

Index

- acceleration factor 358, 361
- access time 136–7
- accessibility
 - measures 3
 - study 6
- activity
 - equivalence 78–80
 - matrix 79
- Activity-Travel Framework (ATF) 10
- actual travel time 337
- actuated signal control 83, 110
- additive random utility maximizing (ARUM)
 - approach 71, 75
- ADVANCE 179, 181, 208
- advanced traffic management systems (ATMS) 84
- advanced traveler information systems (ATIS) 84, 177, 179, 232–49, 262, 265, 275
- advanced traveler management systems (ATMS) 177
- AIMSUN 263, 268–9
- Akcelik function 92–3
- all-or-nothing assignment 264
- augmented Lagrangian method 322
- Average Trade Coefficient 375

- backpropagation 179, 182, 189–94, 196–8, 201, 207
 - through time (BPTT) 179, 190, 196, 200–201, 207
- behavioral
 - mechanism 11, 18–9
 - predisposition 9
- Bellman-Ford-Moore 286
- Belo Horizonte metropolitan 377
- bi-level model (bilevel model) 339, 356–8, 361
 - see also* bilevel problem 339, 356–8, 361
- bi-level programming (bilevel programming) 136, 143, 157, 234, 239–40, 248
- bi-modal transportation network 134–6, 145, 153
- binary logit model 37
- block Gauss-Seidel decomposition approach 26
- BPR (Bureau of Public Roads) 39, 51, 95, 145, 242, 261, 264, 267, 274–5, 283

- break-even condition 149
- build-operate-transfer (BOT) 158
- business-to-business (B2B) 289–90
- bypass route 349–50

- capacity
 - expansion 16
 - rate 215–7, 220
 - reallocation 15–7
 - reduction 16
- capital product 382
- car
 - occupancy 19
 - ownership 11, 19, 70
- cascade correlation 179, 190, 198–201, 206–7
- category analysis 2
- C-economy 380–81, 388
- central business district (CBD) 384
- Chicago Area Transportation Study (CATS) 56, 58
- Chicago Sketch Network 50
- coastal navigation 365
- Cobb-Douglas assumption 381
- cognitive capacity 380
- combined
 - models 25, 37, 39–40
 - transport and land-use model 113–14
- commercial property 383–84
- complementary slackness theorem 75
- congestion
 - charge 154
 - cost 135
 - level 218
 - pricing 113–6, 119–20, 125–32, 135, 143
 - toll 135, 139, 143–4, 147, 153
- consumer
 - surplus (CS) 139, 158, 162, 164–6, 168–73
 - theory 19
 - welfare 9
- continuous network design problem (CNDP) 158–59, 161–4, 163, 166–72
- CONTRAM 5
- convex
 - combination 314
 - optimization problem 26, 33, 138
- cordon pricing 6
- corridor 374

- corridor-to-corridor flow 375
- CORSIM 263
- cost minimizing behavior 70–81
- counterpropagation 179, 189–90, 193–5, 201, 207
- Cournot-Nash game 86
- creative capacity 380
- C-region 384–5, 388
- C-resource 380
- critical segments 366
- cross
 - elasticity 3, 11, 15
 - flow (CFLOW) 183, 185–9, 196, 206
 - occupancy (COCC) 183–4, 186
- Croydon 6
- cycle length 84, 91–2
- Davidson function 267
- decision pattern 73–4, 77
- demand 366
 - elasticity 16, 17, 154
 - function 5, 12, 19, 307, 309
 - management 1, 4, 6, 10
 - response transit service 154
- Dennis Package 115
- departure time 154
- destination-based travel time 316
- deterministic user equilibrium 88, 104, 157, 170, 172
- DIADEM 20
- Dijkstra algorithm 286
- direct utility function 139, 149
- disaggregate
 - model 19
 - simplicial decomposition (DSD) algorithm 341, 358, 361
- discrete
 - choice 4, 5, 7–9
 - see also* discrete choice model 70, 71–2, 75–7, 78, 80
 - network design problem (DNDP) 158
- dispersion parameter 90, 97–8
- distance-related cost 282, 284
- distributor 289–304, 306–9, 310–11
- Dortmund 58, 61, 66
- double-stage algorithm 314
- doubly
 - constrained model 314
 - constrained origin-destination/departure time/route choice (DUE-DC-OD-D-R) 315–18, 326, 328–9
- Downs-Thomson
 - effect 18
 - paradox 15
- driver
 - information 83, 84, 89, 104, 109
 - reactiveness 97–8, 100, 104–7, 109–110
 - response 93, 105
- dual multiplier 350
- dual-based algorithm 320
- duality theory 74
- dummy time-independent super-origin 319
- dynamic equilibrium condition 328
- dynamic
 - traffic assignment (DTA) 162, 262
 - see also* dynamic travel choice model 326
 - user equilibrium 157, 172, 262, 327–8
 - variable message signs 262
- economic
 - equilibrium condition 297
 - impacts 366–7
 - sector 374
- educated labor 381, 384–5
- educational
 - capital 385
 - density 384
- egress time 136–7
- elastic demand 5, 15–6, 341
- electronic
 - commerce (e-commerce) 289–90, 311
 - road pricing 134
- energy consumption 14
- entropy maximization 8
 - see also* entropy-constrained methods 25
- entry rate 215, 220
- equilibrium 374
 - assignment 5, 346
 - conditions 297, 311, 324, 326–7, 340, 382
 - decomposed optimization algorithm 240
 - flow 340, 343
 - link flow solution 341, 352, 355, 357
 - model 1, 14, 18, 20
 - network design (END) 86, 89
 - rent structure 387
 - solution 340, 346–7, 350, 353, 355–6, 382
 - traffic signal setting (ETSS) 83–7, 89, 91–3, 97, 99, 105–110
- equisaturation control policy 91–2, 94, 99, 101–104, 106–109
- Evans algorithm (method) 26, 34, 39–40, 65–6, 314–15, 319, 330–31, 333–34
- Evans-like algorithm 48–9, 50, 52, 55–6
- Evans-mRAS 324–6
- excess cost (travel time) 47, 270
- exit rate 215, 217
- extreme value distribution 71–2, 81
- feasibility check problem 346–8, 355
- Federal Highway Administration (FHWA) 283, 289

- fee level 128–30
- FIFO 210, 228, 230
- financial disaster 365
- first start solution 359–61
- first-best pricing 139, 141–2, 145
- five-stage model/approach 3, 6, 7
- Fixed Matrix (FM) 11–12, 17, 19, 20
- fixed-point model 266
- flow
 - constraint 358, 361, 363
 - goal 348, 356, 358, 361, 363
 - carrying link 331
 - to-capacity ratio 93
- forward star 285–6
- four-stage model/approach 2–3, 7–8, 11, 13–14, 19–20
- four-step transportation planning model 25, 36–7
- Frank-Wolfe (FW)
 - algorithm (method) 26, 59, 267, 314, 319, 330–31
 - linearization 59
- free flow 160–61, 167, 169, 177–8, 181–2, 191, 235, 237, 241–2, 320, 326
- free trade agreements 365–66
- free-flow travel time (FFTT) 96, 146, 255–56, 264, 283, 322
- frequency elasticity 11
- game theory (game-theoretic approach) 86
- Gaussian function 254
- general
 - equilibrium 382
 - extreme value (GEV) 9
 - household consumption 19
- generalized
 - cost (travel time) 12, 28, 33, 35, 38–9, 70, 72–4, 76, 119, 121, 337, 339–40, 355
 - elasticity 13, 20
 - extreme value (GEV) distribution 75
 - link travel time 339
 - reduced gradient (GRG) 159, 164, 167, 170, 172
- genetic algorithm 339, 358
- geographic information systems (GIS) 6, 278, 287
- global positioning system (GPS) 110, 278
- goal constraints 341, 349
- goal-constrained traffic equilibrium problem 340–41
- gradient law 387
- gradient projection (GP) method 319, 321
- gravity model 29, 59, 72, 76–8, 80, 315
- gravity-type distribution 28, 33, 40
- green (time) split 84, 86, 91–2, 94, 97–101, 104, 109–110
- Gumbel distribution 81
 - see also* probability distribution 137
- handling cost 29, 307, 309
- Heavy Vehicle Participation 375
- hedonic price function 384
- Hessian 167
- high-occupancy vehicle 135
- Highway Capacity Manual (HCM) 283
- highway
 - network 367
 - segment 367
 - traffic volumes 376
 - transportation network 365
- Hitchcock's transportation problem 314–15, 330–31
- Hook and Jeeves 143, 240, 338, 356, 358, 361, 363
- ILUMASS 61
- incremental logit 19
 - see also* nested logit 6, 19
- independence of irrelevant alternatives (IIA) 234
- indirect utility function 154
- individual link travel time adjustment 351
- induced
 - demand 15
 - traffic 1, 11–6, 20
- information
 - flow 380
 - theory 59
- initial solution 363
- inland waterway 365
- intelligent transportation systems (ITS) 177–8, 278, 290
- inter-modal transport 135
- internal flows 377
- intra-regional pricing 387
- intra-trip 315, 326, 331, 335
- in-vehicle route guidance 262
- in-vehicle time 137
- inverse nonlinear multicommodity network
 - flow problem 341
- ISGLUTI 4
- iterative optimization and assignment (IOA) 85–9, 93–5, 97–103, 105–109
- Jacobian matrix, 301
- joint entropy distribution/assignment model (JEDA) 314–15, 319, 326
- Kalman filtering theory 252
- Karush-Kuhn-Tucker (KKT) constraints 32, 140, 329

- see also* Kuhn–Tucker conditions
- kernel regression model 253–4, 258
- knowledge
 - capital 381–2, 388
 - density 381
 - expansion model 383
 - oriented C-economy 388
 - oriented economy 388
 - oriented regional economy 383
- Lagrange multiplier 140, 294, 320–22, 326–7, 340
- Lagrangian 31, 320, 329
- Lanark 5
- land use, transportation and environment (LTE) 67
- land-use 1, 3–4, 7, 13, 19
 - pattern 158, 162, 172, 388
 - structure 113
 - transport model 3–4, 7
- lane changing 261, 269
- least-cost routes 279
- leftmost flow constraint 363
- level of
 - congestion 369
 - service 1–2, 43, 134, 136, 367
- LGORU (Local Government Operational Research Unit) 4
- light rail transit (LRT) 6, 15
- Lighthill-Whitham-Richards theory 210
- linear
 - constraints 342, 350
 - flow constraints 349
 - optimization problem 340
- link
 - capacity 146
 - delay function 85
 - flow 335, 337–8, 340, 342, 346, 348–9, 351, 357
 - capacity 342, 346, 357
 - solution 347, 355–6
 - travel time 341, 345, 347, 358
 - adjustment 357
 - weight 345, 351, 353, 355
 - width 349, 351–2
- link-based algorithm 315, 319, 326, 330
- link-junction-based network model 7
- Linköping network 338, 342, 348–50, 352, 361, 363
- link-route incidence 90
- Lipschitz continuous 305–306
- local
 - constant model 253
 - linear model 253, 255–6, 258
 - regression 253–4, 258
 - minimum 357–8
- location
 - criteria 381
 - pattern 116, 121, 125, 130–31, 380
- location-based mobile services (LBMS) 278–79
 - see also* location-based services (LBS)
- logit
 - formula 136–7
 - model 71, 75, 77, 90, 97, 139
- logit-based
 - modal split 141
 - SUE 86, 90, 93, 99, 234
- logit-type share model 15
- loop detector 177, 181–3, 189–90
- Lowry model 3, 9
- Lowry-type mechanism 4
- LTE 67
- LUTR cluster 114, 132
- macroeconomic model 367
- macro-region 374
- macroscopic traffic theory 184, 210
- Malmö 385
- marginal cost 280, 292–3, 296–7, 300
 - see also* external cost 139; social cost 143–4, 149
- marginal-cost pricing 141–2, 146, 148–53
- market equilibrium conditions 297
- Markowitz's model 386
- maximal exhaust fume emission 337
- mean squared error (MSE) 193
- MERCOSUL 365
- method of successive average (MSA) 49, 50, 52, 55–6, 59, 91, 94, 97–101, 106–107, 241, 265–6
- microeconomic
 - approach 7, 10
 - model 3–4, 6
- microsimulation 5–7, 61, 63
 - module 61, 63
- mid-value theorem 305
- minimal
 - adjustment 347
 - perceived travel time adjustment 355
 - unconstrained travel time adjustment 354
- minimum-cost flow problem 330
- mixed network design problem (MNDP) 158
- mobile position determination system 278
- modal choice 2, 4
- modal split 2, 8, 15, 25–7, 29, 37, 39–40, 134–6, 139, 142–5, 149, 153–4, 341
- mode choice 43, 113, 118, 138, 141, 147
 - see also* split 137, 151

- model flow capacity 338
- modified link travel time 346
 - projection method 307–311
- Mohring effect 154
- monetary
 - outlay 337
 - cost 117, 120
- Monte Carlo simulation 248
- movement
 - occupancy 216–8, 220
 - queue 216
- mRAS 335
- multi-class problems 26, 37, 40
- multicollinearity 187, 207
- multi-modal equilibrium 15
- multinational Corporations (MNCs) 384
- multinomial logit model 9, 71–2, 77
- multi-objective optimization 158
- multiple-equilibrium behavior 87

- nested
 - diagonalization (ND) 315, 317–18, 334
 - diagonalization-augmented Lagrangian-GP (ND-AGP) 320
 - logit models 4, 7–9, 17, 19, 118
- network
 - assignment (loading) 260, 265, 267, 269, 342
 - design problem (NDP) 157–8, 172, 240
 - equilibrium model 26, 28, 240
 - topology 158
- neural
 - network model 252–3
 - networks 177–82, 189–207
- Newton–Raphson method 164
- none-home-based 38
- non-FIFO 211, 214–5, 228, 230
- nonlinear (non-linear)
 - eigen-value equation 382
 - non-convex problem 339
 - optimization 120
- nonparametric method 252–3

- occupancy 183–4, 186–91, 206
- O–D
 - cost 45–6, 48–9
 - demand 317, 322, 324, 330, 333, 335
 - flow 44–9, 50, 52, 56, 314, 330, 332
 - generalized cost 51
 - matrix 153, 240
 - pair 44–5, 137–40, 144–8, 150–52, 159–62, 166, 168–71, 173, 235–36, 238, 242, 264, 267, 269–71, 274–6, 281, 286, 315, 319, 324, 326, 328, 330
 - route travel time 316, 333
 - trip demand 318, 334–5
- OECD 380–81
- operational
 - capacities 366–7
 - costs 366
- optimal
 - dual solution 349
 - location 380
 - network performance 234, 239, 248
- optimality conditions 293–4, 296–8
- origin-based
 - algorithm 48–9, 50, 52, 55–6
 - travel time 316
- origin-destination (O–D)
 - demand 235–36, 238, 243
 - flow 159
 - matrix 374

- Pallottino graph growth algorithm 286
- PARAMICS 5, 263
- parking
 - fee 117–18, 121
 - information system (PIS) 232–33, 243
- passenger car-equivalent units 283
- path flow 317, 330
- path-based algorithm 315, 319, 322, 326
- penalty
 - method 320
 - parameter 320–22, 326, 357
- perceived utility 70–71, 75–6, 81
- Perron theorem 382
- phase sequencing 83
- planning horizon 158–59, 162–4, 166, 169–70, 172
- platoon dispersion 177, 214
- political stability 381
- positioning technology 278
- prediction horizon 258
- predictive data mining 252
- pricing regime 15, 18
- primary goal 339
- probabilistic
 - discrete choice 9
 - user equilibrium 157
- probit-based
 - approach 235
 - SUE model 234, 241
- production cost 291–2, 300–302, 307–308
- PROSPECTS project 114, 132
- public
 - transit 136
 - transport 3, 13, 15, 18, 114–15, 117–18, 122–8, 131–2, 134
 - transport assignment 5

- quality of service 233
- queuing delay 337
- quick propagation 198
- random
 - utility 8–9
 - function 136–7
 - theory 59
- RAS algorithm 315, 334–5
- real-time traffic data 282–3, 286
- recurrent cascade correlation (RCC) 179, 190, 200–201, 206–207
- Reduction of Coefficient 375
- relative mean error (RME) 256, 258
- rental bid-price 387
- reserve capacity 158
- response mechanism 6, 10, 12–14, 17, 20
- resulting traffic equilibrium problem 355
- revealed preference (RP) 5–7
- reverse star 285–6
- right-hand-side link 342
- ring road 113, 115–16, 119–32
- road
 - accessibility 384
 - investment 115, 130
 - pricing 10, 16, 113, 115–8, 120–28, 130–32, 134–5, 149, 153, 337
 - segment 349–50, 355
 - space allocation 13
 - toll 134
- route choice 11, 43, 83–5, 87, 89–91, 98, 100, 104, 109–110, 113, 118–20, 125, 131–2, 147, 157, 166, 232–5, 237, 239–40, 248, 263, 266–8, 270, 339
 - dispersion 104, 107, 109
 - cost 45
 - flow 47, 91, 317, 338
 - guidance 84
 - information 233–7, 239–40, 242–9
 - proportion 49
 - selection 13
 - split 8
 - state 317
 - switching 1, 12, 17, 20
 - travel time 161, 170, 232–3, 235–8, 243, 245
- SACTRA 1, 4, 12–7, 20
- São Paulo 377
- SAS 183–4, 188
- saturation flow (SAT) 91, 96
- SATURN 5, 16
- scenario flow 342
- second start solution 359–60, 362
- secondary goal 339
- second-best price 136, 142
- SELNEC study 2
- sensitivity analysis 13, 143, 240–41, 358
- service trip 118
- shopping trip 118, 125
- shortest-route algorithm 66
- short-term
 - forecasting algorithm 252
 - traffic planning 276
- SIAS 5
- side constraints 347, 350–51
- side-constrained
 - problem 320
 - traffic equilibrium problem 342, 347, 349, 351, 353
- signal control 177, 240
 - setting 83–9, 91–4, 104, 109–110
 - timing 83, 90, 222, 230
- signalized intersection 90, 95, 97, 210, 215–16
- simplex algorithm 330
- simulated annealing 339
- simulation 252, 262, 267, 269, 273
- single-level optimization model 240
- singly constrained model 314
- Sioux Falls network 338, 342, 357–8
- Slater condition 340
- slow mode 117, 125, 127, 131
- smartcard 134
- social
 - marginal cost 120, 134, 140–42
 - optimum 136, 143
 - welfare 16, 136, 140, 147, 149, 153
- spatial economic network 300
- spatiotemporal pattern 252–3, 255–6, 258
- speed limit 337
- stability analysis 300
- Stackelberg game 86, 339
- starting solution 358, 361
- stated preference (SP) 4–7, 10
- steady state 212, 214
- step size 47–9, 50, 51–2, 55
- stimulus-response relationship 8
- stochastic
 - network loading 107–108
 - route choice 84, 104
 - traffic equilibria 92
 - user equilibrium (SUE) 25, 84, 88–90, 92, 94, 97, 99, 109, 157, 172, 234–5, 239–40
- Stockholm 113, 115–16, 385, 387–8
- stopping criterion 94
- strategic
 - planning 113
 - traffic management 337
- Stuttgart Neural Network Simulator 208
- sum squared error (SSE) 193
- supernetwork 289–90, 299, 308

- supply chain 289, 290, 296, 297–9, 306, 311
- supply-demand equilibrium 233
- sustainability 113
- Swedish Agency for Innovation Systems 132
- system optimization (system optimum) 139, 142, 144, 148–53

- target flow equilibrium pricing problem 341, 345–8, 350–51, 353, 355
- tentative travel time adjustment 338
- time series model 252
- time-dependent destination 319
 - O–D demand 315–16
 - origin 319
 - shortest path 315
 - travel time 324, 327
 - user equilibrium problem 319
 - trip arrival 317
 - trip departure 317
- time-space
 - link 320
 - network 318, 321
- time-variant prediction 252
- toll charge (toll fee) 129–30, 138, 141
 - ring 115–16, 120–21, 127–31,
- topmost flow constraint 350
- total
 - marginal cost 120
 - social cost 149
 - travel time 85
- trade coefficients 374–5
- traffic
 - assignment 13, 83–7, 90–91, 93, 95, 104, 109–110, 114, 138, 157, 160–61, 163–4, 234, 260–63, 265–7, 269, 271, 273, 274–6, 314
 - contour map 252
 - control system 178, 240
 - equilibrium 260
 - model (problem) 337, 341–2, 348, 358, 361
 - flow 177, 190, 207, 210, 217, 337, 349, 355, 363
 - induction 20
 - information 232, 238
 - loading 260, 265, 267
 - management 4–5, 134, 339, 356
 - mix 367
 - network 338–9
 - pattern 214
 - signal 214, 218, 222, 230, 240
 - simulation model 177
 - system 178
 - volume 115, 131, 366–7, 374
 - responsive signal control 83–4, 97, 109–110
- transaction cost 291–302, 308
- transfer cost 365
- TRANSIMS 5, 18, 60
- transit
 - fare 134, 138–9, 141–3, 146–7, 149, 153
 - frequency 137, 154
 - subsidy 134, 142–4, 153
 - travel time 146
 - trans-modal transport pricing 135, 149
 - transponder 134
- transport
 - demand 116
 - pattern 116, 118, 126
 - planning 1–3, 7, 10, 14, 19
 - pricing 134, 136, 142, 145, 153
- Transport Research Board (TRB) 14
- transportation
 - capacity 380
 - facilities 366
 - links 366
 - networks 380
 - system 380
- travel
 - behavior 1, 10, 17, 19, 139
 - choice 232, 235, 238–9
 - cost 12, 19, 119, 235
 - demand 70, 84, 118–19, 134, 142, 146–7, 149, 153, 158, 160, 162, 166–70, 172, 238, 338, 340–42, 349
 - distance 115, 117–18, 126–30
 - forecasting 1–2, 5, 17, 43
 - mode 117, 136
 - pattern 43, 130
 - travel time 114–15, 117–23, 125–9, 131, 136–7, 141, 145, 177–9, 181–3, 190, 206–207, 338, 340, 350, 357, 366
 - adjustment 340–41, 345–6, 350–52, 354–5, 357–8, 361–2
 - function 51, 341–2, 345, 347–8
 - perception 84
- trip
 - attraction 314, 319, 321–2, 324, 327, 329–30, 333–4
 - dispersion (distribution) 3, 25–6, 37, 39–40, 43, 72, 76–80, 113, 157–58, 314
 - distribution and traffic assignment (TDTA) 314
 - trip end 2, 8
 - generation 2, 25, 37, 40, 43, 113
 - matrix 6, 11
 - production 314, 319, 324, 327, 329–30, 333, 335
 - rate 3, 90, 95–6
- TRIPS 19

- two-stage
 - decision process 381
 - management procedure 337–8, 342, 347–8, 356, 358, 361, 363
- urban
 - economics model 114
 - simulation model 114, 116, 121, 132
- urbanization economy 384
- user equilibrium (user optimal, user-equilibrium, user-equilibrium route choice model) 16, 32, 37, 40, 43, 46, 59, 60, 65–6, 84–6, 88, 92, 119, 141, 157–60, 172, 233, 260, 262, 274, 319, 326
- user-optimizing network production model 369
- utility
 - function 9
 - maximization 19, 70
 - theory 9
- V/C 367
- value of time (VoT) 2, 5, 120–21
- variable trip matrix (VM) 12–13
- variance inflation factor (VIF) 187
- variance-covariance matrix 9
- variational inequality (VI) 26, 44, 139, 290, 292, 294, 297–302, 304–6, 311, 315, 316–17, 326, 328–9
- VISSIM 263
- volume
 - delay 261, 263, 264–5, 267, 269, 275
 - to-capacity ratio 367
- waiting time 137, 154
- Wardrop 16, 59, 161, 260, 274
- Wardrop principle (Wardrop's condition) 45, 59, 84, 119
- weighted adjustment 346
- Weighted Average of Coefficient 375
- weighted
 - least square (WLS) 187
 - regression model 253
- zero-elasticity method 11
- zigzagging phenomenon 326
- zonal-based regression 2