

Index

A

Absolute-directional method, 136
Additive model, 66–69, 82, 85,
259, 269, 293, 406
Allocative efficiency, 9, 61, 232
Assembly system, 389
Assurance region, 34–36

B

Bargain game, 218
BCC model, 26–32, 36, 37, 39, 66–68, 89, 91,
92, 94, 95, 97, 100, 101, 103–109, 114,
116, 118, 119, 138, 139, 210, 232, 269
Benchmark, 6, 7, 9, 11, 12, 24, 25, 29, 32, 43,
48–52, 54–61, 65–73, 75–77, 81–83, 85,
114, 115, 118, 164
Bounded adjusted measure, 85

C

Carryover, 410, 411, 415, 416, 419, 424–428
Categorical data, 140
CCR model, 20–26, 28, 32, 36, 39, 67, 68,
71–74, 91, 97, 102, 119, 120, 177,
179, 181, 183, 209, 210, 312, 313,
330, 337, 344
Common weight, 36, 37, 330
Cone ratio, 35
Congestion, 89, 90, 103–110
Connected model, 185, 187, 189–191, 193,
194, 198–202
Cooperative game, 248
Cost efficiency, 331
Cross efficiency, 37, 39

D

Directional distance function, 43, 58–61, 83,
86, 110, 126, 129, 157, 169, 170, 172,
173, 260, 261, 295, 326, 417–420, 427
Disassembly system, 15, 355–387
Disposability, 46, 90, 91, 98, 104–110,
121, 124–127, 129, 226, 243,
255, 418, 427
Distance function, 2, 12, 43–61, 65, 70, 82, 91,
152, 157–161, 165, 169, 178, 185, 207,
223–225, 227, 232, 237, 255–257, 259,
261, 269, 270, 275, 289, 291, 295, 306,
319, 322–327, 331, 356, 381, 383–385,
387, 389, 394–396, 410, 414–420, 427
Division efficiencies, 325
Dynamic models, 410, 415, 422, 427

E

Efficiency aggregation, 14, 211, 219–223, 230,
232, 240, 241, 246, 248–249, 269,
280–284, 297–301, 304, 305, 311, 312,
317, 320, 327–329, 393, 413
Efficiency decomposition, 14, 165, 211–220,
222, 225, 228, 230, 241, 246, 250–254,
257, 276–281, 285, 289, 291, 298, 301,
303, 304, 311, 312, 317, 320, 328, 329,
368, 372, 378, 385, 387, 396
Envelopment form, 48, 49, 54, 55, 67, 73,
118, 180, 182–183, 185–187, 190,
192, 193, 196, 198, 199, 203, 255, 270,
314, 317, 350
Envelopment model, 22, 24, 31, 186, 194, 203,
225, 231, 314, 317, 341, 345, 350, 381
Extension principle, 150, 152

F

Feedback, 237, 238, 241–243
 Free disposal hull, 90, 98–103, 110, 153, 428
 Fuzzy data, 148–153, 232, 306, 320, 330
 Fuzzy numbers, 133, 141, 148–150, 330, 406

G

Game-theoretic approach, 218–219
 Gauge function, 61
 Global malmquist productivity index,
 166–169, 173, 219

H

Hierarchical structure, 335, 336, 352
 Hyperbolic model, 126, 127, 427

I

Imprecise data, 86, 133, 148, 153, 330
 Independent model, 181, 185, 186, 188–190,
 195–205, 207–211, 213, 214, 218, 219,
 222, 231, 247, 251, 283, 305
 Input possibility set, 44, 45, 47, 49, 53
 Intertemporal effect, 409, 428
 Interval data, 133, 146–148, 151, 153, 269
 Isocost, 9, 11
 Isoquant, 2, 7–9, 23, 44, 45, 47, 71, 97, 101,
 108, 109, 114, 115, 121, 245, 246
 Isorevenue, 11
 Isotonic, 153

L

Luenberger productivity index, 157, 169–173

M

Malmquist productivity index, 157, 158,
 160–169, 171, 173, 269
 Measure of inefficiency proportions, 68, 72, 74
 Membership function, 148–150, 152
 Multi-component system, 310–315, 317,
 336–342, 344
 Multi-function system, 309, 314–318, 330,
 335, 336, 342–347
 Multiplicative model, 90–98, 100, 110
 Multiplier form, 67, 179, 181–183, 187–190,
 192, 195, 199, 202, 211, 228, 257, 265
 Multiplier model, 21
 Multi-stage system, 15, 275–306, 314, 355, 410

N

Negative data, 134–136, 152
 Non-Archimedean number, 20, 33, 48, 49, 54,
 55, 69, 73, 92, 99, 103, 105, 180, 212,
 221, 224, 243, 255, 290, 317, 322, 326,
 341, 346, 350, 382, 414, 415
 Non-cooperative game, 270
 Non-discretionary factor, 113–120, 128, 129
 Nonparametric approach, 2, 6, 11
 Nonzero-sum game, 218

O

Ordinal data, 136–138, 153
 Output possibility set, 45, 46, 53, 57

P

Parallel structure, 15, 309, 335, 340, 344, 352,
 357–359, 361, 367–370, 372, 373, 375,
 377, 379, 391, 393, 396, 398
 Parametric approach, 2, 6, 9, 11, 141
 Pareto efficiency, 20, 33, 54
 Pareto optimality, 20
 Price efficiency, 9, 11
 Production delay, 409, 415–416
 Production frontier, 5–7, 9, 11–13, 21–26,
 28, 29, 31, 32, 44, 49, 58, 60, 65–67,
 81, 83, 89, 90, 94, 96, 97, 99–103,
 108, 122, 124, 134, 139, 141, 142,
 161–163, 208, 216, 217, 245, 246,
 311, 313, 340, 385
 Production function, 2–6, 8, 10, 43–45, 91, 97,
 118, 158, 161
 Production possibility set, 43–48, 53, 55, 58,
 61, 66, 70, 75, 89–91, 94, 95, 98, 99,
 101, 102, 110, 122, 124, 127, 128,
 138, 185, 200, 204, 205, 224, 255, 262,
 385, 428
 Product transformation curve, 9–11, 25, 45, 53,
 54, 73, 117, 125, 245
 Projection point, 79, 80, 86, 93, 102, 106,
 107, 114, 126, 127, 134, 163, 186,
 187, 190, 193, 199, 203, 210,
 225, 226
 Pure technical efficiency, 103, 105, 106,
 108, 110

Q

Qualitative data, 137–141, 153
 Quasi-fixed inputs, 409, 422, 423, 426, 427

R

Radial measure, 7, 9, 10, 43, 65, 67, 69, 82, 83, 102, 129, 152
 Range adjusted measure, 68, 152
 Range-direction method, 136
 Ranking
 Ray unboundedness, 47, 95, 101
 Reference point, 49, 50, 52, 55, 57, 58, 76, 385
 Relational model, 190, 192, 193, 202, 205, 212, 214, 251, 259, 263, 271, 310, 330, 338, 351, 356, 360, 385–387, 395, 398–401, 404, 405
 Returns to scale, 2, 25, 26, 28, 29, 31, 32, 36, 37, 39, 47–51, 53, 55–59, 66, 68, 70, 72, 75, 76, 79–81, 89–91, 95, 97, 98, 101, 103, 110, 114, 116, 119, 124, 136, 157, 161, 165–167, 171, 173, 185, 187, 189, 190, 200, 208, 210, 211, 214–217, 220, 222, 224, 227, 244, 255, 262, 265, 277, 283, 284, 289, 290, 292, 298, 306, 310, 315, 319, 337, 349, 356, 358, 390, 392, 398, 400, 401, 411, 414, 416, 418, 421, 428
 Revenue efficiency, 428, 429
 Reversal link, 275, 299–306, 329
 Russell measure, 65, 69–77, 85

S

Scale efficiency, 30, 32, 50, 57, 97, 102, 105, 108, 120, 165, 166, 214–218
 Series structure, 15, 253, 275–283, 285, 286, 288, 289, 299, 309, 356–362, 367, 370–372, 377, 379, 389, 391, 403, 405
 Shared input, 237, 264–268, 270, 271, 318–332, 419
 Shortage function, 61, 169
 Slacks-based measure, 12, 65, 72, 74, 77, 78, 83, 121, 127, 129, 152, 178, 189, 193, 204, 205, 207, 231

Static model, 409, 411, 423
 Stochastic data, 86, 141–146
 Stochastic frontier approach, 141
 Strong efficient, 21, 101, 114, 116, 117, 139, 259, 261
 Super efficiency, 37, 38
 Supply chain, 15, 110, 232, 233, 247, 269, 299, 306, 386
 Supporting hyperplane, 30, 69, 81, 82, 93

T

Target
 Technical efficiency, 30, 32, 50, 75, 97, 110, 166, 215–217, 406, 427
 Törnqvist index, 159
 Translation invariant, 68, 136
 Two-level mathematical programming, 146, 150
 Two-person game, 246
 Two-stage system, 14, 15, 207–233, 237–271, 275–277, 295, 361

U

Undesirable factors, 113, 121, 122, 124, 127, 129, 230, 261, 263, 389, 390, 396, 398, 417, 418, 421, 425
 Unit invariant, 67, 68, 135, 136

V

Value-based model, 306, 332, 425, 426

W

Weakly efficient, 21, 23, 48, 52, 65, 69, 71, 82, 83, 92, 99, 101, 114–117, 140, 232, 259, 261, 383
 Window analysis, 32