

Index

A

- Accept–reject simulator (AR), 115–20
 - importance sampling and, 210–12
 - mixed logit and, 145
 - problems with, 118–20
 - smoothed, 120–2
 - truncated densities, 209–10
- Aggregation, 29–32, 54
- Akaike Information Criterion (AIC), 367
- Allocation parameter, 91
- Alternative-specific constants, 20–1, 33, 62, 67,
73, 153–5, 167, 308
- Anticipatory behavior, 113, 146
- Antithetic draws, 216–18, 221, 236
- AR. *See* Accept–reject simulator
- Asymptotic distribution, 219, 245–6, 249, 255–6,
264, 288, 290, 293
- Attraction variables, 54
- Automobile demand models, 134
- Average conditional distribution, 269–70

B

- BART. *See* Bay Area Rapid Transit (BART)
- Base-year shares, 33
- Bay Area Rapid Transit (BART), 71
- Bayes' rule, 262, 285–6
- Bayesian Information Criterion (BIC), 367
- Bayesian methods, 282–314
 - hierarchical, 283, 299–305
 - mixed logit and, 299–305
 - overview of, 284–91
 - probit and, 313–14
- Berndt–Hall–Hall–Hausman method (BHHH),
192–8, 258
- Bernstein-von Mises theorem, 266–7,
288–92
- BFGS. *See* Broyden–Fletcher–Goldfarb–Shanno
method
- BHHH. *See* Berndt–Hall–Hall–Hausman method
- Binary logit, 4, 35, 39–40, 162
- Binary probit, 7, 14, 97, 115, 317
- BLP, 8, 317–28, 334–5, 339, 342, 346
- Bootstrap, 201–2, 355, 370
- Broyden–Fletcher–Goldfarb–Shanno method
(BFGS), 197

C

- California Energy Commission (CEC), 48
- Car–bus example, 17, 20
- Causal perspective, 3
- Central limit theorem, 245–6, 249, 252, 292
- Chatter, in simulations, 250
- Choice probabilities, 18–21. *See specific models*
- Choice sets, 11–14, 37, 57, 73, 157, 282
- Choleski factor, 116–17, 123–4, 129–30, 208–9,
265, 297, 299, 302, 307–8, 338, 364
- Clark algorithm, 115
- College/work model, 169–82
- Concavity, 191–2
- Conditional distribution, 114, 260, 262–7,
269–70, 274–8, 280, 335–42, 349, 358, 362
 - average, 269–70
 - derivation of, 262–4
- Conditional likelihood function, 65
- Constants, recalibration of, 33
- Consumer surplus, 55–7
- Contingent valuation, 164–6
- Contraction, 317, 322–4, 335, 343
- Control function, 8, 317–18, 334–40
- Convenient error partitioning, 6, 113, 173, 176
- Convergence, criterion for, 198–9
- Cross-nested logits, 89, 91
- Cross-subject variance, 112

D

- Davidon–Fletcher–Powell method (DFP), 197–8
- Densities, drawing from, 205–36
- Derivatives, 29–31, 39, 47, 57–61, 63, 73, 93–5,
119–20, 123, 186–7, 191, 193, 197, 202–4,
243–4, 249–50, 253–4, 287, 289, 334, 351,
354–5, 365
- DFP. *See* Davidon–Fletcher–Powell method
- Diffuse prior, 297–8, 301
- Dimensionality, curse of, 178
- Discrete mixing distribution, 355–61
- Double-bounded methods, 165
- Dynamic choice models, 50–2, 114, 169–82,
314
- Dynamic optimization, 169–82

E

- Elasticities, 29–31, 45, 47–8, 57–60, 141, 144,
286–7, 329, 332–3, 339–40

Electric cars, 48
 Elimination by aspects model, 81
 EM algorithm, 347–70
 Endogeneity, 315–46
 Energy efficient vehicles, 48
 Energy supplier, choice of, 152–3, 270–80, 305–13
 Exclusivity conditions, 12–13
 Exhaustiveness, 12–13
 Exogenous sample, 60–6
 Expectation-maximization algorithm. *See* EM algorithm
 Explanatory variables, 8, 14, 29, 31–2, 37, 50, 60, 62–3, 70–1, 81, 85, 88, 103, 134, 136, 138, 140, 157, 162, 203, 240–2, 270, 285, 309, 315, 317, 319–21, 324, 327, 331, 336, 339, 343, 348
 Exploded logit, 157, 321, 342–3, 367
 Exponential transformation, 81
 Extreme value terms, 16, 18–19, 34–5, 39, 40, 43, 51, 55–6, 74, 76, 79–80, 89, 92, 137, 139, 142–3, 145, 154, 156–7, 162, 169, 173–4, 176, 181, 207, 262, 267, 300, 304, 308, 319, 321, 337–9, 341, 356

F

Factor-analytic structure, 103
 Fishing site model, 147–50, 259
 Fixed coefficients, 139–40, 308–10, 317–18
 Forecasting, 11, 32–3, 36, 44, 71–4, 144, 156, 280, 328–9
 Full information maximum likelihood, 8, 335

G

Generalized autoregressive structure, 103
 Generalized extreme value models (GEV), 11, 17–18, 50, 76–96
 heteroskedastic logit, 92
 nested logit and, 76–88, 91–2
 ordered, 89
 PCL model and, 88, 90–1, 94, 96
 substitution patterns, 77–8
 Generalized least squares (GLS), 325
 Generalized method of moments (GMM), 326–8, 331, 333–4
 Geographic aggregation, 54
 GEV. *See* Generalized extreme value models
 Geweke simulator. *See* GHK simulator
 GHK simulator, 115, 122–33
 as importance sampler, 131–3
 Gibbs sampling, 212, 214, 284, 293–5, 299, 300–4, 306, 309–11, 313
 MH algorithm and, 213–14, 293–4, 300–3, 309
 Global maximum, 199, 270, 283
 Goodness of fit, 68–9
 Goods-leisure tradeoff, 53
 Gourioux–Monfort model, 7
 Gumbel distribution, 34

H

Hajivassiliou simulator. *See* GHK simulator
 Halton sequences, 224–38
 multidimensional, 226–7

 randomized, 231–3
 scrambled, 233–5
 Heating system example, 38–40, 66
 Hessian matrix, 186
 expected, 194, 200–2
 information identity, 202–4
 information matrix, 200–4
 Heteroskedastic extreme value models (HEV), 92
 Heteroskedasticity, 18–19, 168–9
 HEV models, 92
 HEV. *See* Heteroskedastic extreme value models
 Hierarchical Bayesian procedures, 283, 299–305
 for probit, 313–14
 Hydrogen vehicles, 365–6
 Hyper-parameters, 305
 Hypothesis testing, 70–1, 81, 280, 288, 292

I

Identification, 19–29, 100–6
 IIA, 45–50
 advantages of, 48–9
 nested models, 78, 88
 probit model, 108–10
 tests of, 49–50
 Importance sampling, 131, 210–12, 293
 Inclusive value, 83, 85, 87–8, 139–40
 Independence assumption, 18, 35
 Independence from irrelevant alternatives. *See* IIA
 Individual-level parameters, 259–81
 Information identity, 194–6, 200–4, 248, 250, 255, 257
 Information matrix, 200, 204, 248, 289
 Initial conditions problem, 114
 Instrumental variables estimation (IV), 317, 330
 Integral expressions, 3–6
 Inverted gamma, 297–9, 307
 Inverted Wishart, 298–301, 308, 312

K

Keane simulator. *See* GHK simulator

L

Lagged response, 51, 113, 146
 Latent class model, 135, 261, 357, 359
 Likelihood function. *See* Log-likelihood
 Likelihood ratio index, 68–9, 72, 149
 Limiting distribution, 245–6, 249, 255, 257, 292
 Linear regression models, 29, 52, 62, 261, 317, 321, 324–5
 Liu–Mahmassani method, 199–200
 Local maximum, 199
 Log-likelihood function, 7, 37, 52, 63, 65, 67–8, 70–1, 84, 118–19, 129–30, 144, 162, 166, 185, 187, 189, 191–5, 197–9, 215, 225, 237–9, 248, 324, 341
 curvature of, 193–5, 197
 globally concave, 37, 191
 maximization of, 185–204
 simulated, 8, 118, 144, 185, 237, 264–5, 282–3, 324–6
 Logistic distribution, 35, 162
 Logit model, 4, 18, 24–5, 29, 34–75
 applicability of, 42

BART ridership, 71–4
 choice-based samples, 66–7
 consumer surplus, 55–7
 cross-elasticities, 48, 60
 decomposition into, 81–4
 derivation of, 74–5
 exploded logit, 157
 extreme value distribution, 34–5, 56
 heteroskedastic logit, 92, 140
 IIA, 45–50
 limitations of, 42–52, 97
 logit-kernel probit, 121
 log-sum term, 56
 maximum-likelihood estimator, 61–3
 ordered logit, 162–3, 165, 167
 power of, 42–52
 probability, 37
 smoother, 121–2
 substitution patterns, 45–50
 taste variation, 42–5
 tests of IIA, 49–50
 Lognormal distributions, 148, 282, 310–12
 Log-sum term, 56, 83, 181–2

M

Marginal cost, 328–34, 339–40
 Marginal cost pricing, 330–1, 339–40
 with control function, 339–40
 fixed markup over, 331
 with GMM, 331
 with MSL/IV, 330–1
 Marketing efforts, 315–16
 Market-share data, 33
 Markov chain Monte Carlo methods (MCMC), 8, 214, 293
 Maximization methods, 185–204
 Maximum-likelihood estimation, 61, 118, 129, 323, 327, 343
 Maximum simulated likelihood (MSL), 8, 118, 144, 237–9, 255–6, 264, 283, 291, 305, 324–6
 MCMC. *See* Markov chain Monte Carlo methods (MCMC)
 MC-squared methods. *See* Markov chain Monte Carlo methods (MCMC)
 Method of moments (MOM), 237–8, 240–2, 247–8, 250, 256, 326, 328
 Method of simulated moments (MSM), 8, 237–8, 240–3, 256–7, 326, 328
 Method of simulated scores (MSS), 8, 238, 243–5, 257
 Metropolis–Hastings algorithm (MH), 205, 213–14, 284, 293–4, 300–3, 309–10, 312
 Bayesian procedures and, 293–4, 300–3, 309–10, 312
 Gibbs sampling and, 213–14, 293–4, 300–3
 MH. *See* Metropolis–Hastings algorithm (MH)
 Mixed logit, 2, 6–7, 16–17, 19, 29, 37, 45, 48, 50, 52, 122, 137–9, 141–5, 156–9, 167–8, 299–305
 accept–reject simulator, 145
 Bayesian procedures and, 299–305
 defined, 134
 error components, 139–41

 mixed nested logit, 167–8
 mixing distribution, 141–3
 random coefficients, 137–9
 ranked data, 156–9
 relation to probit model, 134
 RUMs and, 141–3
 simulation, 144–5
 substitution patterns, 141
 Mixed models, 166–9
 Mixed nested logit, 167–8
 Mixed probit, 19, 168–9, 314, 337
 Mixing distribution, 50, 135, 138, 141, 143, 167, 355–65
 ML. *See* Maximum-likelihood method
 MOM. *See* Method-of-moments
 Monopoly pricing, 332–4, 339
 MSL. *See* Maximum simulated likelihood
 MSM. *See* Method of simulated moments
 MSS. *See* Method of simulated scores
 Multi-level nested logits, 182
 Multiple ordered responses, 163–4
 Multiresponse probit, 164, 166
 Multivariate ordered probit, 164

N

Nash equilibrium, 332–4, 339
 Nested logit, 16, 29, 37, 48, 76–7
 estimation and, 84–5
 generalized, 91–2
 GEV models and, 76–7, 94–5
 IIA, 77–8, 88
 overlapping nests, 89–92
 PCL model, 90–1
 software, 84
 substitution patterns, 77–8
 three-level, 86–8
 two-level, 81–4
 Newton–Raphson method, 187–92
 Nonlinear representative utility, 52–4
 Nonparametric estimation, 356, 361, 365
 Non-rational model, 171
 Nonsimulation procedures, for integrals, 114
 Non-uniform conditioning, 66
 Normal densities, 111–13, 116–17, 120, 124–5, 131–2, 136, 205–6, 208–9, 265, 296, 300, 302, 362
 Choleski factor and, 208–9
 multivariate, 208–9
 transformations of, 206
 Normalization, 11, 16, 21, 23–9, 91, 100–8, 110, 163
 Numerical maximization, 37, 84, 185–204, 311

O

Ordered logit, 162–3, 165–7
 Ordered probit, 162–4, 166
 Ordered responses, 159–64
 Outside good, 319, 342
 Overlapping nests, 89–92, 139–40, 167

P

Paired combinatorial logit (PCL) model, 77, 89–91, 93, 96

- Panel data, 50–2, 97, 110–15, 134, 145–7, 158
 PCL. *See* Paired combinatorial logit model
 Percent correctly predicted statistic, 69
 Posterior distribution, 265–7, 288–99
 Bernstein–von Mises theorem, 266, 267,
 288–91
 drawing from, 293–4
 mean of, 291–3, 295–9
 Prime numbers, Halton draws and, 221–35
 Probit model, 7, 14, 23, 100–6, 108–10, 115–20,
 122–33, 142, 218, 313–14
 accept–reject simulator for, 115–20
 antithetic draws and, 218
 approximation by mixed logit, 142
 Bayesian procedures and, 313–14
 GHK simulator, 122–33, 168
 identification, 23, 100–6
 IIA, 108–10
 mixed, 19, 168–9, 314, 337
 normalization, 100–6
 random coefficients, 106
 ranked data, 158–9
 route choice, 103
 simulation, 115
 substitution patterns, 108–10
 unobserved utility, 97
 Proportionate substitution, 48
 Proposal density, 211, 393
 Pseudo-observations, 157–8
- Q**
- Quadratic functions, 188–90, 197, 199, 347
 Quadrature methods, 92, 115, 134
 Quasi-random methods, 7, 230, 236. *See also*
 Halton sequences
- R**
- Random coefficients, 103, 106, 137–40, 147, 168,
 259–60, 270, 308–9, 317, 342–4, 348, 356,
 362
 Random draws, 8, 149, 205–15, 218–19, 224,
 228–31, 236, 311, 314
 Random utility models (RUMs), 14, 141–3, 145.
 See specific models
 Ranked data, 156–9
 Recalibration, of constants, 33
 Regime-switching models, 261
 Representative utility, 15, 29–31, 35–8, 40, 42–3,
 45–7, 51–62, 65, 67, 73, 76, 81, 106, 113
 Respondent fatigue, 26
 Revealed-preference data, 152–6
 Robust covariance matrix, 201
 RUMs. *See* Random utility models
- S**
- Sampling, 60–7, 131–3, 200–2, 210–12, 218–21,
 238, 245–6, 264–5, 274–8, 280, 284, 286,
 288–91, 293–5, 300–1, 304, 306–7, 309–11,
 313, 323
 of alternatives, 64–6
 choice-based, 66–7
 exogenous, 60–6
 Sandwich estimator, 201
 Scale parameter, 26, 40–2, 155
 Segmentation, 31–2, 219
 Sigmoid shape, 38
 Simulated log-likelihood function. *See* Maximum
 simulated likelihood
 Simulated mean of the posterior (SMP), 292–3,
 301, 305
 Simulated moments. *See* Method of simulated
 moments
 Simulated scores. *See* Method of simulated
 scores
 Site choice model, 148
 Smoothing, 121–2, 144–5, 274
 Stated-preference experiments, 152–6, 228, 270,
 365
 Steepest ascent method, 196–8
 Step function, 119, 121, 145
 Step size, 189–91
 Student choice model, 171–82
 Substitution patterns, 36, 42, 45–50, 77–8,
 108–10, 141
 logit model, 42, 45–50
 mixed logit, 141
 nested logit models, 77–8
 probit model, 108–10
 proportionate, 47–8
 See also specific models
 Systematic sampling, 205, 218–21
- T**
- Target density, 131, 211
 Taste variation, 42–5, 97, 106–7, 123, 134, 138,
 146, 282
 Taylor expansion, 187, 191, 196, 249,
 253–4
 Triangular density, 312
 t-statistic, 70, 72, 85, 199, 344
 Type I extreme value distribution, 34
- U**
- Uncertainty, 58, 171, 178–82, 297,
 368
 Uniform conditioning property, 65
 Univariate densities, drawing from,
 208–11
 Unobserved attributes, 89, 315–16, 319–20,
 325–6, 329, 339, 345–6
- V**
- Variance reduction, 214–36
 Vehicle choice, 322, 325, 343–4,
 349–55
- W**
- Weibull distribution, 34
 White noise, 35–6, 76
 Work/college model, 169–82