

Index

- active galactic nuclei (AGN), 325–332
- Akaike information criterion (AIC), 101, 106, 137, 224, 262–266, 379
- approximate Bayesian computation (ABC), 276, 355–361
- astronomical applications, 276–363
- astrostatistics, 1–5, 8, 364
- Astrostatistics and Astroinformatics Portal (ASAIP), 5, 364
- Bayes' theorem, 27–29
- Bayesian hierarchical models, 215–261
- Bayesian information criterion (BIC), 101, 106, 137, 224, 262, 263
- Bernoulli model, 7, 8, 32–36, 54, 71, 72, 74, 118, 125, 134, 140, 184, 186, 196, 202, 212, 234, 307–312, 325–334
- Bernoulli trials, 148
- beta binomial model, 7, 125–134
- beta model, 7, 32–38, 75, 92–98, 302–307
- beta prior, 32–38, 94, 267
- binaries, 290–297
- binomial models, 98–117, 235–240
- black hole, 277, 278, 313, 325
- boundary likelihood ratio test, 139
- canonical link, 72, 84, 150
- censored binary component, 197, 202
- classification of statistical models, 7
- complementary loglog link, 99, 104, 111, 118, 125, 126, 134, 202, 206
- confidence interval, 27, 29–31, 45, 49, 142
- continuous models, 46–67, 74–98, 283–302
- correlation, 2, 6, 23, 72, 106, 125, 149, 161, 190, 215, 219, 253, 267–269, 277, 284, 291, 303, 307, 333
- cosmology, 283, 333, 347, 361
- count models, 6, 44, 70, 71, 77, 134, 135, 140, 142, 149, 153, 184, 206, 240, 369, 376
- CRAN, 10, 88, 95, 101, 136, 140, 152, 174, 220, 240, 258
- credible interval, 12, 29–31, 43, 45, 49, 53, 92, 101, 106, 122, 125, 129, 142, 161, 186, 222, 263, 287, 300, 310, 336, 345, 356
- deviance information criterion (DIC), 106, 111, 176, 197, 224, 264–266, 319, 366
- deviance statistic (Bayesian), 106, 202, 263–265
- dispersion
 - overdispersion, 44, 72, 125, 139, 141, 142, 149, 150, 152, 153, 161, 171, 180, 197, 220, 240, 253, 317, 323
 - parameter, 6, 44, 69–72, 139, 149–152, 154, 158, 161, 164–165, 167, 176, 180, 191, 193, 202, 253, 257–259, 315, 317, 320, 321, 323, 324, 366, 368, 373, 374
 - Pearson, 140, 167, 253
 - statistic, 106, 125, 139, 140, 149, 153, 165, 167, 171, 240, 253, 258, 316, 323, 367, 379
 - underdispersion, 125, 139–142, 149, 180, 241, 379
- distribution, probability
 - Bernoulli, 7, 33, 34, 71, 98, 99, 112, 118, 196, 234, 307, 308, 311, 325, 327, 333
 - beta, 34, 37, 75, 92, 94, 303
 - beta binomial, 126, 127
 - binomial, 71, 98, 99, 118, 307
 - gamma, 20, 82, 83, 148, 154, 157
 - Gaussian, 46–48, 68, 271, 284, 356–358
 - generalized Poisson, 77, 134, 136, 164, 165
 - geometric, 71, 72
 - inverse Gaussian, 75, 87, 88
 - lognormal, 75, 297, 298, 300, 334
 - NB-P, 180
 - negative binomial, 71, 148, 150, 154, 176, 182, 323, 346
 - Poisson, 54, 71, 135, 141, 149, 150, 154, 165, 170, 171, 184–190, 219, 253
 - Poisson inverse Gaussian (PIG), 149, 253
- double-exponential, 274
- errors in measurements, 62, 277, 314, 353, 363
- frequentist statistics, 2, 3, 6–8, 23, 29, 43, 44, 46, 49, 73, 75, 77, 153, 217, 219, 220, 248, 262–265, 377
- galaxies, 34, 106, 277, 278, 298, 302, 303, 307, 308, 313, 314, 325–327, 329, 333

- gamma–logit model, 206
 gamma models, 82, 149, 206
 generalized
 additive models (GAM), 366, 368
 linear mixed models (GLMMs), 217, 222, 230
 linear models (GLMs), 68–75, 111, 113, 120, 136, 238, 313, 340, 366
 Poisson models, 134, 136, 139, 140, 149, 161, 164–167, 206, 253, 368, 369, 374, 376
 globular clusters, 35, 37, 135, 313, 314
 goodness-of-fit, 2, 106, 137, 263
- halos, 196, 313, 329, 333
 hierarchical GLMM models, 217
 binary logistic, 228, 229
 binomial logistic, 235, 238
 Gaussian, 219
 negative binomial, 252
 Poisson, 240
 Hubble residuals, 283, 284, 287
 hurdle model, 141, 170, 185, 190, 196, 197, 202, 210, 332, 333, 337
 generalized Poisson, 202
 log-gamma hurdle, 206
 log-gamma-logit hurdle, 206
 log-normal-logit hurdle, 333, 334
 negative binomial, 190, 202
 Poisson, 170, 207
 Poisson-logit, 197, 200, 206
 two-part, 134, 141, 206
- initial mass function, 297, 298
 integrated nested Laplace approximation (INLA), 9, 10, 31, 366, 368
 International Astronomical Union (IAU), 3, 5, 341, 364
 International Astrostatistics Association (IAA), i, 5, 364
 inverse Gaussian model, 71, 87, 88, 265
 inverse link, 70, 104, 113, 121, 126, 130, 134, 137, 218
- JAGS software, 12–14
- Kuo and Mallick selection method, 267–269
- least absolute shrinkage and selection operator (LASSO), 274–275
 linear regression, 3, 11, 16, 24, 41
 log-gamma model, 71, 75, 82
 lognormal model, 75, 210, 298
- Markov chain Monte Carlo (MCMC), 4, 31, 43, 53, 101, 200, 361, 366
 maximum likelihood estimate, 25, 33, 140, 262, 370
 multivariate normal model, 58, 292
- negative binomial model, 44, 68, 136, 148, 150, 154, 164, 167, 176, 180, 317, 373
 negative binomial model (GLMMs), 252
 negative binomial three-parameter model, 179, 313
 normal models, 38, 41, 46–48, 68, 75, 219, 277, 350
- odds ratio, 111, 329
 offsets, 369
 ordinary differential equation (ODE), 349
- parameter
 alpha, 156, 158, 161, 202, 257, 258
 delta, 165, 259, 368
 dispersion, 44, 69, 149, 150, 180, 193, 257, 259, 315, 317, 323, 373
 scale, 6, 30, 33, 44, 52, 68, 71, 75, 94, 226, 298, 357
 variance, 44, 68, 80, 90, 317
- pD, 265
 Pearson χ^2 statistic, 106, 139, 240, 253
 Pearson dispersion, 140, 167, 253
 Poisson model, 44, 71, 135, 139, 314
 Poisson-logit hurdle model, 206
 posterior distribution, 2, 7, 19, 27, 43, 48, 49, 68, 79, 140, 215, 219, 250, 263, 316, 329, 336, 356
 predicted values, 52, 74, 98, 113, 129, 137, 218, 377
- priors
 diffuse, 30, 33, 38, 44, 82, 89, 265, 370, 372, 374
 flat, 33, 38
 gamma, 89, 298
 informative (explanation of), 30, 82, 89, 96, 265, 267, 271, 368
 inverse gamma, 327
 non-informative (explanation of), 30, 32, 33, 38, 44, 45, 142, 327
 uniform, 33, 52, 321
- Probit model, 110, 124
 Python, 14
- quadrature, 49
- R, 10
 R2jags, 112
 Rate parameter, 112, 369
 residuals, 23, 139, 150, 152, 166, 218, 222, 253, 340, 341, 344, 377
- Schwarz criterion (SC), 262
 sensitivity test, 89
 software for modeling, 4
 spatial analysis, 368
 Stan software, 17
 standard errors, 106, 140, 153
 standardized residuals, 12
 supernovae, 283, 347
- time series model, 340
 truncated model, 169

Uniform prior, 19, 25, 38, 50, 89
VGAM, 373
zero-altered models, 196
zero-inflated models, 184

negative binomial, 190
Poisson, 184
zero-truncated models, 169
negative binomial, 176
Poisson, 170