
IVHS	315
Jackson network	317
Job shop scheduling <i>Jones/Rabelo/Yih</i>	317
Johnson's theorem.....	324
Just-in-time (JIT) manufacturing	324
Karmarkar's algorithm.....	325
Karush-Kuhn-Tucker (KKT) conditions	325
Kendall's notation	325
Kilter conditions	325
KKT conditions	325
Klee-Minty problem.....	325
Knapsack problem.....	325
Knowledge acquisition.....	326
Knowledge base	326
Knowledge engineer	326
Königsberg bridge problem.....	326
König's theorem.....	326
Kruskal's algorithm.....	326
Kuhn-Tucker (KT) conditions	326
Lack of memory	327
Lagrange multipliers.....	327
Lagrangian decomposition.....	327

Lagrangian function	327
Lagrangian relaxation	327
Lanchester attrition	327
Lanchester's equations <i>Engel</i>	327
Laplace-Stieltjes transform	330
Laplace transform	330
Large-scale systems <i>Ho</i>	330
Latest finish time	333
Latest start time	333
Latin square	333
LCFS	333
LCP	333
LDU matrix decomposition	333
Learning <i>Buck</i>	333
Learning curves <i>Loerch</i>	335
Least-squares analysis	338
Leontief matrix	338
Level-crossing methods <i>Brill</i>	338
Level curve	340
Lexicographic ordering	340
Lexico-positive (negative) vector	340
LGP	340
Libraries <i>Reisman/Xu</i>	340
LIFO	343
Likelihood ratio	343
Limiting distribution	343
Lindley's equation	343
Line	343
Linear combination	343
Linear equation	343
Linear fractional-programming problem	343
Linear functional	343
Linear equality	343
Linear programming <i>Hillier</i>	343
Line segment	347
Lipschitz	347
Little's law <i>Albin</i>	347
Local balance equations	348
Local improvement heuristic	348
Local maximum	348
Local minimum	349
Local optimum	349
Local solution	349
Location analysis <i>ReVelle</i>	349
Logic programming	354

Logical variables	354
Logistics <i>Solomon</i>	354
Log-linear model.....	357
Longest-route problem	357
Loss function.....	358
Lottery.....	358
Lower-bounded variables.....	358
Lowest index anticycling rules	358
LP.....	358
LU matrix decomposition	358
MAD	359
Maintenance <i>Ushakov</i>	359
Makespan.....	359
Malcolm Baldrige award.....	359
Manhattan metric	359
Manpower planning <i>Bartholomew</i>	359
MAP.....	361
Marginal value (COST)	361
Marketing <i>Eliashberg/Lilien/Wind</i>	361
Markov chains <i>Harris</i>	365
Markov decision processes <i>White</i>	368
Markovian arrival process (MAP)	370
Markov processes <i>Miller</i>	370
Markov property	374
Markov random field.....	374
Markov renewal process	374
Markov routing	375
Marriage problem	375
Master problem.....	375
Matching <i>Eglese</i>	375
Material handling <i>Rosenblatt</i>	377
Material requirements planning	380
Mathematical model	380
Mathematical programming	380
Mathematical-programming problem	380
Mathematical programming society	381
Mathematical-programming system (MPS).....	381
Matrices and matrix algebra <i>Tucker</i>	381
Matrix-analytic stochastic models <i>Neuts</i>	384
Matrix geometric	388
Matrix game	388
MAUT.....	388
Max-flow min-cut theorem.....	388
Maximum	388
Maximum feasible solution.....	388

Maximum-flow network problem	388
Maximum matching problem	388
MCDM.....	388
Measure of effectiveness (MOE)	388
Medicine and medical practice <i>Flagle</i>	388
Memoryless property.....	391
Menu planning	391
Metagame analysis	392
Metamodeling <i>Pressman/Friedman</i>	392
Method of stages	394
Military operations research <i>Thomas</i>	394
MIMD	398
Minimum	398
Minimum (maximum) feasible solution	398
Minimum-cost network-flow problem.....	398
Minimum spanning tree problem	398
Minor.....	398
MIP	398
MIS.....	398
Mixed-integer programming problem (MIP).....	398
Mixed network	398
Model.....	399
Model accreditation <i>Gass</i>	399
Model builder's risk	399
Model evaluation <i>Gass</i>	399
Model management <i>Krishnan</i>	400
Model testing	404
Model user's risk	404
Model validation	404
Model verification	404
MODI.....	404
MOIP	404
MOLP	404
Monte-Carlo sampling and variance reduction <i>Kleijnen/Rubinstein</i>	405
MOR.....	407
MORS	407
MRP.....	407
MS	407
MSE.....	407
Multi-attribute utility theory <i>Sarin</i>	407
Multicommodity network-flow problem.....	410
Multicommodity network flows <i>Shetty</i>	410
Multi-criteria decision making (MCDM)	412
Multidimensional transportation problem	412
Multi-echelon inventory systems.....	412

Multi-echelon logistics systems	413
Multi-objective linear-programming problem.....	413
Multi-objective programming <i>Steuer</i>	413
Multiple criteria decision making <i>Ramesh/Zionts</i>	419
Multiple optimal solutions	425
Multiple pricing	425
Multiplier vector	425
Nash saddle-point.....	427
Natural resources <i>Weintraub</i>	427
Near-optimal solution.....	431
Neighboring extreme point	431
Network	431
Network design.....	431
Network optimization <i>Magnanti</i>	431
Network planning <i>Rand</i>	437
Network simplex algorithm.....	441
Networks of queues <i>Disney</i>	441
Neural networks <i>Ignizio/Burke</i>	449
Newsboy problem	452
Newsvendor problem.....	452
Newton's method	452
NLP	452
Node.....	452
Node-arc incidence matrix.....	452
Nonactive (nonbinding) constraint.....	452
Non-Archimedean number	452
Nonbasic variable	452
Non-compensatory choice strategies.....	452
Nondegenerate basic feasible solution.....	452
Nondominated solution	453
Nonlinear goal programming.....	453
Nonlinear programming <i>Fiacco</i>	453
Nonnegative solution	461
Nonnegativity conditions.....	461
Non-preemptive.....	461
Nonsingular matrix	461
Nontrivial solution	461
Nonzero-sum game.....	462
Normative model	462
Northwest-corner solution.....	462
NP, NP-complete, NP-hard	462
Null matrix	462
Null space	462
Numerical analysis <i>Nash</i>	462
O, o notation	467

Objective function	467
Object-oriented database	467
OEG	467
Offered load	467
Open network	467
Operations Evaluation Group (OEG).....	467
Operations management <i>Vonderembse/Marchal</i>	467
Operations Research Office and Research Analysis Corporation <i>Visco/Harris</i>	470
Operations Research Society of America (ORSA)	475
Opportunity cost.....	476
Optimal feasible solution.....	476
Optimality criteria.....	476
Optimal solution.....	476
Optimal value	476
Optimal value function.....	476
Optimization	476
Optimization of queues.....	476
OR.....	476
Organization <i>Burton/Obel</i>	476
Origin node	481
OR/MS.....	481
ORO	481
ORSA.....	481
Out-of-kilter algorithm	481
Output process	481
Outside observer distribution.....	481
Overachievement variable.....	482
Overflow process	482
Overtaking.....	482
P^4	483
Packing problem.....	483
Palm measure	483
Parallel computing <i>Eckstein</i>	483
Parameter.....	485
Parameter-homogeneous stochastic process.....	485
Parametric bound.....	485
Parametric linear programming.....	485
Parametric programming <i>Gal</i>	486
Parametric solution.....	489
Pareto-optimal solution	489
Partial balance equations	489
Partial pricing.....	489
PASTA.....	489
Path	489
Payoff function.....	489

Payoff matrix.....	489
PDA.....	489
PDF.....	489
PDSA.....	489
Periodic review.....	489
PERT.....	489
Perturbation.....	490
Perturbation methods.....	490
Petro-chemical industry <i>Baker</i>	490
PFI.....	492
Phase I procedure.....	492
Phase II procedure.....	492
Phase-type distribution.....	492
Phase-type probability distributions <i>Neuts</i>	492
Piecewise linear function.....	494
Pivot column.....	494
Pivot element.....	494
Pivot row.....	494
Pivot-selection rules.....	494
Po.....	495
Point stochastic processes <i>Ushakov</i>	495
Point-to-set-map.....	496
Poisson arrivals.....	496
Poisson process.....	496
Politics <i>Hess/Wong-Martinez</i>	496
Pollaczek-Khintchine formula.....	498
Polling system.....	498
Polyhedron.....	498
Polynomial hierarchy.....	498
Polynomially bounded (-time) algorithm (polynomial algorithm).....	498
Polynomial-time.....	498
Polynomial-time reductions and transformations.....	498
Portfolio analysis.....	498
Portfolio theory: mean-variance <i>Board/Ziemba</i>	498
POS.....	503
Postoptimal analysis.....	503
Posynomial programming.....	503
Power model.....	503
PP.....	503
PPB(S).....	503
Practice of Operations Research and Management Science <i>Miser</i>	504
Precedence diagramming.....	508
Predictive model.....	508
Preemption.....	509
Preemptive priorities.....	509
Preference theory <i>Dyer/Jia</i>	509

Prescriptive model.....	512
Prices.....	512
Pricing multipliers.....	512
Pricing out.....	512
Pricing vector.....	512
Primal-dual algorithm.....	512
Primal-dual linear-programming problems.....	512
Primal problem.....	512
Prim's algorithm.....	512
Prisoner's dilemma game.....	512
Probabilistic algorithm.....	513
Probabilistic programming.....	513
Probability density function (PDF).....	513
Probability distribution.....	513
Probability distribution selection.....	513
Probability generating function.....	513
Probability integral transformation method.....	513
Problem solving.....	514
Problem structuring methods <i>Rosenhead</i>	514
Processor sharing.....	516
Product form.....	516
Product form of the inverse (PFI).....	516
Product-form solution.....	516
Production function.....	517
Production management <i>Bitran/Dasu</i>	517
Product-mix problem.....	522
Production rule.....	522
Program evaluation <i>Kaplan/Strauss</i>	522
Program evaluation and review technique (PERT).....	525
Project management <i>Rand</i>	525
Projection matrix.....	525
Project SCOOP.....	526
Proper coloring.....	526
Prospect theory.....	526
Protocols.....	526
Pseudoconcave function.....	526
Pseudoconvex function.....	526
Pseudoinverse.....	526
Pseudo-polynomial-time algorithm.....	526
Pseudorandom numbers.....	526
Public policy analysis <i>Walker/Fisher</i>	526
Pull system.....	528
Pure-integer programming problem.....	528
Push system.....	528
QC.....	529
Q-GERT.....	529

QP.....	529
Quadratic assignment problem.....	529
Quadratic form.....	529
Quadratic-integer programming.....	529
Quadratic programming <i>Murty</i>	529
Quadratic-programming problem.....	535
Quality control <i>Alt/Jain</i>	536
Quasi-concave function.....	549
Quasi-convex function.....	549
Quasi-reversibility.....	549
Queue inference engine <i>Larson</i>	549
Queueing discipline.....	554
Queueing networks.....	554
Queueing theory <i>Heyman</i>	554
RAC.....	563
Rail freight operations <i>Martland</i>	563
RAND corporation <i>Fisher/Walker</i>	566
Random field.....	571
Random number generators <i>L'Ecuyer</i>	571
Random variates.....	578
Random walk.....	578
Ranging.....	579
Rank.....	579
Rate matrix.....	579
Ray.....	579
R-chart.....	579
R&D.....	579
Readiness.....	579
Reasoning.....	579
Reasoning knowledge.....	579
Recognition problem.....	579
Recourse linear program.....	579
Reduced costs.....	579
Reduced gradient methods.....	579
Redundancy <i>Ushakov</i>	579
Redundant constraint.....	579
Regeneration points.....	579
Regression analysis <i>Greenberg</i>	580
Relational database.....	583
Relative costs.....	583
Relaxed problem.....	583
Reliability.....	583
Reliability function.....	583
Reliability of systems <i>Gross</i>	583
Reneging discipline.....	587

Renewal equation.....	587
Renewal processes <i>Ushakov</i>	587
Representation theorem for polyhedral set	588
Research Analysis Corporation (RAC)	588
Research and development <i>Papageorgiou</i>	588
Resource aggregation	593
Resource leveling.....	593
Resource smoothing.....	593
Response time	593
Restricted-basis entry rule.....	593
Retailing <i>Tone</i>	594
Revenue equivalence theorem	595
Revenue neutrality theorem.....	595
Reversible Markov process	595
Revised simplex method	596
RHS	596
Right-hand-side	596
Risk	596
Risk assessment <i>Chittister/Haimes/Harris</i>	596
Risk management <i>Chittister/Haimes</i>	598
Ritter's partitioning method.....	606
Robustness analysis.....	606
Rosen's partitioning method.....	606
Roundoff error	606
Route construction heuristic	606
Route improvement heuristic	606
Row vector	606
Rule	606
Rule set.....	607
Running time of an algorithm	607
SA.....	609
Saddle-point of a function	609
Saddle-point of a game.....	609
Saddlepoint problem	609
St. Petersburg paradox.....	609
Safety <i>Ushakov</i>	609
Sand table battle model.....	610
Satisficing.....	610
Scaling.....	610
Scenario	614
Scenario analysis.....	614
SCERT.....	614
Scheduling and sequencing <i>Magazine</i>	610
Score functions <i>Rubinstein/Shapiro/Uryasev</i>	614
Scoring model	617

Scripted battle model	617
Search theory <i>Stone</i>	617
Second-order conditions	620
Self-dual parametric algorithm	620
Semi-Markov process	620
Semi-strictly quasi-concave function	620
Semi-strictly quasi-convex function	620
Sensitivity analysis	621
Separable function	621
Separable-programming problem	621
Separating hyperplane theorem	621
Series queues	621
Service systems	621
Set-covering problem	621
Set-partitioning problem	621
SEU	621
Shadow prices	621
Shapley value	622
Shell	622
Shewhart chart	622
Shortest-route problem	622
Signomial programming	622
SIMD	622
Simple upper-bounded problem (SUB)	622
Simplex	622
Simplex method (algorithm)	622
Simplex multipliers	622
Simplex tableau	623
Simulated annealing <i>Anandalingam</i>	623
Simulation of discrete-event stochastic systems <i>Gross</i>	626
Simulator	633
Single-server network	633
Singular matrix	633
Sink node	633
SIRO	633
Skew-symmetric matrix	633
Slack variable	633
Slack vector	633
SLP	633
S-model	633
Smooth patterns of production	633
Soft systems methodology (SSM)	634
Sojourn time	634
Solution	634
Solution space	634

SOS.....	634
Source node.....	634
Space <i>Evans</i>	634
Spanning tree.....	636
Sparse matrix.....	636
Sparsity.....	636
Special-ordered sets (SOS).....	636
Splines <i>Johnson</i>	636
Sports <i>Ladany</i>	639
Spreadsheets <i>Plane</i>	643
SQC.....	646
Square root law.....	646
ST.....	646
Stages.....	646
Staircase structure.....	646
Stanford-B model.....	646
Stationary distribution.....	646
Stationary stochastic process.....	646
Stationary transition probabilities.....	646
Statistical equilibrium.....	646
Statistical process control.....	647
Steady state.....	647
Steady-state distribution.....	647
Steepest descent method.....	647
Steiner tree problem.....	647
Stepping-stone method.....	647
Stigler's diet problem.....	647
Stochastic duel.....	648
Stochastic model.....	648
Stochastic process.....	648
Stochastic programming <i>King</i>	648
Strategic assumption surfacing and testing (SAST).....	651
Strategic choice.....	651
Strategic options development and analysis (SODA).....	651
Strictly quasi-concave function.....	651
Strictly quasi-convex function.....	651
Strong duality theorem.....	651
Strongly NP-complete (NP-hard).....	652
Strongly polynomial-time algorithm.....	652
Structural variables.....	652
Structured modeling <i>Geoffrion</i>	652
Subjective probability.....	655
Suboptimization.....	655
SUB problem.....	655
Super-sparsity.....	655

Supplemental variables	656
Surplus variable	656
Surplus vector	656
Symmetric matrix	656
Symmetric network	656
Symmetric primal-dual problems	656
Symmetric zero-sum two-person game	656
System	656
System dynamics <i>Richardson</i>	656
System reliability	660
Systems analysis <i>Mason/Conger</i>	660
Tableau	671
Tabu search <i>Glover</i>	671
Takuchi loss function	679
Tandem queues	679
Technological coefficients	679
Telecommunication networks	679
Terminal	679
The Institute of Management Sciences (TIMS)	679
Theorem of alternatives	679
Thickness	679
Time/cost trade-offs	679
Time series analysis <i>Mastrangelo/Montgomery</i>	679
Time-stepped simulation	683
Time-tabling	683
TIMS	683
Tolerance analysis	683
Total float	683
Total quality management <i>Ramberg</i>	684
TQC	690
TQM	690
Traffic analysis <i>Gazis</i>	690
Traffic equations	695
Traffic intensity	695
Traffic process	695
Transfer function	695
Transient analysis	695
Transition function	695
Transition matrix	695
Transition probabilities	696
Transportation problem	696
Transportation problem paradox	696
Transportation simplex (primal-dual) method	696
Transposition theorems	697
Transshipment problem	697

Traveling salesman problem <i>Hoffman/Padberg</i>	697
Tree	700
Triangular matrix	700
Trim problem.....	700
Trivial solution.....	701
Truck dispatching	701
Truckload (TL) shipment.....	701
TS.....	701
TSP.....	701
Tucker tableau	701
Two-phase simplex method	701
Unary NP-complete (NP-hard).....	703
Unbalanced transportation problem.....	203
Unbalanced optimal solution	703
Unconstrained optimization <i>Sofer</i>	703
Unconstrained solution	706
Uncontrollable variables	706
Underachievement variable.....	706
Undetermined system of linear equations.....	706
Undirected arc	706
Unimodular matrix	706
Unique solution	706
Unrestricted variable	706
Unsymmetric primal-dual problems	707
Upper-bounded problems	707
Urban services <i>Chelst</i>	707
Utility function.....	709
Utility theory <i>Fishburn</i>	709
Vacation model.....	713
Vacation time	713
Validation.....	713
Value function	713
VAM	713
Variance reduction	713
Vector maximum problem	713
Vector optimization problem	713
Vector space	713
Vehicle routing <i>Bodin</i>	713
Vehicle scheduling.....	718
Verification	718
Verification, validation and testing of models <i>Balci</i>	719
VERT.....	723
Vertex	724
Virtual reality.....	724
Visualization <i>Bell</i>	724

Vogel's approximation method (VAM)	726
Von Neumann-Morgenstern (expected) utility theory.....	726
Voronoi constructs <i>Beichl/Bernal/Witzgall/Sullivan</i>	726
Voronoi diagram.....	729
VV&A	729
VV&T.....	729
Waiting time	731
War game.....	731
Warehouse problem.....	731
Water resources <i>Krzysztofowicz</i>	731
Weak duality theorem	734
Weakly-coupled systems.....	734
Weber problem	734
Wilkinson equivalent random technique.....	734
WIMP	734
Wolfe's quadratic-programming problem algorithm.....	734
Work schedule	734
Worst-case analysis	734
\bar{X} -bar chart	735
Yield management <i>Mason/Conger</i>	737
Zero-one goal programming	739
Zero-one variables	739
Zero-sum	739
Zero-sum game	739
Zero-sum two-person game	739